

University of Mumbai



No. AAMS_UGS/ICC/2022-23/ 177

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/130 of 2016-17 dated 9th November, 2016, relating to the revised syllabus as per Choice Based Credit System for Master of Engineering (Mechanical) Manufacturing System Engineering Sem. I to IV.

You are hereby informed that the recommendations made by the Board of Studies in **Mechanical Engineering** at its meeting held on 31st May, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 vide item No. 6.51 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 vide item No. 6.51 (R) and that in accordance therewith, the revised syllabus of **M.E. (Manufacturing System Engineering) (Sem.- I to IV) (CBCS) (REV - 2022 Scheme)**, has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

19th November, 2022

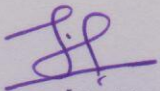
To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.51 (R)/11/07/2022

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Mechanical Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL.


(Prof. Sunil Bhirud)
I/c Registrar

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

University of Mumbai



Revised Syllabus for

M.E.

(Manufacturing System Engineering)

Semester – (I to IV)

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai



O: _____	Title of Course	M.E. (Manufacturing Systems Engineering)
O: _____	Eligibility	Ordinance 0.5134
R: _____	Passing Marks	45%
No. of years/Semesters:		4 semesters
Level:		P.G. / U.G. / Diploma / Certificate
Pattern:		Yearly / Semester
Status:		New / Revised
To be implemented from Academic Year :		With effect from Academic Year : 2022-23

Dr. Vivek Sunnapwar
Chairman
of Board of Studies in Mechanical Engineering

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and Technology

Dr Anuradha Majumdar
Dean,
Faculty of Science and Technology

Preamble

Education in engineering is growing in India and is expected to increase by a factor of several in the near future. The current situation presents a significant challenge in terms of ensuring quality to stakeholders while expanding. To face this challenge, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary form of quality assurance in higher education, and it signifies that the institution or programme of study is committed to meeting certain minimum stated requirements and is available to external assessment in order to get recognition. The main goal of this accrediting procedure is to assess the outcomes of the programme being evaluated. Program outcomes are a collection of skills and information that a student will possess upon completion of the programme. In keeping with this, the University of Mumbai's Faculty of Science and Technology has taken the lead in implementing the principle of outcome-based education into the curriculum building process.

We are pleased to report that the Postgraduate Program Educational Objectives were completed in a brainstorming session attended by more than 20 members from the University's associated institutes. They were either department heads or senior faculty from the Mechanical Engineering Department. 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 aforementioned, linked Institutes may add 2 to 3 additional programme instructional objectives of their own. In addition to Program Educational Objectives, each course in a postgraduate program's curriculum includes objectives and expected outcomes from the perspective of the learner to support the idea of outcome-based education. We are convinced that even a tiny move in the correct manner will go a long way toward ensuring that the main stakeholders receive high-quality education.

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

University of Mumbai

Dr Anuradha Muzumdar

Dean

Faculty of Science and Technology

University of Mumbai

Preface

To tackle the challenge of assuring engineering education excellence, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary way of ensuring the quality of higher education. The main goal of the certification procedure is to determine how good a company is. 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 Science and Technology, University of Mumbai, in one of its meetings collectively 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 linked institutes are aware of the depth of approach to the subject to be given, so improving the learning process of students It was also decided that while changing the curriculum, the most senior academics from institutions and industry specialists should be included.

We are happy to state that the 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 System is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System allows for a much-needed shift in education focus from teacher-centric to learner-centric, since the workload estimate is based on time spent learning rather than teaching. It also emphasises constant evaluation, which will improve educational quality. 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. REV-2022 scheme is implemented for Master of Engineering from the academic year 2022-2023.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

Board of Studies in Mechanical Engineering

Dr. Vivek K. Sunnapwar	: Chairman
Dr. S. M. Khot	: Member
Dr. V. M. Phalle	: Member
Dr. Siddappa Bhusnoor	: Member
Dr. S.S. Pawar	: Member
Dr. Sanjay U. Bokade	: Member
Dr. Dhanraj Tambuskar	: Member
Dr. V. B. Tungikar	: Member
Dr. K.P. Karunakaran	: Member
Dr. S. S. Thipse	: Member
Dr. Milind Deshmukh	: Member

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
MSEC101	Computer Integrated Manufacturing Systems	3	--	--	3	--	--	3	
MSEC102	Quality Engineering	3		--	3		--	3	
MSEPE101X	Program Elective 1	3	--	--	3	--	--	3	
MSEPE102X	Program Elective 2	3	--	--	3	--	--	3	
MSEIE101X	Institute Elective 1	3	--	--	3	--	--	3	
MSEL101	Computer Integrated Manufacturing Lab	--	2	--	--	1	--	1	
MSESBL101	Advanced Manufacturing Lab	--	4 ^{\$}	--	--	2	--	2	
Total		15	06	--	15	03	--	18	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
MSEC101	Computer Integrated Manufacturing Systems	20	20	20	80	3	--	--	100
MSEC102	Quality Engineering	20	20	20	80	3	--	--	100
MSEPE101X	Program Elective 1	20	20	20	80	3	--	--	100
MSEPE102X	Program Elective 2	20	20	20	80	3	--	--	100
MSEIE101X	Institute Elective 1	20	20	20	80	3	--	--	100
MSEL101	Computer Integrated Manufacturing Lab	--	--	--	--	--	25	25	50
MSESBL101	Advanced Manufacturing Lab	--	--	--	--	--	50	50	100
Total		--	--	100	400	--	75	75	650

Course Code	Program Elective 1	Course Code	Program Elective 2	Course Code	Institute Elective 1
MSEPE1011	New Product Design & Development	MSEPE1021	Precision Engineering	MSEIE1011	Product Lifecycle Management
MSEPE1012	Advanced Materials Science	MSEPE1022	Knowledge Management	MSEIE1012	Reliability Engineering
MSEPE1013	World Class Manufacturing	MSEPE1023	Micro and Nano Manufacturing	MSEIE1013	Management Information System
				MSEIE1014	Design of Experiments
				MSEIE1015	Operation Research
				MSEIE1016	Cyber Security and Laws
				MSEIE1017	Disaster Management and Mitigation Measures
				MSEIE1018	Energy Audit and Management

Semester II

Course Code	Course Name	Teaching Scheme(Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
MSEC201	Industrial Automation	3	--	--	3	--	--	3	
MSEC202	Advanced Quantitative Techniques	3		--	3		--	3	
MSEPE201X	Program Elective 3	3	--	--	3	--	--	3	
MSEPE202X	Program Elective 4	3	--	--	3	--	--	3	
MSEIE20X	Institute Elective 2	3	--	--	3	--	--	3	
MSEL201	Industrial Automation Laboratory	--	2	--	--	1	--	1	
MSESBL201	Manufacturing Simulation Lab	--	4 ^{\$}	--	--	2	--	2	
Total		15	06	--	15	03	--	18	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
MSEC201	Industrial Automation	20	20	20	80	3	--	--	100
MSEC202	Advanced Quantitative Techniques	20	20	20	80	3	--	--	100
MSEPE201X	Program Elective 3	20	20	20	80	3	--	--	100
MSEPE202X	Program Elective 4	20	20	20	80	3	--	--	100
MSEIE201X	Institute Elective 2	20	20	20	80	3	--	--	100
MSEL201	Industrial Automation Laboratory	--	--	--	--	--	25	25	50
MSESBL201	Manufacturing Simulation Lab	--	--	--	--	--	50	50	100
Total		--	--	100	400	--	75	75	650

Note 1: Skill Based Lab- I and II are focused on the learning through experience. SBL shall facilitate the learner to acquire the fundamentals of practical engineering in his or her specialization in a project-oriented environment. The learning through skill based labs can be useful in facilitating their research work and hence useful in early completion of their dissertation work.

Course Code	Program Elective 3	Course Code	Program Elective 4	Course Code	Institute Elective 2
MSEPE2011	Strategic Manufacturing for Sustainability	MSEPE2021	Logistics & Supply Chain Management	MSEIE2011	Project Management
MSEPE2012	Additive Manufacturing and Rapid Prototyping	MSEPE2022	Machine Health Monitoring Management	MSEIE2012	Finance Management
MSEPE2013	Manufacturing Systems Design	MSEPE2023	Smart Industries	MSEIE2013	Entrepreneurship Development and Management
				MSEIE2014	Human Resource Management
				MSEIE2015	Professional Ethics and CSR
				MSEIE2016	Research Methodology
				MSEIE2017	IPR and Patenting
				MSEIE2018	Digital Business Management
				MSEIE2019	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
MSEMP301	Major Project: Dissertation -I	--	20	--	--	10	--	10	
Total		00	20	00	00	10	--	10	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
MSEMP301	Major Project: Dissertation -I	--	--	--	--	--	100	--	100
Total		--	--	--	--	--	100	--	100

Online Credit Courses

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSEOCC301	Online Credit Course - I	--	--	--	--	--	--	3
MSEOCC302	Online Credit Course - II	--	--	--	--	--	--	3
Total		--	--	--	00	00	00	06

Note 2: It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UoM. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. University shall make a provision that credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet with actual names of courses. The learner shall be allowed to take up these courses from his or her institute or organisation/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
MSEMP401	Major Project : Dissertation -II	--	32	--	--	16	--	16	
Total		--	32	--	--	16	--	16	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
MSEMP401	Major Project : Dissertation -II	--	--	--	--	--	100	100	200
Total		--	--	--	--	--	100	100	200

Total Credits: 68

Note 3: The Dissertation -II submission shall not be permitted till the learner completes all the requirements ME course.

Note 4: The contact hours for the calculation of load of the teacher for Major Project are as follows:
Major Project Dissertation I and II - 02 Hour / week / student

Course Code	Course Name	Credits
MSEC101	Computer Integrated Manufacturing Systems	03

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: On completion of the course, learner will be able to:

1. Understand the basic principles of CIM and its elements.
2. Distinguish different types of inspection methods.
3. Emphasis the importance of group technology and cellular manufacturing systems.
4. Design automated material handling and storage systems for a typical production system.
5. Understand the importance of data communications in CIM environment.

Module	Detailed Contents	Hrs.
01	Introduction to CIM: 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.	07
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 (Case study: Automatic Identification and data capturing).	06
04	Computer Aided Process Planning and Quality Control: (CAPP): Introduction and types. (CAQC): Introduction to inspection and testing. Automated inspection principles and methods- When and where to inspect, quantitative analysis of inspection, inspection technologies – contact and non-contact types. Computer aided testing.	07
05	Cellular Manufacturing Systems: Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Composite Part Concept, Machine Cell Design, Applications of Group Technology, Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell, introduction to just in time and Holonic manufacturing. Concurrent Engineering: Benefits and techniques of Concurrent Engineering, Framework for integration of Life-cycle phases in CE, and Collaborative Product Development.	07
06	Role of Information Systems & Enterprise Wide Integration in CIM and CIM Models: 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. CIM database and database management systems. Manufacturing Data: Types, sources, Database models, Architecture, Database Management System (DBMS), Product Data Management (PDM), Advantages of PDM.	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. 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. Nanua Singh, "Systems Approach to Computer Integrated Design and manufacturing" - John Wiley.
5. Geoffrey Boothroyd , "Assembly Automation and Product Design", (Manufacturing Engineering and Materials Processing).
6. Radhakrishnan.P, Subramanyan. S, "CAD/CAM/CIM", New Age International Publishers.

Course Code	Course Name	Credits
MSEC102	Quality Engineering	03

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: On completion of the course, learner will be able to:

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

Module	Detailed Contents	Hrs.
01	Quality Dimensions of Products and Services: 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.	07
02	Statistical Quality Control: 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. Concept of Acceptance Sampling, Lot by lot sampling process, types.	07
03	Total Quality Management: 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.	07
04	Total Productive Maintenance: History and Impact of TPM, Overall Equipment Effectiveness (OEE). Developing the TPM implementation Plan, Preventive Maintenance, techniques- FMEA, POKAYOKE and Future of TPM.	07
05	Six Sigma and Modern Quality Management Tools: Evolution of six-sigma quality approach, steps involved in the application of six sigma, six sigma and Indian Industries. Concept of process capability, Basic & Modern tools in quality improvement, Benchmarking, KAIZEN, JIT, 5-S, Taguchi quality loss function. Introduction to DOE and RSM.	07
06	Case Studies: Few case studies to understand how companies in various industries successfully implemented QE into their systems and optimized it.	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. 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 Edition 2001.
5. John.S. Oakland, "Statistical process control", Elsevier, 5th edition, 2005.
6. Besterfield D. H., "Quality Control", Prentice Hall, 1993.
7. Sharma S. C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991.
9. J. Juran, "Quality Control Handbook", Mcgraw Hill USA.
10. A. V. Feigenbaum, "Total quality control", Mcgraw hill Int.edition USA.
11. W. E .Deming, "Out of crisis", Productivity & Quality publishing Pvt. Ltd., Chennai.
12. A. J. Duncan, "Quality control & Industrial statistics", Richard D. Irwin INC USA.
13. A. Zaidi, "SPC, concepts, Methodology & tools", Prentice Hall India ltd., New Delhi.
14. Terry Wireman, "Total Productive Maintenance", Industrial Press, 2nd Edition, New York.

Course Code	Course Name	Credits
MSEPE1011	New Product Design & Development	03

Objectives:

1. Acquire a deep understanding & assimilate key concepts pertaining to new product design & development process.
2. Get familiarised with product design & development approach & methodologies based on modern engineering practises, tools and processes.
3. To stimulate creative & inventive solutions to problems.
4. Enable the learner to cope up with the product design challenges posed by the ongoing global competitive scenario.

Outcomes: On completion of the course, learner will be able to:

1. Understand the generic product design & development process, tools and methodologies.
2. Get familiarised with product life cycle & product life cycle assessment.
3. Get familiarised with various software solutions and choose appropriate design approaches.
4. Understand product costing approach and economic feasibility of the product.
5. Get conversant with I.P rights & patenting procedure.

Module	Detailed Contents	Hrs.
01	Introduction: Definition of product design, classification of products and product mix, product architecture. Various considerations for design. Generic steps involved in modern design and development process. Generation of concepts and embodiment of concept. Morphology of design, Design optimization.	07
02	Development Process: Product life cycle & its implications, identifying customer needs, Kano Model, Bench marking techniques & establishing engineering specifications, creativity techniques, simulation, Rapid Prototyping techniques, Axiomatic design, Pugh concept selection approach, Weighted design matrix.	07
03	Design Process: Design for manufacturing & assembly (DFMA) , Design for Reliability & Maintainability, Green Design, Sustainable design, Nano design, Sequential and Concurrent design, Reverse engineering techniques, Robust Design & Taguchi's DOE, Legal , Social & Ethical issues related to Design.	07
04	Ergonomics & Aesthetics: Concepts of human engineering, Psychological & Physiological Considerations, Anthropometry, Workplace, Man- Machine interaction, Comfort Criteria, Environmental Conditions including temperature, illusion, noise, vibrations, control panels and displays. Visual communication skills related to products & services, Concepts of size, shape & texture, Generation of product forms, analogies from nature, colours and colour wheel, psychological implications & interaction of colours.	07
05	Product Costing: Product costing elements and methodology of product costing. Economic analysis – qualitative and quantitative, Techno commercial viability, case studies on product costing. Value engineering/value analysis – methodology, value engineering job plan, value engineering check list, case studies on value engineering.	07
06	Software solutions& IP Rights: Drafting Modeling, CAD/CAE tools, CAM interface, CAPP, various softwares employed and their capabilities. Patents & IP Acts – overview & disclosure preparation.	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. 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 Product Development", 1/e 2004, Pearson Education, New Delhi.
6. L. D. Miles, "Value Engineering".
7. Hollins B. & Pugh S., "Successful Product Design", Butterworths London.
8. Baldwin E. N. & Neibel B. W., "Designing for Production", Edwin Homewood Illinois.
9. Jones J. C., "Design Methods", John Willey New York.
10. Bralla J. G., "Handbook of Product Design for Manufacture", McGrawhill New York.

Course Code	Course Name	Credits
MSEPE1012	Advanced Materials Science	03

Objectives:

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

Outcomes: On completion of the course, 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.

Module	Detailed Contents	Hrs.
01	Review of fundamentals: Covalent, Ionic, Metallic and Van-der Waals 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 behaviour, 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.	12
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 fibers, Carbon fibers, Silicon Carbide fibers, 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.	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. Materials Science by R. S. Khurmi & R. S. Sedha, S. Chand & Co.
2. Mechanical Metallurgy by George Dieter, Mc Grawhill.
3. Heat Treatment Principles by Rajan, Sharma & Sharma Prentice Hall.
4. Plastics Engg by R. J. Crawford, Butterworth Hieneman.
5. Composite Materials Science & Engineering by Krishnan Chawla, Springer Verlag.
6. Plastics Technology Handbook by M. Chandra & S. K. Roy, Marcel Dekker.
7. Mechanical properties of ceramics by John B. Wactman, John Willey & Sons.
8. Metal Matrix composites: Thermomechanical behaviour by Taya M. & Arsenault R. J., Pergamon press - Oxford.
9. Analysis & performance of fibre composites by B D Agarwal & L J Broutman, John Willey & sons - New York.
10. Transport in Nanostructures, D. K. Ferry and S. M. Goodnick, Cambridge University Press, 1997.
11. Chemistry of Advanced Materials, Edited L. V. Interrante and M. J. Hampden-Smith, Wiley-VCH - U.S.A., 1998.

Course Code	Course Name	Credits
MSEPE1013	World Class Manufacturing	03

Objectives:

1. Help the learner understand and assimilate deeper insights into the opportunities & challenges faced by manufacturing as a domain today.
2. Prepare the learner to face the demands and complexities of a global market place.

Outcomes: On completion of the course, learner will be able to:

1. Understand the relevance and basics of World Class Manufacturing.
2. Design and develop a roadmap for world class manufacturing.
3. Meet the challenges that the Indian manufacturer's faces, 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.	06
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.	07
05	Typical Characteristics of WCM Companies: Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy.	07
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.	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. 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.

Course Code	Course Name	Credits
MSEPE1021	Precision Engineering	03

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: On completion of the course, 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.	06
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.	06
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.	05
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.	09
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.	09
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.	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. Murthy R. L., "Precision Engineering in Manufacturing", New Age International (P) Limited, 1996.
2. James D. 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
MSEPE1022	Knowledge Management	03

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: On completion of the course, 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.	06
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.	08
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.	08
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.	06
06	Knowledge Management in Manufacturing: How to foster innovation within own organizations - policy adoption of new 08 University of Mumbai, ME (Mechanical) Manufacturing Systems Engineering, Rev 2016 20 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.	06

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. Elias. M. Award & Hassan M. Ghaziri, "Knowledge Management", Pearson Education 2003.
2. Guus Schreiber, Hans Akkermans, AnjoAnjewierden, 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, "Working Knowledge: How Organizations Manage What They Know", Harvard Business School Press.
5. Nonaka, Ikujiro& Takeuchi, Hirotaka, "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", 2010.

Course Code	Course Name	Credits
MSEPE1023	Micro and Nano Manufacturing	03

Objectives:

1. To give awareness of different techniques used in micro and nano manufacturing.
2. To give in-depth idea of the conventional techniques used in micro manufacturing.
3. To introduce Non-conventional micro-nano manufacturing and finishing approaches.
4. To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano manufacturing.
5. To know different techniques used in Micro Joining and the metrology tools in micro and nano manufacturing.

Outcomes: On completion of the course, learner will be able to:

1. Get an awareness of different techniques used in micro and nano manufacturing.
2. Get in-depth idea of the conventional techniques used in micro manufacturing.
3. Become aware about non-conventional micro-nano manufacturing and finishing approaches.
4. Get awareness on micro and nano finishing processes.
5. Understand micro and nanofabrication techniques and other processing routes in micro and nano manufacturing.
6. Know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

Module	Detailed Contents	Hrs.
01	Introduction to Precision engineering: Macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications. Introduction to Precision engineering, macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications, Introduction to Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Micro Mechatronics, Nanofinishing – finishing operations. Laser technology in micro manufacturing- Practical Lasers, application of technology fundamentals. Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology, Carbon Nano-tubes – properties and structures, Molecular Logic Gates and Nano level Biosensors – applications.	06
02	Introduction to mechanical micromachining: Micro drilling – process, tools and applications. Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications. Micro milling and Micro grinding – process, tools and applications. Micro extrusion- process and applications. micro bending with Laser. Nano-Plastic forming and Roller Imprinting.	06
03	Introduction to Non-conventional micro-nano manufacturing: Process, principle and applications – Abrasive Jet Micro Machining, WAJMM. Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications. Micro ECM, Micro LBM - Process principle, description and applications. Focused ion beams - Principle and applications.	07
04	Introduction to Micro and Nano Finishing Processes: Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications. Force analysis of MRAFF process, Magnetorheological Jet finishing processes. Working principle and polishing performance of MR Jet Machine. Elastic Emission Machining (EEM) – machine description, applications. Ion Beam Machining (IBM) – principle, mechanism of material removal, applications. Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications.	08
05	Introduction to Micro Fabrication: Basics, flowchart, basic chip making processes. Introduction to Nanofabrication: Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp) Manipulative techniques – process principle, applications. Introduction to Carbon nano materials – CN Tubes CN Tubes – properties and applications CN Tube Transistors – Description only Diamond - Properties and applications, CVD Diamond Technology LIGA Process.	08
06	Laser Micro welding: Laser Micro welding – description and applications, Defects Electron Beam Micro-welding – description and applications Introduction to micro and nano measurement, defining the scale, Uncertainty Scanning Electron Microscopy – description, principle Scanning White-light Interferometry – Principle and application Optical Microscopy – description, application Scanning Probe Microscopy, scanning tunneling microscopy description, application Confocal Microscopy - description, application Introduction to On-Machine Metrology.	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. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
3. NitaigourPremchandMahalik, Micro-manufacturing and Nanotechnology, 2006.
4. V. K. Jain, Micro-manufacturing Processes, CRC Press, 2012.

Course Code	Course Name	Credits
MSEIE1011	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: On completion of the course, 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.	07
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.	07
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.	07
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.	07
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.	07
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.	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. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229.
3. SaaksvuoriAntti, ImmonenAnselmie, "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
MSEIE1012	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: On completion of the course, 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: 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.	06
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.	06
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.	08
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, Fault tree analysis and Event tree Analysis.	06

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. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, 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
MSEIE1013	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: On completion of the course, 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 trend.
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.	06
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	08
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	06
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.	08
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	08
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.	06

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. 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 Information Systems: Strategy and Organization, Prentice Hall, 2008.

Course Code	Course Name	Credits
MSEIE1014	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: On completion of the course, 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: Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	06
02	Fitting Regression Models: Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	08
03	Two-Level Factorial Designs and Analysis: The 2^2 Design, The 2^3 Design, General 2^k Design, a Single Replicate of the 2^k Design, Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs.	08
04	Two-Level Fractional Factorial Designs and Analysis: One-Half Fraction of the 2^k Design, One-Quarter Fraction of the 2^k Design, General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	08
05	Conducting Tests: Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute vs Variable data sets.	06
06	Taguchi Approach: Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples	06

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. Raymond H. Myers, 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, Practical Experiment Designs for Engineers and Scientists, John Wiley and Sons Inc., ISBN: 0-471-39054-2.
5. A. M. Dean, and D. T. Voss, Design and Analysis of Experiments (Springer text in Statistics), Springer.

Course Code	Course Name	Credits
MSEIE1015	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: On completion of the course, 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.	08
02	Queuing models: Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population.	06
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.	06
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.	07
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.	08
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model.	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. 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
MSEIE1016	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: On completion of the course, 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.	06
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	08
03	Tools and Methods Used in Cyberline: Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft).	06
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.	08
05	Indian IT Act.: Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments.	08
06	Information Security Standard compliances: SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06

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. Nina Godbole, SunitBelapure, "Cyber Security", Wiley India, New Delhi.
2. Suresh T. Vishwanathan, "The Indian Cyber Law", Bharat Law House New Delhi.
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Advocate Prashant Mali, "Cyber Law & Cyber Crimes", Snow White Publications, Mumbai.
5. Nina Godbole, Information Systems Security", Wiley India, New Delhi.
6. Kenneth 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
MSEIE1017	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: On completion of the course, 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: 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.	06
02	Natural Disaster and Manmade disasters: 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 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.	08
03	Disaster Management, Policy and Administration: Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and coordination 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: 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, Use of Internet and softwares for effective disaster management, Applications of GIS, Remote sensing and GPS in this regard.	08
05	Financing Relief Measures: 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, International relief aid agencies and their role in extreme events.	08
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general. Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication, Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 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 (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. '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
MSEIE1018	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: On completion of the course, 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.	06
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 equipment 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.	06
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.	08
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.	08
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC), Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources.	06

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. 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 Lab	01

Module	Detailed Contents	Lab. Sessions
01	Case study presentation /Actual Visits/Presentation on below topic- 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.	06
02	Simulation and performance analysis of the FMS, parts flow control on Assembly station.	03
03	Study experiments on Integration aspects in computer integrated manufacturing environment.	02
04	Importance of Artificial Intelligence.	01
05	Machine vision based quality control	01

Assessment:

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

Course Code	Course Name	Credits
MSESBL101	Advanced Manufacturing Lab	02

Module	Detailed Contents	Lab. Sessions
01	Machining experiments to be conducted on the Vertical Machining Center that include Step turning, Taper turning, Threading and Grooving	03
02	Machining experiments to be conducted on the Vertical Machining Center that include Engraving, Mirroring, Rotation, Circular pocketing and Rectangular pocketing.	03
03	Design and manufacture of a composite job, highlighting an industrial application.	02
04	Manufacturing an industrial application component, using Selective Laser Sintering (SLS) technique.	02
05	Manufacturing an industrial application component, using Stereo lithography (SLA) technique.	02
06	Manufacturing an industrial application component, using Fused Deposition Modeling (FDM) technique.	01

Assessment:

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

Course Code	Course Name	Credits
MSEC201	Industrial Automation	03

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: On completion of the course, 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: Need of Automation, Automation Principles and Strategies, Elements of Automated system, Levels of Automation, Automation in manufacturing system, Advanced automation function, Arguments for and against automation (with case studies).	03
02	Hardware components for Automation: Sensors- Displacement, position and Proximity Sensors, Velocity and Motion Sensors, Force and Fluid Pressure Sensors, Liquid level and Flow sensors, Temperature and light Sensors, Actuators- Hydraulic, Pneumatic and electric, ADC and DAC and systems concepts, time domain analysis, frequency domain analysis, time-frequency analysis.	06
03	Industrial Circuits: 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 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.	12
04	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, Data acquisition system, Data logger, Microprocessor, Microcontroller, digital communication, digital controller, SCADA.	08
05	Control Engineering: 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 Mathematical modelling of Servo systems - Armature controlled D. C. motor, Field controlled D.C. motor.	07

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.	06
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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.

5. Question paper will comprise of total six question.
6. All question carry equal marks.
7. 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).
8. Only Four questions need to be solved.

References:

1. Mikell P. Grover, Automation Production Systems, and Computer Integrated Manufacturing, PHI, 2011, Third Edition.
2. W. Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering, Pearson Education, 2003.
3. K. Ogata, Modern Controls Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
4. Antony Esposito, Fluid Power Systems and control, Prentice-Hall, 1988.
5. Joji P., Pneumatic Controls, Wiley India, 2011.
6. I. J. Nagrath and Gopal, Control System Engineering, New age international (P) Ltd., 2005.

Course Code	Course Name	Credits
MSEC202	Advanced Quantitative Techniques	03

Objectives:

To equip the students with the expert knowledge and skills needed to apply the various quantitative techniques for decision making.

Outcomes: On completion of the course, learner will be able to:

1. Explain significance of sensitivity analysis of LPP and Perform sensitivity analysis on various parameters involved in LP model.
2. Recognize the limitations of simplex method in deriving integer solution to LPP and Employ suitable algorithm to obtain integer solution.
3. Analyse various decision-making situations, Outline decision alternatives and Select the best alternative.
4. Describe a real-world problem as a Non-Linear Programming Problem and Distinguish local, global extreme points and point of inflection.
5. Explain significance of Markov Analysis to predict the state of a system.

Module	Detailed Contents	Hrs.
01	Introduction to Decision model and Quantitative techniques: Concept of decision making and decision problem, Mathematical Model of decision problem, Concept of Optimization, Quantitative techniques for finding optimal solutions to decision problems. Linear Programming Problem: Mathematical Formulation. Overview of Simplex Method. Sensitivity Analysis. Linear Goal programming: Formulation as Goal programming model, Optimal solution by graphical method and simplex method.	08
02	Integer Programming Problem: Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique.	06
03	Nonlinear programming problems (NLPP): Convex programming. Unconstrained NLPP –Search Algorithm and Gradient method. Constrained NLPP – Kuhn-Tucker Conditions, Geometric Programming. Quadratic programming.	08
04	Network Optimization Models: Shortest Path, Minimum Spanning Tree, and Maximum Flow Problems.	06
05	Decision Theory: Decision Making under risk, under uncertainty, Decision Trees & Utility Theory, Bayesian approach in decision making. Decision Making under certainty, Introduction to concepts of AHP (Analytic Hierarchy Process) & ANP (Analytic Network Process).	08
06	Markov Analysis: Stochastic Process, Markov Process, Transition Probability Matrix, Markov Chain.	06

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. Taha H.A., Operations Research - An Introduction, Prentice Hall.
2. Ravindran A., Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice, John Willey and Sons.
3. Hiller F. S. and Liebermann G. J., Introduction to Operations Research, Tata McGraw Hill.
4. Pradeep Prabhakar Pai, Operations Research Principles and Practice, Oxford University Press.
5. S. D. Sharma and Kedar Nath Ram Nath, Operations Research, Meerut.

Course Code	Course Name	Credits
MSEPE2011	Strategic Manufacturing for Sustainability	03

Objectives:

1. To get acquainted with concepts, various dimensions and significance of sustainability.
2. Acquire knowledge on emerging approaches in waste management.
3. Understand the ongoing trends and innovations in energy management.
4. Get exposure to the role of environmental management in modern business world.

Outcomes: On completion of the course, learner will be able to:

1. Identify and deal with economic, social and technological concerns in sustainable manufacturing front.
2. Pursue eco-friendly approaches in managing various forms of waste including hazardous waste.
3. Apply environment friendly options in design and manufacturing operations to bring down carbon foot prints.
4. Get adequate exposure to energy efficient initiatives and energy management.
5. Get exposure to environmental standards/legislations and develop capability in assessing environment impact.

Module	Detailed Contents	Hrs.
01	Introduction: Concepts related to sustainability and sustainable development, Green expectations and global sustainability agenda. Confronting climate change and global warming, Environmental preservations, wake up conferences, voice of society and green movement.	07
02	Waste Management: Types & sources of waste, segregation & waste processing, Green processing and engineering approaches, energy recovery, life cycle approach – cost benefits, R3&R6 cycles, methods to infuse sustainability in early phase of product design approach, cradle to cradle approach.	07
03	Materials for Sustainability: Energy efficient and environment friendly materials. New age materials, Materials and process selection, Material disposal, Material for recycling, biodegradable materials, control on non-renewable material usage, integrating sustainability concepts, Toxicity and health impact.	07
04	Design for Sustainability: Conversion technologies, concept of Eco-innovation, sustainable loading on ecosystems, energy conservation and energy audit, environmental analysis from raw material to disposal, product life cycle assessment, sustainable design approach and matrices for sustainable designs, case studies on sustainable design.	07
05	Environment Management: Influence of cultural, political and economic changes in transforming role of environmental management in business world, Environmental standards & legislation, carbon foot print assessment and carbon trading, Anti-Pollution boards, Kyoto protocol, Initiatives at national and global level, Alternative product & process change and manufacturing practices, Environment and human health effect hazards, mitigation management. Role of IT & communication networking.	07

06	Sustainability Assessment: Multi-Objective decision making, concept models and approaches, evolving sustainability issues in operating strategy. Product and process sustainability and risk /benefit assessment. Sustainability impact assessment, corporate social responsibilities and initiatives, sustainability rating schemes, eco - labelling and energy labelling programmes, Continuous sustainability awareness initiatives, Industrial case students.	07
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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 by S. P. Misra, S.N. Pandey - Sheth Publishers.
4. Design for Environment: A Guide to Sustainable Product Development by Joseph Fiksel - McGraw-Hill Companies.
5. E books Sustainable Manufacturing by J. Paulo Davim – Wiley Publishers.
6. E book - Sustainable Manufacturing- Shaping global value creation by Gunther Seliger – Springer.

Course Code	Course Name	Credits
MSEPE2012	Additive Manufacturing and Rapid Prototyping	03

Objectives:

1. To familiarize with importance of Rapid Prototyping in Product Development.
2. To make students aware about latest additive manufacturing technology used in industry.
3. To make students aware about various additive manufacturing processes and material availability.
4. To enable students to understand, describe and evaluate the different post processing techniques currently used on Additive Manufacturing parts.
5. To make students aware about latest research in the area of additive manufacturing.

Outcomes: On completion of the course, learner will be able to:

1. Understand importance of Rapid Prototyping in product development.
2. Apply basic knowledge of additive manufacturing to decide type of additive manufacturing process and material according components design requirement.
3. To calculate and justify the cost of a typical additive manufacturing operation including labour costs, overhead costs, and consumable costs.
4. Evaluate the different post processing techniques used on AM parts, including those required for removal of support structures, improvement of surface characteristics and structural integrity.
5. Conduct research work and research writing in the field of additive manufacturing.

Module	Detailed Contents	Hrs.
01	Introduction: Product Development Cycle and the product Life Cycle, Problems in Product Development, Relationship between Product Development Cost and the Selling Price, Rapid prototyping need, Classification of RP systems, advantages and limitations of RP, Applications and scope of RP, Introduction to additive manufacturing.	08
02	Design for Additive Manufacturing: Multiple Materials, Hybrids, Functionally Graded Materials, Composite Materials, current and future directions; Process Modelling of AM process- Design optimization through finite-element modelling of AM- Simulation of phase transformations- heating, melting, forming, solidification and finishing and rheological studies of various AM materials.	06
03	Classification of Additive Manufacturing Processes: Seven Classes of Additive Manufacturing, Binder jetting, Directed Energy Deposition, Powder Bed Fusion, Sheet Lamination, Material Extrusion, Material Jetting, Vat Photo Polymerization Detailed discussion on latest technique available on each type of additive manufacturing processes. Specification, working principal, material compatibility and Post processing.	08
04	Additive Manufacturing System Design: Process selection, Material selection, labour cost involved, overhead cost calculation, consumables cost, machine maintenance, Project Planning, Sensors used Jigs and fixtures, Thermal management, Manufacturing Quality management.	08
05	Applications of Additive Manufacturing: Aerospace Applications, Medical applications, Art and Design applications, Energy applications, architecture applications.	06
06	Intellectual Property Rights, IPR in Additive Manufacturing: Case studies on Latest patents in the field of additive manufacturing, Case studies based on latest article Published in Scopus, SCI, and ESCI indexed journal.	06

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. Additive Manufacturing Technologies – Ian Gibson, David W Rosen, Brent Stucker., MahyarKhorasani – Springer.
2. Additive Manufacturing – Juan Pou, Antonio Riveiro and J. Paulo Davim – Elsevier.
3. Multi-dimensional Additive Manufacturing – SoshuKiriharal, Kazuhiro Nakata – Springer.
4. Additive Manufacturing Processes – SanjayKumar – Springer.
5. Polymer Based Additive Manufacturing – Declan M. Devine – Springer.
6. Materials for Additive Manufacturing – Yusheng Shi, Chunze Yan, Yan Zhou, Jiamin Wu, Yan Wang, ShengfuYu, Ying Chen – Academic Press, Elsevier.
7. Additive Manufacturing (A Tool for Industrial Revolution 4.0) – M. Manjaiah, K. Raghavendra, N. Balashanmugam, J. Paulo Davim – Woodhead Publishing.

Course Code	Course Name	Credits
MSEPE2013	Manufacturing Systems Design	03

Objectives:

1. To acquaint the students with concepts of manufacturing systems engineering and design.
2. To familiarise the students with various manufacturing systems and approaches for various areas of applications.
3. To impart knowledge in design and adoption of manufacturing systems to achieve improved productivity and cost benefits.

Outcomes: On completion of the course, learner will be able to:

1. Understand and appreciate the capabilities and limitations of various manufacturing systems.
2. Identify and select appropriate manufacturing systems for specific applications.
3. Design and implement appropriate model of manufacturing systems in specific contexts.
4. Cope up with the ongoing demands of the industry, specifically on the manufacturing front.

Module	Detailed Contents	Hrs.
01	Manufacturing system fundamentals: Basic concepts and definition of system, system design, structural and transformational aspects of manufacturing systems, integrated manufacturing and management systems.	04
02	Process systems for manufacturing: Logistics planning and design, Product planning and design, Process planning and design, Layout planning and design.	06
03	Group technology and cellular manufacturing systems: Concepts of cellular manufacturing, comparison between cellular and traditional manufacturing, Cell characteristics, Techniques of cellular manufacturing, Advantages and Limitations. Cell design and cell formation techniques, processing of exceptional components in cellular manufacturing. Evaluation of cellular manufacturing solutions, cell characteristics, Production control activities in cellular manufacturing and implementation issues.	10
04	Management systems for manufacturing: Managerial information flow, Aggregate production planning and scheduling, Inventory management, Production control and Quality control.	08
05	Automation systems for manufacturing: CAD, CAM, CIM, FMS, Computer integrated automation systems- concept of ghost factory and Overview of industry 4.0.	07
06	Information system for manufacturing: MIS (Management information systems), SIS (Strategic information systems), Parts oriented production information systems, Online production control systems and Computer based production management systems.	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. Marco Garetti, Design and Management of Production Systems: Tutorials and Case Studies.
2. Wallace J. Hopp and Mark L. Spearman, Factory Physics, Waveland Press Inc. USA.
3. B. S. Nagendra Parashar, Cellular Manufacturing Systems: An Integrated Approach, PHI Learning Pvt. Ltd.
4. Manufacturing Systems Engineering, KatsundoHitomi, Viva Books Pvt. Ltd.

Course Code	Course Name	Credits
MSEPE2021	Logistics and Supply Chain Management	03

Objectives:

1. To understand the primary differences between logistics and supply chain management.
2. To understand the individual processes of supply chain management and their interrelationships within individual companies and across the supply chain.
3. To understand the management components of supply chain management.
4. Familiarize the students with the tools and techniques used in implementing supply chain management.
5. To understand how supply chain strategy can provide competitive advantage for organization.

Outcomes: On completion of the course, learner will be able to:

1. Demonstrate the functional strategy map of supply chain management.
2. Analyze the determinants of Supply Chain and Transportation networks design.
3. Demonstrate the need of coordination and sourcing decisions in supply chain.
4. Understand pricing, revenue management and role of IT in supply chain.
5. Understand various sustainability aspects of a supply chain.

Module	Detailed Contents	Hrs.
01	Introduction to LSCM: Objective, Importance, Decision Phases, Process Views. Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges to Achieving and Maintaining Strategic Fit. Supply Chain Drivers and Metrics: Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing. Creating the Responsive Supply Chain: Product push versus demand pull, The Japanese philosophy, The foundations of agility, A route-map to responsiveness. 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.	09
02	Network Design in the Supply Chain: The Role of Network Design in the Supply Chain, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.	07
03	Designing Global Supply Chain Networks: The Impact of Globalization on Supply Chain Networks, The Offshoring Decision: Total Cost, Risk Management in Global Supply Chains, Discounted Cash Flows, Evaluating Network Design Decisions Using Decision Trees.	07
04	Coordination and Sourcing Decisions in a Supply Chain: Lack of Supply Chain Coordination and the Bullwhip Effect, The Effect on Performance of Lack of Coordination, Obstacles to Coordination in a Supply Chain, Managerial Levers to Achieve Coordination, Continuous Replenishment and Vendor-Managed Inventories, Collaborative Planning, Forecasting, and Replenishment. The Role of Sourcing in a Supply Chain, In-House or Outsource, Third- and Fourth-Party Logistics Providers, Using Total Cost to Score and Assess Suppliers, Supplier Selection—Auctions and Negotiations, Contracts, Risk Sharing and Supply Chain Performance, Design Collaboration, The Procurement Process.	07

05	Pricing and Revenue Management in a Supply Chain: The Role of Pricing and Revenue Management in a Supply Chain, Pricing and Revenue Management for Multiple Customer Segments, Pricing and Revenue Management for Perishable Assets, Pricing and Revenue Management for Seasonal Demand, Pricing and Revenue Management for Bulk and Spot Contracts.	06
06	Sustainable Supply Chain: The Role of Triple Bottom Line, Key Metrics for Sustainability, Greenhouse gases and the supply chain, Reducing the transport-intensity of supply chains, Beyond the carbon footprint, Reduce, reuse, recycle, Sustainability and Supply Chain Drivers.	06

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. 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 and Sons.
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 Practices, Biztantra.

Course Code	Course Name	Credits
MSEPE2022	Machine Health Monitoring Management	03

Objectives:

3. To introduce parameters involved in machine health monitoring management.
4. To make students aware about Instrumentation and Signal Processing in machine health monitoring management.
5. To introduce importance of pattern recognition in machine health monitoring management.
6. To impart knowledge about the application of artificial intelligence techniques in Condition monitoring.
7. To impart knowledge about the application of Machine learning techniques in Condition monitoring.

Outcomes: On completion of the course, learner will be able to:

1. Understand basics of machine health monitoring management.
2. Apply basic Instrumentation and signal processing technique in machine health monitoring management.
3. Recognize pattern in problems involved in machine health monitoring.
4. Gain knowledge about the application of artificial intelligence techniques in Condition monitoring.
5. Gain knowledge about the application of Machine learning techniques in Condition monitoring.

Module	Detailed Contents	Hrs.
01	Introduction to Asset Management: Digital Asset Management, Fixed Asset Management, IT Asset Management, Enterprise Asset Management, Financial Asset Management, Infrastructure Asset Management. Introduction to Maintenance Strategies: Proactive Maintenance, Predictive Maintenance, Planned Maintenance, Condition-Based Maintenance, Responsive Maintenance, Emergency Maintenance.	08
02	Introduction to Machine Health Monitoring Management: Machine failures, Maintenance strategies, machine condition monitoring, Vibration signatures of faults in rotating and reciprocating machines, detection and diagnosis of faults. Fracture mechanics: LEFM, EPFM, Stress intensity factor, crack identification, crack propagation, residual life, residual life determination, Airy's stress function, Westguard's solution.	08
03	Instrumentation and Signal Processing: Types of sensors used in machine health monitoring: vibration, acoustics and noise, acoustic emission, temperature, ultrasonic and infrared sensors - Signal processing: basic signal and systems concepts, time domain analysis, frequency domain analysis, time-frequency analysis.	06
04	Pattern Recognition: Feature extraction and feature selection methods, feature reduction using PCA - discriminant functions and decision boundaries, decision trees, maximum likelihood and nearest neighbour. Application and case studies of machine health monitoring: Bearings, gear boxes, engines, structural health monitoring, machine tool condition monitoring etc.	08
05	Introduction to Condition Monitoring Using Artificial Intelligence: Approaches to Condition Monitoring, Components of Condition Monitoring, Measurement System and Pre-processing, Feature Extraction, Statistical Features, Vibration-based Condition Monitoring, Dissolved Gas Analysis, Artificial Intelligence Approaches, Single AI Approaches, Hybrid AI Approaches.	06

06	Introduction to Machine Learning in Conditioning monitoring: Machine Learning Tools, Artificial Neural Network, Support Vector Machine, Extension Neural Network, Fuzzy ARTMAP. Introduction to Incremental Learning and its Application to Condition Monitoring.	06
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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. Telli Van der Lei, Paulien Herder and YpeWijnia, Asset Management, Springer.
2. Dan B. Marghitu and Mihai DupacButterworthHeinemann, Machine Component Analysis with MATLAB, Elsevier.
3. Juan Carlos A. Jauregui Correa and Alejandro A. Lozano Guzman, Mechanical Vibrations and Condition Monitoring, Academic Press, Elsevier.
4. Hasmat Malik, NuzhatFatema and Atif Iqbal, Intelligent Data-Analytics for Condition Monitoring, Academic Press, Elsevier.
5. Ray S. Beebe, Predictive Maintenance of Pumps Using Condition Monitoring, Elsevier Science.
6. William Bolton Newnes, Instrumentation and Control Systems, Elsevier.
7. Leonidas Deligiannidis and Hamid R. Arabnia Morgan Kaufmann, Emerging Trends in Image Processing, Computer Vision and Pattern Recognition, Elsevier.
8. SergiosTheodoridis, AggelosPikrakis, Konstantinos Koutroumbas and DionisisCavouras, Introduction to Pattern Recognition, Academic Press, Elsevier.
9. Lin C. and Lee G., Neural Fuzzy Systems, Prentice Hall International Inc.
10. Cornelius Leondes, Fuzzy Logic and Expert Systems Applications, Academic Press, Elsevier.

Course Code	Course Name	Credits
MSEPE2023	Smart Industries	03

Objectives:

To provide students with a comprehensive understanding of the smart industry concept, Industry Revolution and Industry 4.0, key drivers and technologies for Smart Industries and Implications of Smart Industry.

Outcomes: On completion of the course, learner will be able to:

1. Understand the basic principles behind smart industry.
2. Identify smart industry key levers and drivers.
3. Understand the supporting technologies for Smart factories.
4. Learn from leading industries and develop smart factory roadmaps.

Module	Detailed Contents	Hrs.
01	Introduction to Smart Industry: Traditional Manufacturing Practices and Limitations, Industry Revolution, Introduction to Fourth Industrial Revolution and Concept of Smart Industry, Journey of Smart Industry, Key Drivers of smart industry/Industry 4.0, Changing Society, Product and Processes, Need for renovating and standardizing production and manufacturing Industries to compete with global challenges, Smart Industry Roadmap, Opportunities and Challenges.	06
02	Supporting Tools and Technologies for Smart Industries – Part I: Introduction to and Use of following Technologies in Smart Industries: Industrial IOT, Sensing and actuation, Autonomous Robots, Additive Manufacturing, Horizontal and Vertical System Integration.	06
03	Supporting Tools and Technologies for Smart Industries – Part II: Introduction to and Use of following Technologies in Smart Industries: AI, Cloud Computing, Big Data and advanced analytics, ICT, Block chain technology, smart grids, Cyber Physical Systems, Augmented Reality and Virtual Reality in Smart Factories.	10
04	Dimensions of Smart Manufacturing and Logistics: Smart manufacturing: Smart and connected products, Smart Machines, Smart materials, smart manufacturing processes, Smart material handling, Sustainable manufacturing and renewable energy. Smart Logistics: Marketing and sales, post sales service and customer relationship management, Smart Money: Digital payment strategy in India.	10
05	Real time tracking and Machine monitoring: Real time tracking of parts, WIP, tools, personnel and associated tools and challenges. Purpose of machine monitoring, tools and functions involved in predictive maintenance of machines.	05
06	Smart Industry applications with case studies: Discussion on case studies and success stories across industries who had developed and implemented several smart factory solutions.	05

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. Handbook of Industry 4.0 and SMART Systems, Diego Galar Pascual, Pasquale Daponte and Uday Kumar, CRC Press.
2. Implementing Industry 4.0: The Model Factory as the Key Enabler for the Future of Manufacturing, Carlos Toro, Wei Wang, and Humza Akhtar, Springer Publications.
3. Smart Digital Manufacturing: A guide of digital transformation with real case studies across industries, Rene Wolf and RaffaelloLepratti, Wiley- VCH publications.
4. Intelligent Transportation Systems: Smart and Green Infrastructure Design, Frank Kreith, Mechanical Engineering Series, Taylor and Francis Group.
5. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, Pethuru Raj and Anupama C. Raman, CRC Press.
6. Internet of Things, Jeeva Jose, Khanna Publishing House, Delhi.
7. Block Chain Basics, Daniel Drescher, Apress.
8. Sensors and Actuators, C.W. De Silava, CRC Press.
9. Introduction to sensors, J. Vetelino and A. Reghu, CRC Press.
10. Smart Plant Factory: The Next Generation Indoor Vertical Farms, ToyokiKozai, Springer Nature Publications.
11. Introduction to Industry 4.0 and Industrial Internet of Things, Prof. Sudip Misra, NPTEL Course, IIT Kharagpur.
12. Smart Industry & Smart Education, Michael E. Auer and Reinhard Langmann – Springer Publications.
13. Cyber physical systems in the context of Industry 4.0, IEEE International Conference on Automation, Quality and Testing, Robotics, 2014.

Course Code	Course Name	Credits
MSEIE2011	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: On completion of the course, 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).	07
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.	06
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).	07
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.	08
05	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. 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. Project Contracting: Project procurement management, contracting and outsourcing,	07

06	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. 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.	07
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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. 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, 9th Ed.

Course Code	Course Name	Credits
MSEIE2012	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: On completion of the course, 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.	08
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.	07
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.	06
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.	08
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.	07

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.	06
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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. 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
MSEIE2013	Entrepreneurship 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: On completion of the course, 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.	06
02	Business Plans and Importance of Capital to Entrepreneurship: 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.	08
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	06
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.	07
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.	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. 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. T. N. Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi.
4. Dr. C. N. Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi.
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House.
6. MaddhurimaLall, ShikahSahai, 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. LaghuUdyogSamachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
MSEIE2014	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: On completion of the course, 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.	06
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.	08
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.	06

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.	07
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.	07
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.	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. 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 Ed., 2011.
4. C. B. Mamoria and S. V. Gankar, Dynamics of Industrial Relations in India, 15th Ed., 2015, Himalaya Publishing, 15th edition, 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
MSEIE2015	Professional Ethics and Corporate Social Responsibility (CSR)	03

Objectives:

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

Outcomes: On completion of the course, 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.	07
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.	07
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.	07
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.	07
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.	07
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.	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. 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
MSEIE2016	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: On completion of the course, 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: Research – Definition, Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle, Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research, Issues and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical.	07
02	Types of Research: Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches.	06
03	Research Design and Sample Design: Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors.	07
04	Research Methodology: Meaning of Research Methodology, Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design, Data Collection, Data Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report.	08
05	Formulating Research Problem: Considerations- Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis.	07
06	Outcome of Research: Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation.	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. 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
MSEIE2017	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: On completion of the course, 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	Hrs.
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.	07
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.	08
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge, etc.	07
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.	06
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.).	06
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.	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. 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 Dufield, 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. LousHarns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO.
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH.
8. R. Radhakrishnan & 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
MSEIE2018	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: On completion of the course, 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 Contents	Hrs.
01	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.	07
02	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.	08
03	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system. Application Development: Building Digital business Applications and Infrastructure.	07
04	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.	07
05	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).	07
06	Materializing e-business: From Idea to Realization-Business plan preparation Case Studies and presentations.	06

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, Elsevier, 2006.
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson.
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, 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
MSEIE2019	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: On completion of the course, 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.	06
02	Global Environmental concerns: Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Manmade disasters, Atomic/Biomedical hazards, etc.	08
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	07
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency, Environment Quality Management and Corporate Environmental Responsibility.	08
05	Total Quality Environmental Management, ISO-14000, EMS certification.	06
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.	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. 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, Macmillan India, 2000. Introduction to Environmental Management, Mary K. Theodore and Louise Theodore, CRC Press.
6. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015.

Course Code	Course Name	Credits
MSEL201	Industrial Automation Lab	01

Module	Detailed Contents	Lab. Sessions
01	Simulation of basic hydraulic, pneumatic and electric and combination circuits using software like automation studio etc.	05
02	Design and Testing of hydraulic, pneumatic, electro pneumatic and PLC circuits.	03
03	Simulation of Nyquist plots and State-space representation.	02
04	Development of Ladder logic programmer for control of real time processes.	03

Assessment:

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

Course Code	Course Name	Credits
MSESBL201	Manufacturing Simulation Lab	02

Module	Detailed Contents	Lab. Sessions
01	Simulation in the Fields of Forming considering any of the following: Cold Forming, Hot Forging, Ring Rolling, Sheet Metal Forming, Rolling.	05
02	Simulation in the Fields of Joining considering any of the following: Arc Welding, Mechanical Joining.	04
03	Simulation in the Fields of Additive Manufacturing considering any of the following Fields of application: Power bed Fusion, Deposition method, Metal Binder Jetting.	04

The experiments can be performed on SIMUFACT, ANSYS or Any other relevant software.

Assessment:

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

Course Code	Course Name	Credits
MSEOCC301 & MSEOCC302	Online Credit Course – I & II	03 + 03

Guidelines for Online Credit Course:

It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UoM. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. University shall make a provision that credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet with actual names of courses. The learner shall be allowed to take up these courses from his or her institute or organisation/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

Online Credit Course – I

The learner shall opt for the course in the domain of Research Methodology or Research & Publication Ethics or IPR. The opted course shall be of 3 credits of equivalent number of weeks.

Online Credit Course –II

The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

Course Code	Course Name	Credits
MSEMP301	Major Project: Dissertation -I	10

Guidelines for Dissertation-I

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.

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 Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

Course Code	Course Name	Credits
MSEMP401	Major Project: Dissertation -II	16

Guidelines for Dissertation-II

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 or learner contribution
- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.