UNIVERSITY OF MUMBAI

Revised Syllabus for the M. E. Program

Program: M. E. (Mechanical)

MANUFACTURING SYSTEMS ENGINEERING

(As per **Choice Based Credit and Grading System**
with effect from the academic year 2016–2017)

From Co-ordinator's Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meetings unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs), give freedom to Affiliated Institutes to add few (PEOs), course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth of approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry are to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education, since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy, adopting a ten point scale to grade learner's performance. Choice Based Credit and Grading System is implemented for Master of Engineering from the academic year 2016-2017.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives for Postgraduate Program were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the postgraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above, 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of postgraduate program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

Dr. S. M. Khot

Chairman, Board of Studies in Mechanical Engineering, University of Mumbai

Program Structure for
ME Mechanical Engineering (Thermal Engineering)
Mumbai University
(With Effect from 2016-2017)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MSEC101	Product Design & Development	04	--	04	--	04
MSEC102	Computer Integrated Manufacturing Systems	04	--	04	--	04
MSEC103	Quality Engineering	04	--	04	--	04
MSEDLO101X	Department Level Optional Course I	04	--	04	--	04
ILO101X	Institute Level Optional Course I	03	--	03	--	03
MSEL101	Laboratory I - Computer Integrated Manufacturing Systems	--	02	--	01	01
MSEL102	Laboratory II - Quality Engineering	--	02	--	01	01
Total		**19**	**04**	**19**	**02**	**21**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract /Oral	Total
		Test1	Test 2	Avg					
MSEC101	Product Design & Development	20	20	20	80	03	--	--	100
MSEC102	Computer Integrated Manufacturing Systems	20	20	20	80	03	--	--	100
MSEC103	Quality Engineering	20	20	20	80	03	--	--	100
MSEDLO101X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ILO101X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
MSEL101	Laboratory I - Computer Integrated Manufacturing Systems	--	--	--	--	--	25	25	50
MSEL102	Laboratory II - Quality Engineering	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

Course Code	Department Level Optional Course I	Course Code	Institute Level Optional Course I
MSEDLO1011	Advanced Material Science	ILO1011	Product Lifecycle Management
MSEDLO1012	World Class Manufacturing	ILO1012	Reliability Engineering
MSEDLO1013	Knowledge Management	ILO1013	Management Information System
MSEDLO1014	Precision Engineering	ILO1014	Design of Experiments
		ILO1015	Operation Research
		ILO1016	Cyber Security and Laws
		ILO1017	Disaster Management and Mitigation Measures
		ILO1018	Energy Audit and Management

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MSEC201	Sustainable Manufacturing	04	--	04	--	04
MSEC202	Industrial Automation	04	--	04	--	04
MSEC203	Advanced Quantitative Techniques	04	--	04	--	04
MSEDLO 202X	Department Level Optional Course II	04	--	04	--	04
ILO202X	Institute Level Optional Course II	03	--	03	--	03
MSEL201	Laboratory III - Industrial Automation	--	02	--	01	01
MSEL202	Laboratory IV - Advanced Quantitative Techniques	--	02	--	01	01
Total		**19**	**04**	**19**	**02**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
MSEC201	Sustainable Manufacturing	20	20	20	80	03	--	--	100
MSEC202	Industrial Automation	20	20	20	80	03	--	--	100
MSEC203	Advanced Quantitative Techniques	20	20	20	80	03	--	--	100
MSEDLO 202X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ILO202X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
MSEL201	Laboratory III - Industrial Automation	--	--	--	--	--	25	25	50
MSEL202	Laboratory IV - Advanced Quantitative Techniques	--	--	--	--	--	25	25	50
Total			**100**	**100**	**400**		**50**	**50**	**600**

Course Code	Department Level Optional Course II	Course Code	Institute Level Optional Course II
MSEDLO2021	Logistics & Supply Chain Management	ILO2021	Project Management
MSEDLO2022	Business Intelligence	ILO2022	Finance Management
MSEDLO2023	Rapid Prototyping and Tooling	ILO2023	Entrepreneurship Development and Management
MSEDLO2024	Micro and Nano Manufacturing	ILO2024	Human Resource Management
		ILO2025	Professional Ethics and CSR
		ILO2026	Research Methodology
		ILO2027	IPR and Patenting
		ILO2028	Digital Business Management
		ILO2029	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MSES301	Seminar	--	06	--	03	03
MSED301	Dessertation I	--	24	--	12	12
Total		**--**	**30**	**--**	**15**	**15**

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam			
		Test1	Test 2	Avg				
MSES301	Seminar*	--	--	--	--	50	50	100
MSED301	Dessertation I	--	--	--	--	100	--	100
Total			**--**	**--**	**--**	**150**	**50**	**200**

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract /Oral	Total
MSED401	Dessertation II	--	30	--	15	15
Total		**--**	**30**	**--**	**15**	**15**

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam			
		Test1	Test 2	Avg				
MSED401	DessertationII*	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	**100**	**100**	**200**

*Seminar of Semester III and Dissertation II of Semester IV should be assessed jointly by the pair of Internal and External Examiners

Note- The Contact Hours for the calculation of load of teacher are as follows
Seminar   - 01 Hour / week / student
Dissertation I and II   - 02 Hour / week / student

Course Code	Course Name	Credits
MSEC 101	**Product Design & Development**	**04**

Objectives
1. The purpose of teaching this subject on Product Design & Development is to facilitate a deeper understanding & assimilation of key concepts of the topic to the learner.
2. It is also expected that the learner knows the state of the art methodologies and technologies in the subject.
3. The learner therefore is able to face the global challenges in this domain.

Outcomes: Learner will be able to…
1. Understand the basic design process
2. Understand Generic development process , Product Life Cycle & various state of the art tools/techniques used
3. Choose appropriate design method
4. Understand economic feasibility of the product
5. Understand the process of IP rights & Patenting.

Module	Detailed Contents	Hrs.
01	**Design Process :** Introduction to Design Process / Materials , Processes, Product Mix / Specs / Classification / Architecture, Conceptual Design, Generation , Selection & Embodiment of Concept, Morphology of Design, Design Optimization/Constrained, Unconstrained, Multi objective ,Simulation based	08
02	**Development Process** Modern / Generic Development Process / Innovative Thinking, Product Life Cycle, Customer Needs, Affinity Diagrams, Competitive Benchmarking, Creativity Techniques, Simulation / RP, TRIZ, Axiomatic design, Decision Making, Decision Tree, Pugh Concept Selection Method, Weighted Decision Matrix, AHP	10
03	**Design Methods** Design for Manufacturing & Assembly, Design for Maintainability & Environment, Sequential versus Concurrent Design, Robust Design & Taguchi's DOE. Legal , Social , Ethical issues related to Design.	10
04	**Industrial Design** Ergonomics / Aesthetics , Psychological & Physiological Considerations Design for Serviceability / Environment – Climate, Noise, Motion, Sound, Vibrations. Anthropometry – Workplace & Equipment Design. Animation, Size, Texture, Color, Comfort Criteria.	08
05	**Product Costing & Techno commercial Viability** Product Costing Elements / Levies, Value Engg / Value Analysis – Definition, Methodology, Economic Analysis, Qualitative & Quantitative, Important Finance Ratios, Return on Investment, Return on Sales, Gross Profit Margin, Net Profit Margin, Case Studies	08
06	**Allied Issues** Tools for Product Design , Drafting , Modelling – CAD / CAE Tools, CAM Interface, CAPP, Patents & IP Acts Overview & Disclosure Preparation, Emerging Areas of Design – Nano Design , Green Design , Sustainable Design	08

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGrawhill New Delhi 2003
2. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992
3. N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods." John Willey & Sons 1995
4. Byers, Mel, The Design Encyclopedia, John Wiley & Sons, 1994
5. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new
6. Product Development." 1 / e 2004 , Pearson Education New Delhi
7. L D Miles "Value Engineering."
8. Hollins B & Pugh S "Successful Product Design." Butterworths London.
9. Baldwin E N & Neibel B W "Designing for Production." Edwin Homewood Illinois
10. Jones J C "Design Methods." Seeds of Human Futures. John Willey New York.
11. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill NewYork

Course Code	Course Name	Credits
MSEC102	**Computer Integrated Manufacturing**	**04**

Objectives

1. To understand overall aspects of manufacturing systems and the manufacturing supporting systems.
2. To understand the CIM database and database management system of a manufacturing firm.
3. To understand the functioning of computer integrated manufacturing Enterprise

Outcomes: Learner will be able to…

1. Apply the knowledge and explore new dimension of research in the field of Computer Integrated Manufacturing.
2. Work in an integrated manufacturing industry

Module	Detailed Contents	Hrs.
01	**Introduction to CIM :** Background: Manufacturing systems and its support systems, Computer applications in Design and manufacture-Fundamentals of CAD, CAM. Concurrent Engineering: Benefits and techniques of Concurrent Engineering, Framework for integration of Life-cycle phases in CE, Integrated Product Development (IPD), Product Life-Cycle Management (PLM), and Collaborative Product Development. Introduction to CIM, Evolution, objectives, benefits, limitations, relationship between automation and CIM, CIM hardware and software, role and functioning of elements of CIM, CIM Wheel	10
02	**Computer Process Monitoring and Control:** Computer Process Monitoring: Data logging systems-Data acquisition systems-Multilevel scanning. Computer Control: Computer-Process Interfacing-Manufacturing Process Data-System Interpretation of Process Data-Interface Hardware Devices-Digital Input /Output Processing Interrupt system-Control programming-Computer Process Control-Structural Model of a Manufacturing Process- Process Control Strategies-Distributed Control versus Central Control- Supervisory Computer Control	08
03	**Development and implementation of an FMS:** Planning phase, Integration, System configuration, FMS layouts, Simulation, FMS Project development steps. Project management, Equipment development, Host system development, planning, Hardware& Software development. Automated Material Handling & Storage: Functions, Types, Analysis of material handling equipment's, Design of Conveyor & AGV systems. Problems. Development for total material handling system.	08
04	**Computer Aided Quality Control (CAQC):** Introduction, QC inspection and testing, the computer in QC, Automated inspection principles and methods, sensor technologies for automated inspection – contact and non-contact types, Computer aided testing, Integration of CAQC with CAD/CAM	08
05	**Role of Information Systems:** Information requirements of manufacturing, group technology, computer aided process planning, computer integrated production planning systems, material requirements planning, capacity planning, shop floor control, automatic identification techniques. CIM database and database management systems: Manufacturing Data: Types, sources, Database models, Architecture, Database Management System (DBMS), product Data Management (PDM), Advantages of PDM	08

		Enterprise Wide Integration in CIM and CIM Models	
06		Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks, Selection of Network Technology, networks for manufacturing, Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration, CIM Models.	10

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Groover, M.P: "Automation, Production System and CIM"- Prentice-Hall of India.
2. Vajpayee,"Principles of CIM" - Prentice-Hall of India.
3. Ranky, Paul G: "Computer Integrated Manufacturing"- Prentice-Hall of India.
4. David Bedworth: "Computer Integrated Design and Manufacturing" -TMH, New Delhi.
5. Robert Levine et al;" A Comprehensive guide to AI and Expert Systems"- McGraw Hill Inc,1986.
6. Nanua Singh," Systems Approach to Computer Integrated Design and manufacturing "John Wiley.
7. Scheer A.W. "CIM Towards the factory of the Future", Springer-Verlag,New York.
8. Geoffrey Boothroyd "Assembly Automation and Product Design", (Manufacturing Engineering and Materials Processing)
9. Radhakrishnan.P, Subramanyan. S, 'CAD/CAM/CIM', New Age International Publishers
10. Yorem Koren, 'Computer Control of Manufacturing System', McGraw Hill
11. Horst Tempelmeier and Heinrich Kuhn "Flexible Manufacturing Systems: Decision Support for Design and Operation"

Course Code	Course Name	Credits
MSEC103	**Quality Engineering**	**04**

Objectives

1. To study fundamentals of statistical techniques.
2. To acquaint with various quality management tools.
3. To overcome obstacles for achieving a successful quality management.
4. To enable and understand Total Quality Management (TQM).

Outcomes: Learner will be able to…

1. Demonstrate the understanding of modern quality concepts.
2. Demonstrate the understanding of statistical quality control charts
3. Apply the use of standard sampling plan.
4. Analyze the modern management trends in quality improvement.
5. Apply the use of concepts of TQM

Module	Detailed Contents	Hrs
01	**Quality:** Definition & Evolution of Quality, Quality Assurance, and Quality Characteristics (dimensions). Quality Control, Quality tasks & means to control them, Quality costs concept& its categories, Cost reduction program and economics of quality	**08**
02	**Statistical Quality Control (SQC):** Basic Concept of Statistical Quality Control (SQC), Statistical Tools in Quality Control. Concept & causes of variation, statistical aspect of control charting. Concept of rational sub-grouping and detecting patterns on the control charts, for variables and attributes: X and R, p, np, c and u charts; specification and tolerances, natural tolerance limits, specification limits, process capability ratio analysis and studies	**10**
03	**Acceptance Sampling:** Concept of Acceptance Sampling, Lot by lot sampling process, types. Probability of acceptance in single, double, multiple and sequential sampling plans, OC curves, Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts, standard sampling plans for AQL and LTPD, use of standard sampling plans, Introduction to Variable sampling plans	**08**
04	**Total Quality Management(TQM):** Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Implementation of TQM, ISO 9000 quality system, Jurans Triology, Deming's Approach to TQM, Zero defect Concept	**08**
05	**Total Productive Maintenance (TPM):** History and Impact of TPM, Overall Equipment Effectiveness (OEE). Developing the TPM implementation Plan, Preventive Maintenance, techniques-FMEA, POKA-YOKE and Future of TPM	**08**

Module	Detailed Contents	Hrs
06	**6σ & Modern Management Tools:** Evolution of six sigma quality approach, steps involved in the application of six sigma, six sigma and Indian Industries, Six sigma 6.2 concept of process capability, Basic & Modern tools in quality improvement, Benchmarking, KAIZEN, JIT, 5-S, Taguchi quality loss function. Introduction to DOE and RSM.	**10**

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Statistical Quality Control By M.Mahajan
2. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
3. Ross, P. Taguchi Techniques for Quality Engineering, 2nd edition, McGrawHill,1966
4. Douglas.C.Montgomery, "Introduction to Statistical quality control" John wiley 4th edition2001.
5. John.S. Oakland. Statistical process control", Elsevier, 5th edition, 2005
6. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
7. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
8. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
9. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
10. J.Juran, "Quality Control Handbook,Mcgraw Hill USA
11. A.V.Feigenbaum, "Total quality control" Mcgraw hill int.edition USA
12. W.E.Deming, "Out of crisis", productivity & quality publishing pvt.ltd.,Chennai.
13. A.J.Dunkan, "Quality control & Industrial statistics", Richard D.Irwin,INC USA.
14. A.Zaidi, "SPC,concepts,Methodology & tools", Prentice Hall India ltd., New Delhi
15. Terry Wireman, "Total Productive Maintenance", Industrial Press, 2nd Edition, New York

Course Code	Course Name	Credits
MSEDLO 1011	**Advanced Materials Science**	**04**

Objectives
1. The aims of the course is to give fundamental knowledge about type of materials, their usage, properties and characteristics, which are important in engineering design.
2. It is also aimed to give a theoretical background about the analysis of behaviour of engineering materials by emphasizing important relationships between internal structure and properties.
3. Understand the relationship between Nano/microstructure, characterization, properties and processing and design of materials.
4. Understand the behaviour of composite material.
5. Differentiate the properties and applications of metals, ceramics, polymers and composite materials.
6. Understand the significance, properties and applications of nanomaterials

Outcomes: Learner will be able to…
1. Demonstrate extensive knowledge and skills related to selected topics covered by the course.
2. Use this knowledge and skills to discuss and analyse relevant problems connected to these topics.
3. Prepare and present selected topics from the course in form of Power-Point presentations for colleagues and fellow students

Module	Detailed Contents	Hrs.
01	**Review of fundamentals:** Covalent, Ionic, Metallic and Van-der Walls Bond, Bond strength and melting point, Crystalline structures, Vacancies, Dislocations and other crystal defects. Metals Vs Alloys – Microstructure characterization	06
02	**Mechanical behaviour of metals and alloys:** Elastic and plastic behaviours, Tensile & compressive stress-strain relations for elastic behaviours. Fracture toughness, fatigue failure, creep failure, wear and abrasion	05
03	**Metals and alloys:** HSLA Steels, tool and die materials, alloy cast-irons, stainless steels, PH and Maraging steels. Materials for low temperature applications, refractory metals and super alloys, hard field steels, ball bearing steels, automobile alloys and aerospace alloys	05
04	**Polymers :** Definitions, Classifications, Monomers, Polymerization principles, Addition, Condensation, Mass ,Suspensions and emulsion polymerizations Classification – Thermoplastic and Thermosets, Crystalline and Amorphous, Natural and Synthetic, Linear, branched and cross-linked; Engineering, commodity and speciality polymers Homo polymers and co-polymers, Elastomers and Thermoplastic elastomers Polymer Blends and Alloys, Liquid crystal polymers, Polymer foams Properties and applications of polymers, Viscoelastic, Thermal, Electrical, Optical, Environmental & Mechanical behaviour. Important thermoplastics and thermosets - their moulding characteristics, properties and applications	18

05	**Ceramics and Composite:** Various ceramic materials and their applications Engineering ceramics, Environmental influence on ceramics Ceramic crystal structures – Binary and Ternary structures **Fundamentals of composite**: Definition, Classification of composite materials, Laws of mixtures, Factors affecting composite properties, Interfacial bonding, Mechanical Behaviour of Composites, Glass fibres, Carbon fibres, Silicon Carbide fibres, and Metallic Glasses		06
06	**Advanced Materials:** Concept of nano materials, scale and dimensional aspects for preparing nano materials synthesis and properties, applications of nano materials. Biomaterials, super alloys, shape memory alloys. Carbon as a special material, Smart materials. Nano -Physics, Preparation of Nano phase materials -Sol -gel, electro- deposition, plasma assisted deposition, Molecular beam epitaxy etc. Advanced nano -composites Thin film preparation of metal oxides, Application of Nanostructured Materials		12

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

Materials Science by R S Khurmi & R S Sedha S Chand & Co
1. Mechanical Metallurgy by Georgr Dieter (Mc Grawhill)
2. Heat Treatment Principles By Rajan , Sharma & Sharma Prentice Hall
3. Plastics Engg by R J Crawford Butterworth Hieneman
4. Composite Materials Scence & Engineering by Krishnan Chawla (Springer Verlag)
5. Plastics Technology Handbook by M Chandra & S K Roy Marcel Dekker
6. Mechanical properties of ceramics by John B Wactman John Willey & Sons
7. Metal Matrix composites : Thermomechanical behaviour by Taya M & Arsenault R J (Pergamon press oxford)
8. Analysis & performance of fibre composites by B D Agarwal & L J Broutman John Willey & sons NewYork
9. Transport in Nanostructures, D. K. Ferry and S. M. Goodnick, Cambridge University Press, 1997.
10. Chemistry of Advanced Materials, Edited L. V. In terrante, and M. J. Hampden-Smith Wiley -VCH, U. S. A 1998.

Course Code	Course Name	Credits
MSEDLO 1012	**World Class Manufacturing**	**04**

Objectives
1. Help the learner understand and assimilate deeper insights into the opportunities & challenges faced by manufacturing as a domain today.
2. Introduce the learner to be prepared for facing the demands and complexities of a global market place

Outcomes: Learner will be able to…
1. Understand the relevance and basics of World Class Manufacturing, the current Status of Indian Manufacturing scenario and have the ability to design and develop a roadmap for world class manufacturing.
2. Prepare them for meeting the challenges, the Indian manufacturer's face, as it evolves from a domestic to a world class global manufacturer status

Module	Detailed Contents	Hrs.
01	**Historical Perspective** World class manufacturing organizations, Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence. Globalization and International Business; Global Competitiveness and Manufacturing Excellence, Manufacturing and Information age competition; Manufacturing challenges and Problems in Manufacturing Industries	08
02	**System and Tools for World Class Manufacturing** Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping, Poka Yoke, 5-S, 3 M, JIT, Product Mix, Optimization, Procurement & stores practices. Total Productive maintenance, Visual Control	07
03	**Benchmark, Bottlenecks and Best Practices** Concepts of benchmarking, Bottleneck and best practices, Best performers Gaining competitive edge through world class manufacturing Value added manufacturing , Value Stream mapping, Eliminating waste, Toyota Production System, Example	07
04	**HR Dimensions in WCM – WCM Strategy Formulation** Adding value to the organization, Organizational learning – techniques of removing Root cause of problems – People as problem solvers, New organizational structures. Associates, Facilitators – Teamsmanship, Motivation and reward in the age of continuous improvement	08
05	**Typical Characteristics of WCM Companies** Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy	08
06	**Competitive Indian Manufacturing** Manufacturing Performance and competitiveness of Indian Firms, Manufacturing objectives and Strategy; Usage of Management Tools and Technologies. Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure. The Future WCM Manufacturing strategy: Futile search for an Elusive Link, Manufacturing Strategic Intent classification translating into action **WCM - the Indian Scenario** Case studies on leading Indian companies moving towards world class manufacturing –Task Ahead. Green Manufacturing, Clean manufacturing, Agile manufacturing	14

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
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1. Question paper will comprise of total six question
2. All question carry equal marks
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4. Only Four questions need to be solved.

References:

1. Sahay B.S., Saxena KBC and Ashish Kumar, "World Class Manufacturing - Strategic Perspective Mac Milan Publications, New Delhi.

2. Korgaonkar M.G., "Just In Time Manufacturing", MacMilan Publications

3. Narayanan V.K., "Managing Technology and Innovation for Competitive Advantage", Prentice Hall, 2000

4. Adam and Ebert, "Production and Operational Management", 5th Edition, Prentice Hall learning pvt. Ltd., New Delhi

5. Ron Moore, "Making Common Sense Common Practice – Models for manufacturing Excellence", Butter worth Heinmann

6. Jeffrey K.Liker "The Toyota Way – 14 Management Principles", Mc-Graw Hill, 2003.

7. Chase Richard B., Jacob Robert., Operations Management for Competitive Advantage", 11th Edition, McGraw Hill Publications, 2005.

8. Moore Ron, "Making Common Sense Common Practice", Butterworth-Heinemann, 2002

Course Code	Course Name	Credits
MSEDLO 1013	**Knowledge Management**	**04**

Objectives

1. Define KM, learning organizations, intellectual capital and understand the role of knowledge management in organizations and its successful system life cycle.
2. Identify and use tools and techniques of KM for the different stages of creation, acquisition, transfer and management of knowledge.
3. Analyze and evaluate tangible and intangible knowledge assets and address current KM issues.
4. Evaluate the impact of new technologies such as networks and Internet/intranet role in managing knowledge.
5. By understanding of the importance of intellectual capital, articulate how to create the competitive advantage in manufacturing and other organizations.

Outcomes: Learner will be able to…

1. Understand the importance of intellectual capital to benefit in the competitive advantage and how to create conducive KM infrastructure in organizations.
2. Choose application packages in KM and the issues in designing and developing knowledge databases (including intranets and groupware).
3. Develop a working knowledge in the area through focused projects and career options.
4. Analyze impacts of implementation of KM infrastructure.

Module	Detailed Contents	Hrs.
01	**Introduction to Knowledge Management :** Data, Information and Knowledge, KM Myths , KM Life Cycle, Understanding Knowledge, Knowledge, intelligence, Experience, Cognition. KM Types of Knowledge, Expert Knowledge, Human Thinking and Learning-Learning Organization-Characteristics, benefits, challenges of Learning Organization	08
02	**Knowledge Management System Life Cycle** Challenges in Building KM Systems – key differences of Conventional and KM System Life Cycle, Knowledge Creation. Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture and its layers	10
03	**Knowledge Capturing** Evaluating the Expert – Developing a Relationship with Experts – Fuzzy Reasoning. The Quality of Knowledge – Knowledge Capturing or discovery Techniques, Brain Storming, storytelling, knowledge sharing,– Protocol Analysis – knowledge application systems (expert systems and decision support systems- Consensus Decision Making – Repertory Grid for competency mapping- Concept Mapping and use of software's	10
04	**Knowledge Codification and Coordination** Principles of K Codification -Modes of Knowledge Conversion, Codification Tools and Procedures, Knowledge Developer's Skill Sets, System Testing. Deployment, Knowledge Testing, Approaches to Logical Testing, User Acceptance Testing, KM System Deployment Issues, User Training, Post implementation	08
05	**Knowledge Transfer and Sharing** Transfer Methods, Role of the Internet, Knowledge Transfer in e-world, KM System, Tools, Neural Network, Association Rules, Classification Trees, and Data Mining. Business Intelligence, Decision Making Architecture, Data Management, Knowledge Management Protocols, Managing Knowledge Workers.	08
06	**Knowledge Management in Manufacturing** How to foster innovation within own organizations - policy adoption of new	08

| | management methods, to actual innovation or to ICT use, organizational responsiveness, innovation, competency and efficiency (RICE), knowledge sharing, utilization and its evaluation, Knowledge value chain, illustrative case studies in manufacturing | |

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Elias.M. Award & Hassan M. Ghaziri – "Knowledge Management" Pearson Education 2003.
2. Guus Schreiber, Hans Akkermans, Anjo Anjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2001.
3. C.W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003
4. Davenport, Thomas H. & Prusak, Laurence(2000). Working Knowledge: How Organizations Manage What They Know. Boston, MA: Harvard Business School Press.
5. Nonake, Ikujiro & Takeuchi, Hirotaka. (1995) The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. 2010

Course Code	Course Name	Credits
MSEDLO1014	**Precision Engineering**	**04**

Objectives

1. To understand the need for precision and application.
2. To understand concepts of accuracy and errors due to numerical interpolation.
3. To understand the aspects of precision engineering like precision Materials, Measurement and Machining

Outcomes: Learner will be able to…

1. Enhance his/her knowledge in Precision Engineering and its applications.
2. Explore new dimension of research in the field of precision and ultra-precision materials and Machining methods

Module	Detailed Contents	Hrs.
01	**Accuracy and precision:** Introduction - concept of accuracy and precision, Need for high precision, Accuracy of numerical control systems. Errors due to numerical interpolation - displacement measurement system and velocity lags	07
02	**Geometric Dimensioning And Tolerancing:** Interpretation, measurement and application of form tolerances, datum system. Targets –tolerance of position Tolerance zone conversions , Surfaces, features, features of size, datum features-Datum, oddly configured and curved surfaces as datum features, equalizing datum	07
03	**Precision Materials and Machining:** Diamond – types-single crystal- PCD, Natural-synthetic CBN, Ceramics – coated metals and nonmetals, High performance polymer, alloys, refractory metals: cutting tools performance, Components of instruments, Jewels self-Lubrication, smart materials – properties, testing, applications. Precision Machining :Precision grinding- High-speed grinding, High-speed Milling-Micromachining, Diamond turning-MEMS, micro finishing process	06
04	**Precision Measuring Systems:** Units of length, legal basis for length measurement, Traceability – Processing system of nanometer accuracies, LASER light source - LASER interferometer, LASER alignment telescope, LASER micrometer-on-line and in-process measurements of diameter and surface roughness using LASER - Micro holes and topography measurements- In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems. Straightness. Flatness measurement – Optoelectronic Measurement Systems in Metrology, Opto electronic devices contact and non-contact types Applications - Tool wear measurement, 3D Surface roughness, and Pattern generation studies	12
05	**Nano-Positioning Systems Of Nano Accuracy & Repeatability:** Guide systems for moving elements - Servo control systems for tool positioning Computer Aided digital and ultra-precision position control	12
06	**Computer Integrated Quality Assurance:** Concept of Total quality control & quality assurance, Zero defects-POKAYOKE Statistical evaluation of data using computer, CNC CMM applications - Computer Aided measurement, data integration of 3D-CMM	08

Assessment:

Internal:
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End Semester Theory Examination:
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4. Only Four questions need to be solved.

References:

1. MURTHY, R.L., - "Precision Engineering in Manufacturing ", New Age International (P) Limited, publishers, 1996.
2. JAMESD. MEADOWS, - "Geometric Dimensioning and Tolerancing ", Marcel Dekker Inc.1995.
3. Spotts ,"Dimensioning and tolerancing of mass production", Prentice Hall, 1983
4. WATSON .J., " Optoelectronics " - Van Nostrand Rein hold(UK)Co ltd.,1988
5. ROBERT.G. SEIPPEL, - "Optoelectronics for technology and engineering ", Prentice Hall NewJersey,1989
6. ULRICH-REMBOLD, ARMBRUSTER AND ULZMANN-" Interface technology for computer controlled manufacturing processes ", Marcel Dekker Pub. New York, 1993
7. John Frederick Wise Galyer, Charles Reginald Shotbolt,"Metrology for Engineers",Cassell
8. THOMAS.G.G. - "Engineering metrology", Butterworth PUB.1974.
9. NORIO TANIGUCHI, - "Nano Technology ", Oxford university, Press, 1996.
10. Venkatesh, V.C. and Sudin, I., "Precision engineering", Tata McGraw Hill Co., New Delhi.
11. David Dorifield, Dae Eur Lee, -" Precision Manufacturing" Springer Publishers, 2008.
12. Anthony James Thomas Scarr," Metrology and Precision Engineering" McGraw-Hill.

Course Code	Course Name	Credits
ILO 1011	**Product Life Cycle Management**	**03**

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of LCA, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

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REFERENCES:
1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO 1012	**Reliability Engineering**	**03**

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

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4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 1013	**Management Information System**	**03**

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

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REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Informantion Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 1014	**Design of Experiments**	**03**

Objectives:
1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…
1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs and Analysis** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs and Analysis** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07

	Conducting Tests	
05	5.1 Testing Logistics 5.2 Statistical aspects of conducting tests 5.3 Characteristics of good and bad data sets 5.4 Example experiments 5.5 Attribute Vs Variable data sets	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal:
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4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO 1015	**Operations Research**	**03**

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05

06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

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End Semester Theory Examination:
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4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO 1016	**Cyber Security and Laws**	**03**

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:

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End Semester Theory Examination:

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4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings*, Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO 1017	**Disaster Management and Mitigation Measures**	**03**

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction *1.1* Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09

06	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:
1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.
(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 1018	**Energy Audit and Management**	**03**

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:
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End Semester Theory Examination:
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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:
1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
MSEL101	**Computer Integrated Manufacturing Systems**	**01**

Module	Detailed content	Lab. Sessions
01	Operation, Control and Programming of various computer controlled machines in the FMS such as CNC machine tools, Automated Storage/Retrieval (AS/RS) systems, Robots, automated assembly station etc Or Any one from the above and Case study presentation on Simulation and performance analysis of the FMS, parts flow control on Assembly station.	07
02	Study experiments on Integration aspects in computer integrated manufacturing environment. Importance of Artificial Intelligence.	06

Note- With reference to the case study based experiments/presentations on the above topics;
It is desirable to have innovations. Repetition of case studies should be avoided.
May be prepared from recent journal papers, books or actual visit to any Automated (Fully or partially) Manufacturing Industry

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
MSEL102	**Quality Engineering**	**01**

Module	Detailed content	Lab. Sessions
01	Using live data from separate case studies and complete analysis of following topics (minimum three). Every student is expected to do individual and different three case studies from the above syllabus.	05
02	Use of modern software for complete analysis of data from experimentation or a Field / online survey questionnaire. One full report may be submitted mentioning all its objectives, methodologies, inferences etc..	05
03	Assignment based on each module	03

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
MSEC201	**Sustainable Manufacturing**	**04**

Objectives
1. To Study concepts of Sustainability, Environment and Social Dimensions of Sustainability.
2. To impart knowledge of types and Sources of solid and hazardous wastes and methods of recycling.
3. To Study materials for sustainability and integrating sustainability principles.
4. To understand various conversion technology and various aspects of design environment.
5. To acquaint methods of Multi-objective decision making and Sustainability Assessment

Outcomes: Learner will be able to…
1. To understand the economic, technical, and societal issues involved in Sustainable manufacturing.
2. To identify Sources of solid and hazardous wastes.
3. To apply Environment Friendly choices of Materials and Processes selection.
4. To develop design for environment and analyze Environmental Standards, Legislation.
5. To apply Multi-objective decision making and Sustainability Assessment.

Module	Detailed Contents	Hrs.
01	**Sustainability:** Concepts related to Sustainability, Environmental, Economic and Social Dimensions of Sustainability. Sustainable Development, The global sustainability Agenda, Green Expectations, Confronting climatic change, Wake-up Conferences, The Voice of Society, Answering the call- The Green Movement.	05
02	**Types and sources of solid and hazardous wastes**: Nature and hazard of pollutants: waste processing /segregation. Need for waste management, Waste processing, Green processing and engineering operations, incineration, Energy recovery, a life-cycle approach, which considers the costs and benefits associated with material acquisition. Transportation, production, product use, R3 and R6 cycles, Design for recycling – Eco friendly product design methods – Methods to infuse sustainability in early product design phases	08
03	**Environment friendly choices in manufacturing and operations**: Materials for Sustainability, Materials and processes selection, Materials for the future, Materials for Recycling, Control on non-renewable material usage Component toxicity and health impact, Integrating sustainability principles. Adoption of low carbon technologies - need to reduce the carbon footprint of manufacturing operations	10
04	**Design for Environment:** Conversion technologies, Innovations for reuse, bio processing technology, Energy audits, Sustainable loading on ecosystems. The concept of "Eco-innovation," a measurable characteristic of products and processes, Product Life Cycle Assessment: Environmental analysis from raw materials to disposal, Matrices for sustainable design, industrial case studies.	10
05	**Environmental Standards and Legislation**: Role of environmental management in the business world, overview of environmental impact assessment (EIA), EIA Methods. **Environmental Legislations**: Carbon Foot Print, Implications of public policy, Anti-pollution Boards Guarding Against Environmental Impact, Alternative product and process changes, manufacturing practices, Global warming and Kyoto protocol, Environmental preservations. Environment and human health, Access to potable water, Effective Hazards Mitigation Management.	10

06	**Sustainability Assessment:** Multi-objective Decision Making, Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility, Continuous sustainability awareness programmers. Sustainability Rating Schemes, Eco-labeling Programs Case Studies.	09

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Sustainable Development by M. K. Ghosh Roy; Ane Books Pvt. Ltd.
2. Green Management by M. Karpagam, Geetha Jaikumar; Ane Books Pvt. Ltd.
3. Essential Environmental Studies, S. P. Misra, S.N. Pandey, Sheth Publishers.
4. Design for Environment: A Guide to Sustainable Product Development, Joseph Fiksel, McGraw-Hill Companies.

Course Code	Course Name	Credits
MSEC202	**Industrial Automation**	**04**

Objectives
1. To acquaint with basic concepts of industrial automation involving pneumatic and hydraulic controls.
2. To familiarize with the elements of electro-pneumatic interface with control systems.
3. To learn about programmable logic controller.
4. To know the role of robotics in Automation

Outcomes: Learner will be able to…
1. Students shall be able to understand the working of automation systems and shall acquire the insight to build the automation systems.
2. Illustrates the use of PLC in Automation.

Module	Detailed Contents	Hrs.
01	**Introduction to Automation** Automation in production system, Automation principles and strategies, Elements of Automated system., Advanced automation function, Levels of Automation, Arguments for and against automation	04
02	**Microcontrollers , Sensors and Transducers , Actuators** Overview of microcontrollers & Interfacing, Displacement, position and Proximity Sensors, Velocity and Motion Sensors, Force and Fluid Pressure Sensors, Liquid level and Flow sensors, Temperature and light Sensors, Servomotors/Steeper motors	08
03	**Programmable and Logic Controller** PLC configuration and selection PLC Basic components and their symbols Control transformers and fuses - Switches and Indicator lamps, Relays and time delay relays PLC Programming - Fundamentals of Ladder Programming, Ladder programming for logic gates and latching, Sequencing ,counters ,timers, shift register and Master & Jump control, Introduction to Supervisory control and data Aquicission	08
04	**Control Engineering** Mathematical modelling of Servo systems - Armature controlled D.C.motor, Field controlled D.C. motor Design of PD,PI and PID Controllers. Frequency Response Analysis - Frequency domain specifications for second order system, Nyquist plot State Space Analysis - State space representation of systems, Controllability and Observability, Transfer function from state space matrices	09
05	**Pneumatic and Hydraulic actuation systems** Mechanical and Electrical actuators. Pneumatic Control - Different types of valves and Actuators in Pneumatics, their applications and use of their ISO symbols, Design of Pneumatic circuits using Cascade method and Shift Register Method. (Up to 3 cylinders), Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping, Design of Pneumatic circuits using PLC Control (ladder	15

	programming only). Up to 2 cylinders, with applications of Timers and Counters and Concept of Flag and latching. Hydraulic Control - Different types of valves and Actuators in Hydraulics, their applications and use of their ISO symbols, Meter in, meter out and Bleed off circuits. Sequencing circuits, Accumulators and their types. Applications of Accumulator circuits, Problems based on sizing and selection of Hydraulic components, Actuation technology in Hydraulic valves: Proportional and Servo, Hydraulics and Digital Hydraulics. Design of Electro- Hydraulic, circuits	
06	**Robotics** Automation and Robotics, Robot types, anatomy and related attributes, accuracy, repeatability Trajectory planning, Robot control system and end effector, Sensors in robotics, Industrial application and future applications, Introduction to Artificial Intelligence	09

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Mikell P. Grover, AutomationProduction Systems, and Computer Integrated Manufacturing. Pearson Education,2003,Second Edition.
2. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering; Pearson Education
3. John R. Hackwarth, Frederick D. Hackwarth,Jr., Programmable Logic Controllers Programming Methods and Applications, Pearson Education LPE,2004.
4. K.Ogata, Modern Controls Engineering,Prentice Hall of India Pvt. Ltd., NewDelhi,2005.
5. Antony Esposito, Fluid Power Systems and control,Prentice-Hall, 1988
6. Peter Rohner, Fluid Power logic circuit design. The Macmillan PressLtd.,London, 1979
7. Joji P., Pneumatic Controls, Wiley India,2011.
8. Grover, Weiss, Nagel,Odrey, Industrial Robotics Technology, Programming, and Applications, McGRAW-Hill International Editions,1986.
9. I.J.Nagrath and Gopal. "Control System Engineering", New age international (P) Ltd., 2005.
10. Handbook of Robotics – Springer
11. Probabilistic Robotics – Sebastian Thrun , Wolfram Burgard , Dieter Fox
12. Robotics : Modelling & Control – B. Siciliano
13. Robot Dynamics & Control - Spong.

Course Code	Course Name	Credits
MSEC203	**Advanced Quantitative Techniques**	**04**

Objectives

1. Familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To understand and solve linear and nonlinear problems in industrial applications.
3. Familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources

Outcomes: Learner will be able to…

1. Illustrate the need to optimally utilize the resources in various types of industries
2. Demonstrate cost effective strategies in various applications in industry.
3. Apply and analyze mathematical optimization functions to various applications.
4. Perform exhaust gas analysis and comment on adverse implications on environment

Module	Detailed Contents	Hrs.
01	Decision environment, Decision making process; Optimization, search problems, Heuristics, deterministic and probabilistic situations, single and multiple persons making, Introduction to related software	04
02	Linear programming problems(LPP), Big m method Two phase method Advance Topics in linear programming problems - Sensitivity analysis, Revised Simplex Method, Goal programming, Parametric Linear programming, Integer Linear programming	14
03	Introduction Nonlinear programming problems (NLPP) Unconstrained Nonlinear Algorithm, Search and Gradient method Constrained Nonlinear Algorithm - Geometric Programming, Separable Programming, Quadratic programming, Stochastic Programming	10
04	Dynamic (Multistage) programming and its applications in various fields	08
05	Decision Theory Decision under risk Decision under uncertainty Decision tree for decision making, Bayesian approach in decision making	08
06	Queuing Theory - Single channel queuing model (with Poisson arrival and Exponential service times), Poisson-Exponential multiple channel queuing model, Poisson Arrival and Earling service distribution Monte Carlo simulation	08

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Ravindran A. Philips D.T and Solbetrg J.J. Operation Research: Principles Practices, John Wiley, 2nd Ed.
2. Bazzarra M S Jarvis J.J and Sherali H.D: Linear Programming and Network 2nd ED; John Wiley
3. Winston W.L Operation Research: Application and Algorithm, Kent P.W. S 2nd Ed.
4. Taha H.A. Operation Research: An Introduction, Macmillian
5. Kapoor R. Computer assisted decision models Tata McGraw Hill
6. B Banerjee: Operation Research Techniques for Management, Business Book Publishing House.

Course Code	Course Name	Credits
MSEDLO 2021	**Logistics & Supply Chain Management**	**04**

Objectives
1. Understand what supply chain is and how it works.
2. An understanding of the primary differences between logistics and supply chain management
3. An understanding of the individual processes of supply chain management and their interrelationships within individual companies and across the supply chain
4. An understanding of the management components of supply chain management
5. An understanding of the tools and techniques useful in implementing supply chain management
6. Understand how supply chain strategy can provide competitive advantage for organization

Outcomes: Learner will be able to…
1. Analyze the manufacturing operations of a firm
2. Apply sales and operations planning, MRP and lean manufacturing concepts
3. Apply logistics and purchasing concepts to improve supply chain operations
4. Apply quality management tools for process improvement

Module	Detailed Contents	Hrs.
01	**Introduction:** Evolution of SCM, Understanding Supply Chain. Historical developments in supply chain management. Issues in SCM, linkages within the value chain, strategic Supply Chain Management (SCM) decision phases, and Scope of Logistics, philosophy and concept work of logistics. Mission of logistics management, logistics & competitive strategy. Service-driven logistics systems.	06
02	**Supply Chain performance:** Customer driven strategies in production & distribution systems. Customer focus in SCM, management of supply sources,. Drivers & obstacles, Different performance measures. Different multi-objective decision making and application of AHP. Measuring logistics costs & performance	08
03	**Planning Demand & Supply in SC:** Demand forecasting, Aggregate Planning, Planning & managing inventories in SC, Distribution network designs. Factors influencing network designs, distribution networks in practice frame work for network design decision. Network design in uncertain environment.	10
04	**Supply Chain Management:** Transportation in SC, Coordinating SC, Integrated production & distribution networks, source decision in SC. Network Design &IT in SC, SCM in the context of JIT, Total Quality Control and product innovation across the supply chain. Metrics for measurement of supply chain performance. Mathematical programming and other models for supply chain decisions. Measuring Logistics costs & performance.	12
05	**Information Systems in Supply Chain:** IT enabled SC, Best practices & benchmarking for SC, towards Green SC, towards World class SCM. Role of IT in Logistics management, the role of information in the virtual supply chain.	08

06	Leading edge logistics, IT application in freight logistics. Case studies from the literature & practice. Basic familiarity with mathematical modelling & optimization.	08

Assessment:

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Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
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4. Only Four questions need to be solved.

References:

1. Sunil Chopra, P. Meindl, Supply Chain Management, Pearson Education Asia.
2. R.P. Mohanty, S.G. Deshmukh, Essentials of Supply Chain management, Phoenix publishing House Pvt Ltd.
3. Martin Christopher, Logistics and Supply Chain Management, Pitman Publishing.
4. Bowon Kim, Mastering Business in Asia. Supply Chain Management, John Wiley & sons (Asia) Pte Ltd.
5. Michael Hugos, Essentials of Supply Chain Management, John Wiley and Sons
6. S.K. Bhattacharya , Logistics Management, Pearson Publication
7. R.P. Mohanty, S.G. Deshmukh, Supply Chain management, Theories and Pratices , biztantra

Course Code	Course Name	Credits
MSEDLO 2022	**Business Intelligence**	**04**

Objectives

1. To understand importance of state-of-the art and exact information that helps in taking critical business decisions.
2. To understand utility of BI as cost effective tool to improve operations.
3. To understand key components of BI.

Outcomes: Learner will be able to…

1. Apply the concepts of BI to real world problems.
2. Provide effective solutions for cost and profitability analytics and solutions for operational planning and budgeting.
3. Assess the impact of internal and external changes to the organizations, so as to have more agility.

Module	Detailed Contents	Hrs.
01	**Business Intelligence overview:** Introduction to Data, Information, and Knowledge, Introduction to Business Intelligence and Business Models, BI Definitions & Concepts, Business Applications of BI, BI system components. Historical review - Study of Information Technology resources such as Database systems, enterprise systems, and networks explained in their role of supporting decision makers. Special attention given to hands-on-experience in team projects for developing and using Business Intelligence. Ethical, legal, and behavioural issues of conducting Business Intelligence	08
02	**Knowledge Management:** Collaborative Business Intelligence: Integrating BI and KM. Taking lessons from KM to influence business intelligence, Data quality. Technological Support for Strategic Management in the Knowledge Based Economy, People centric BI and KM. Relationship and Integration of KM Content, KM as an Intelligence Tool using MS office/ MS SharePoint /SAP	08
03	**Capture the business and technical requirements for Business Intelligence solution architecture.** The stages and requirements of a Business Intelligence project lifecycle. Implementation of a Business Intelligence development project. Assess and design a Business Intelligence infrastructure. Describe and plan Business Intelligence operations and their management. Managing Data Archiving. Planning and implementing data archiving in a BI solution.	08
04	**Planning a Business Intelligence Project** Determining Business Intelligence Requirements Revising and Updating a Business Intelligence. Intelligence development requirements and implement a Business Intelligence development project. Manage a Business Intelligence development project. Determine effective data management processes.	08

	Designing Business Intelligence Infrastructure	
05	How to identify infrastructure requirements for a Business Intelligence solution, and how to design an effective infrastructure to provide the required levels of scalability and availability. Evaluating Software Requirements. **Managing Business Intelligence Operations** Overview of Business Intelligence Operations , Managing Maintenance and Operations Tasks, Managing Data Archiving , Planning the Operations Solution, Evaluating Operational Costs and Risks	10
06	**The online analytical processing (OLAP)** Extract, transport, Data Migration and ETL (Extract, Transform, and Load). Reporting technologies. Foundational understanding of Web-based architecture	10

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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2. All question carry equal marks
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4. Only Four questions need to be solved.

References:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, "Business Intelligence", ISBN-10: 013610066X Publisher: Prentice Hall.ISBN-13: 9780136100669.
2. Bill Inmon: Building the Data Warehouse. (4Th Ed.) books.google.co.in – 2005.
3. Galit Shmueli, Nitin R. Patel and Peter C. Bruce- Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner, Wiley, 2007.
4. William H. Inmon, Bonnie K. O'Neil, Lowell Fryman: Business metadata: capturing enterprise knowledge : books.google.co.in – 2008.
5. Kimball's Data Warehouse Toolkit Classics: The Data Warehouse Toolkit, 2nd Edition; The Data Warehouse Lifecycle Toolkit, 2nd Edition; The Data Warehouse ETL Toolkit John Wiley & Sons, 2009.
6. Sid Adelman, Larissa Terpeluk Moss: Data warehouse project management, Volume 1, Addison-Wesley, 2000.

Course Code	Course Name	Credits
MSEDLO 2023	**Rapid Prototyping And Tooling**	**04**

Objectives
1. The fundamental Theory behind RP process.
2. Study the Liquid, Solid, Powder RP Processes.
3. Study New Advances in RP Systems
4. The basics concept of different software used in RP system

Outcomes: Learner will be able to…
1. Understand the relevance and basics of Rapid Prototyping, categories of   Prototyping, and advances in 3D printing technology.
2. Understand how to work in team to design the parts and manufacturing by rapid prototyping and tooling method

Module	Detailed Contents	Hrs.
01	**Rapid Prototyping** Historical Development, Prototypes ,Need for Prototypes and Types of Prototypes Applications: Design, Planning, Manufacturing and Tooling Applications: Automotive, Aerospace, Jewelry, Bio-Medical and custom products, Fundamentals of Rapid Prototyping technologies and Process	10
02	**Subsystems of RP Machine** Subsystems of RP machine, Optical System, Mechanical systems, Scanning System, Control System: Signal Flow, 3D Model to RP Prototype, Computer Interfacing hardware, DAQs -3D content creation: Modeling Software's (Auto-CAD, PROE, CATIA, and IDEAs etc.) Preprocessing: Slicing and Scan Path Generation Algorithms, Data Conversion and Transmission, File Formats, IGES, STL, AMF , 3DF Post-processing – The Need, Types and applications	10
03	**Liquid Based Rapid Prototyping Systems** Materials, Stereo lithography, Solid Ground Curing, Solid Object UV (Ultra-Violet).	06
04	**Solid Based Rapid Prototyping Systems** Materials, LOM (Laminated Object Manufacturing) System, FDM (Fuse Deposition Modeling) System, Multi-Jet Modeling (MJM) System Model Maker and Pattern Master Shape Deposition Manufacturing Process	06
05	**Powder Based Rapid Prototyping Systems** Materials, SLS (Selective Laser Sintering), (3DP) Three-Dimensional Printing, (LENS) Laser Engineered Net Shaping, (MJS) Multiphase Jet Solidification, , (EBM) Electron Beam Melting	06
06	**Advances in RP Systems and Case Studies** Advances in RP: Resolution & Accuracy issues, Integrated Hardening Process. Two Photon Process for Micro/Nano Fabrication, Reverse Engineering Process and Applications. **Case Study** Case Study: Wind-Tunnel Testing with RP Models Case Study: Investment Casting with RP Biomedical applications **Industrial Visit / Conference / Trade show on RP / 3D printing / Additive Manufacturing (6 Hours)**	14

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid Prototyping Principles and Applications", World Publishing Co. Pte. Ltd.
2. James O. Hamblen, and Michael D. Furman, "Rapid Prototyping of Digital Systems", Kluwer Academic Publishers.
3. Kenneth G. Cooper, "Rapid Prototyping Technology Selection and Application", 2001, Marcel Dekker Inc, New York.
4. Ali Kamrani, EmadAbouel Nasr, "Rapid Prototyping Theory and Practice", 2006, Springer Inc.
5. BopayaBidanda, Paulo J. Bartolo, "Virtual Prototyping and Bio Manufacturing in Medical Applications", 2008, Springer Inc.
6. I. Gibson, D.W. Rosen, and B. Stucker, "Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing", 2010, Springer Inc.
7. Moore Ron, "Making Common Sense Common Practice", Butterworth-Heinemann, 2002.

Course Code	Course Name	Credits
MSEDLO 2024	**Micro & Nano Manufacturing System**	**04**

Objectives
1. The course aims to provide basic understanding of micromachining processes
2. Students should learn the design and fabrication aspects of micro / nano-manufacturing, by using computer-aided-design tools to design and draw their own microstructures.

Outcomes: Learner will be able to…
1. Calculate power requirements and process performance in laser micromachining
2. Be aware of the hazards involved in dealing with toxic/dangerous materials
3. Develop and present a conceptual design solution to a precision machine operating in the micro and nano range
4. Be aware of techniques for advanced nano polymer materials processing, nano materials, and coatings

Module	Detailed Contents	Hrs.
01	**Scope of Nano Technology:** Nano technology Concepts and Applications Micro- and Nanofabrication, Nano technology in India Scope for Micro fabrication, Rise Nano technology Fields Commercialization Issues of Micro-Nano Technology	06
02	**Micro fabrication:** Mechanical Micromachining, Physical Fabrication Methods, Lithography, Processing Setup, Nano Lithography & Manipulation, Precision Micro-and Nano grinding , Use of Spectrometers & Microscopes	08
03	**Laser-Based Micro- and Nanofabrication** Pulsed Water Drop Micromachining, Nano Materials, Synthesis of Nano materials, Bio Materials, Nano Composites. Development of Nano Particles	10
04	Innovative Applications on Present Devices: Nano chips, Nanotubes and Nanowires, Integration of chip sand microprocessors. Technology Support, Meeting Social Needs	10
05	**Nano Design & CAD:** Computer Aided Nano Design, VLSI product detailing Finite Element Analysis of Microstructures, 3-D Molecular Modeling	08
06	**Acceptability of Nano Workmanship:** Nano to millimeter Integration Atomic Scale Precision & Control, Promising Nano-centered Future	10

Assessment:

Internal:

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End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. ASM handbook on machining
2. N. P. Mahalik, "Micro-manufacturing and nanotechnology", Springer.
3. Mark J. Jackson, "Micro and Nano-manufacturing", Springer.
4. Jeremy Ramsden, "Micro & Nano technologies", Elsevier
5. M. Kahrizi, "Micromachining techniques for fabrication of micro, Nano structures"

Course Code	Course Name	Credits
ILO 2021	**Project Management**	**03**

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	8
06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal:

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End Semester Theory Examination:

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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Credits
ILO 2022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO2023	**Enterpreneurship Development and Management**	**03**

Objectives:
1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…
1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entreperurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

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End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ILO2024	**Human Resource Management**	**03**

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5

05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Assessment:

Internal:

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End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO2025	**Professional Ethics and Corporate Social Responsibility (CSR)**	**03**

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four questions need to be solved.

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ILO2026	**Research Methodology**	**03**

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	09
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	07
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	08
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	04

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four questions need to be solved.

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Course Code	Course Name	Credits
ILO2027	**IPR and Patenting**	**03**

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
ILO 2028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ILO2029	**Environmental Management**	**03**

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:
Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Course Code	Course Name	Credits
MSEL201	**Industrial Automation**	**01**

Module	Detailed content	Lab. Sessions
1	Simulation of basic hydraulic, pneumatic and electric and combinationcircuitsusing software like automationstudio---etc	05
2	Design and Testing of hydraulic. Pneumatic, electro pneumatic andPLC circuits.	04
3	Simulation of Nyquist plots and State-space representation.	04

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
MSEL202	**Advanced Quantitative Techniques**	**01**

Module	Detailed content	Lab. Sessions
1	Exercises on LPP Software, AHP Software's & others.	05
2	Exposure to other OR & Simulation software.	04
3	Live case studies / Assignments.	04

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
MSES301	**Seminar**	**03**

Guidelines for Seminar
o Seminar should be based on thrust areas in Mechanical Engineering (Manufacturing Systems Engineering aspect is appreciated)
o Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literature and understand the topic and compile the report in standard format as per University Guidelines for report writing and present in front of pair of Examiners appointed by the Head of the Department/Institute of respective Programme.
o **Seminar should be assessed jointly by the pair of Internal and External Examiners**
o Seminar should be assessed based on following points
   ▪ Quality of Literature survey and Novelty in the topic
   ▪ Relevance to the specialization
   ▪ Understanding of the topic
   ▪ Quality of Written and Oral Presentation

Course Code	Course Name	Credits
MSED301/ MSED401	**Dissertation (I and II)**	**12 + 15**

Guidelines for Dissertation
- o Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I
- o Dissertation I should be assessed based on following points
    - ▪ Quality of Literature survey and Novelty in the problem
    - ▪ Clarity of Problem definition and Feasibility of problem solution
    - ▪ Relevance to the specialization
    - ▪ Clarity of objective and scope
- o Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II
- o Dissertation II should be assessed based on following points
    - ▪ Quality of Literature survey and Novelty in the problem
    - ▪ Clarity of Problem definition and Feasibility of problem solution
    - ▪ Relevance to the specialization or current Research / Industrial trends
    - ▪ Clarity of objective and scope
    - ▪ Quality of work attempted
    - ▪ Validation of results
    - ▪ Quality of Written and Oral Presentation
- o Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai

Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Refereed Journal)

Desertation Report has to be prepared strictly as per University of Mumbai report writing guidelines.