SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)

Syllabus

for

Master of Technology

in

Mechanical Engineering

(Manufacturing Systems Engineering)

(Autonomous)

DJSCE19

(Choice Based Credit and Grading System)

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2020-2021)

Semester I

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment							Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total (B)			
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total				
1	DJ19MEPGC101	Computer Integrated Manufacturing Systems	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19MEPGL101	Computer Integrated Manufacturing Systems Laborator	--	2	--	1	--	--	25	--	--	25	--	--	--	15	10	25	25	50	1	
2	DJ19MEPGC102	Quality Engineering	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19MEPGL102	Quality Engineering Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	15	10	25	25	50	1	
3	DJ19MEPGC103	New Product Design & Development	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
4	DJ19MEPGC104	Manufacturing Planning and Control	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
5@	DJ19MEPGE101	Advanced Material Science	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE102	World Class Manufacturing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE103	Maintenance Management	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE104	Design of Experiments	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE105	Reliability Engineering	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
6#	DJ19OMEC1021	Cyber Security and Laws	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC1022	System Dynamics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC1023	Operation Research	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC1024	Wavelets	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC1025	Digital Marketing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
		Total	**18**	**4**	**0**	**20**	**--**	**450**	**50**	**0**	**0**	**500**	**150**	**150**	**150**	**30**	**20**	**50**	**200**	**700**	**20**	

@ Any 1 Department Level Elective
# Any 1 Institue Level Elective

Shri Vile Parle Kelavani Mandal's
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Scheme for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2020-2021)

Semester II

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment							Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total (B)			
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total				
1	DJ19MEPGC201	Industrial Automation	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19MEPGL201	Industrial Automation Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	15	10	25	25	50	1	
2	DJ19MEPGC202	Advanced Quantitative Techniques	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19MEPGL202	Advanced Quantitative Techniques Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	15	10	25	25	50	1	
3	DJ19MEPGC203	Strategic Manufacturing for Sustainability	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
4	DJ19MEPGC204	Manufacturing Systems Design	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
5@	DJ19MEPGE201	Logistics & Supply Chain Management	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE202	Data Science	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE203	Additive Manufacturing and Rapid Prototyping	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE204	Micro and Nano Manufacturing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19MEPGE205	Technology and Innovation Management	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
6#	DJ19OMEC2021	Project Management	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC2022	IPR and Patenting	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC2023	Remote Sensing Concepts	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC2024	Product Life Cycle Management	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19OMEC2025	Research Methodology	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
		Total	**18**	**4**	**0**	**20**	**--**	**450**	**50**	**0**	**0**	**500**	**150**	**150**	**150**	**30**	**20**	**50**	**200**	**700**	**20**	

@ Any 1 Department Level Elective
# Any 1 Institue Level Elective

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Scheme for Second Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester III (Autonomous)
(Academic Year 2020-2021)

Semester III

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment							Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total (B)			
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total				
1	DJ19MEPGS301	Special Topic Seminar	--	06	--	3	--	--	50	--	--	50	--	--	--	--	50	50	50	100	3	**3**
2	DJ19MEPGD301	Dissertation I	--	24	--	12	--	--	--	--	--	--	--	--	--	50	50	100	100	100	12	**12**
		Total	**--**	**30**	**--**	**15**	**--**	**--**	**50**	**--**	**--**	**50**	**--**	**--**	**--**	**50**	**100**	**150**	**150**	**200**	**15**	

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Scheme for Second Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester IV (Autonomous)
(Academic Year 2020-2021)

Semester IV

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment							Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total (B)			
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total				
1	DJ19MEPGD401	Dissertation II	--	30	--	15	--	--	100	--	--	100	--	--	--	50	50	100	100	200	15	**15**
		Total	**--**	**30**	**--**	**15**	**--**	**--**	**100**	**--**	**--**	**100**	**--**	**--**	**--**	**50**	**50**	**100**	**100**	**200**	**15**	

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Computer Integrated Manufacturing Systems</td><td colspan="3">Course Code: DJ19MEPGC101</td></tr>
<tr><td colspan="8">Course: Computer Integrated Manufacturing Systems Laboratory</td><td colspan="3">Course Code: DJ19MEPGL101</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">2</td><td rowspan="3">--</td><td rowspan="3">1</td><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of

1. Manufacturing systems.
2. Various stages of Product life cycle.

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

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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.	**06**
2	**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.	**12**
3	**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)	**05**
4	**Computer Aided Process Planning (CAPP) :** Introduction and types **Computer Aided Quality Control (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	**08**
5	**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, Product Life-Cycle Management (PLM), and Collaborative Product Development.	**09**
6	**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.	**08**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

List of Experiments / Tutorials:

1. 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.
2. Simulation and performance analysis of the FMS, parts flow control on Assembly station.
3. Study experiments on Integration aspects in computer integrated manufacturing environment.
4. Importance of Artificial Intelligence.

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Quality Engineering</td><td colspan="3">Course Code: DJ19MEPGC102</td></tr>
<tr><td colspan="8">Course: Quality Engineering Laboratory</td><td colspan="3">Course Code: DJ19MEPGL102</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">1</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of

1. Mathematical statistics
2. Knowledge of sample size, measurements and related terminology

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 the use of standard sampling plan.
4. Analyze the modern management trends in quality improvement.
5. Apply the use of concepts of TQM

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Quality:** Definition & Evolution of Quality, Quality Assurance, and Quality Characteristics (dimensions). Quality Control, Quality tasks & means to control them, Quality costs concept & its categories, Cost reduction program and economics of quality	**06**
2	**Statistical Quality Control (SQC):** Basic Concept of Statistical Quality Control (SQC), Statistical Tools in Quality Control. Concept & causes of variation, statistical aspect of control charting. Concept of rational sub-grouping and detecting patterns on the control charts, for variables and attributes: X and R, p, np, c and u charts; specification and tolerances, natural tolerance limits, specification limits, process capability ratio analysis and studies	**06**
3	**Acceptance Sampling:** Concept of Acceptance Sampling, Lot by lot sampling process, types. Probability of acceptance in single, double, multiple and sequential sampling plans, OC curves, Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts, standard sampling plans for AQL and LTPD, use of standard sampling plans, Introduction to Variable sampling plans	**07**
4	**Total Quality Management(TQM):** Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Implementation of TQM, ISO 9000 quality system, Jurans Triology, Deming's Approach to TQM, Zero defect Concept	**07**
5	**Total Productive Maintenance (TPM):** History and Impact of TPM, Overall Equipment Effectiveness (OEE). Developing the TPM implementation Plan, Preventive Maintenance, techniques- FMEA, POKA-YOKE and Future of TPM	**07**
6	**6σ & Modern 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.	**06**

List of Experiments / Tutorials:

1. Using live data from separate case studies, complete analysis of minimum three topics. Every student is expected to do individual and different three case studies.
2. Use of modern software for complete analysis of data from experimentation or a Field/online survey questionnaire. One full report may be submitted mentioning all its objectives, methodologies, inferences etc.
3. Assignments based on each module

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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. Dunkan, "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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the topics discussed during laboratory/tutorial sessions.

Continuous Assessment (B):

Theory:

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Laboratory: (Term work)

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(Academic Year 2019-2020)

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<tr><td colspan="8">Course: New Product Design & Development</td><td colspan="3">Course Code: DJ19MEPGC103</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
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</table>

Pre-requisite: Knowledge of

1. Machine design fundamentals.
2. Elements of manufacturing engineering.
3. Exposure to computer aided design approach.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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 optimisation.	**06**
2	**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**
3	**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**
4	**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**
5	**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**
6	**Software solutions& IP Rights:** Drafting Modeling, CAD/CAE tools, CAM interface, CAPP, various softwares employed and their capabilities. Patents & IP Acts – overview & disclosure preparation.	**05**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Manufacturing Planning and Control</td><td colspan="3">Course Code: DJ19MEPGC104</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Mathematical statistics.
2. Basic production process.

Objectives:

1. To provide insight into fundamental principles and methodologies related to planning, design, operation, and control of manufacturing systems.
2. To impart analytical abilities to formulate and solve problems faced by modern Manufacturing systems and implement the cost-effective solutions.

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

1. Analyse various aspects of good manufacturing planning and control framework.
2. Design demand management scheme using demand forecasting methods and prepare aggregate plan.
3. Develop the plan for scheduling and sequencing of manufacturing operations.
4. Create a logical approach to Line balancing in various production systems.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Basic Concepts of Manufacturing Planning and Control (MPC)**: Overview of manufacturing systems and changing manufacturing environment. MPC system, its framework. **Demand Management**: Demand Management in MPC environment. Need for Forecasting the demand in MPC, forecasting methods of qualitative type, quantitative type. Time series analysis: least square method, moving average method, exponential smoothing method. Causal method: regression Analysis. Forecasting Errors and Forecasting Bias.	**06**
2	**Aggregate Planning:** Concept of aggregate planning, decision rules, strategies and methods. **Capacity Planning:** Measures of capacity, Factors influencing effective capacity planning, short range, medium range and long-range capacity planning, Rough cut capacity planning. **Master Production Scheduling:** MPS activity, Techniques.	**07**
3	**Inventory Control:** Basic concepts of inventory, Types of inventory – Q system and p system, Economic Order Quantity, Inventory Models – Deterministic and Probabilistic. Other inventory control techniques – ABC Analysis, HML VED etc. techniques. **Operational Planning: MRP, MRP II, JIT:** Material Requirement planning (MRP) and Manufacturing Resource Planning (MRP-II) - general concepts, types of demands, Inputs to MRP, MRP objectives, outputs of MRP, Estimation of planned order releases. Benefits and Limitations of MRP II, Concept of JIT.	**07**
4	**Production Scheduling and Sequencing:** Inputs for scheduling, factors affecting scheduling, use of Gantt Charts. Sequencing of m jobs on one, two, three and m machines. Two jobs on m machines. Resource Scheduling: Resource smoothing, Resource levelling.	**07**
5	**Process Planning:** Need, pre-requisites and steps in process planning. **Line balancing:** Objectives and constraints in assembly line, heuristic methods for line balancing. **Enterprise Resource Planning (ERP):** Evolution, features, purpose of modeling an enterprise, information mapping, generic model of ERP, Modules in ERP, Methodology of implementation, critical success factors of ERP, Case studies of success and failure of ERP implementations, ERP packages.	**06**
6	**Quantitative Techniques in MPC:** Linear Programming Problems, Assignment, Transportation and Transshipment Models.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

1. Thomas E. Vollmann, William L. Berry, D. Clay Whybark (2004), Manufacturing Planning And Control Systems For Supply Chain Management, Mcgraw-hill Companies
2. Stephen N. Chapman (2005), Fundamentals of Production Planning and Control, Prentice hall, 2006

Reference Books:

1. Sipper D. and Bulfin R. L., Production Planning, Control and Integration, McGraw Hill, 1997

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: I</td></tr>
<tr><td colspan="8">Course: Advanced Material Science</td><td colspan="4">Course Code: DJ19MEPGE101</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Engineering Physics.
2. Materials Technology.
3. Strength of Materials.

Objectives:

1. To understand structure-property-performance relationship of materials.
2. To understand various strengthening mechanisms.
3. To understand phase diagrams-iron iron carbide phase diagram, TTT and CCT diagrams, Heat treatment techniques.
4. To understand processing and applications polymers and composites.

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

1. Understand basics of the structure - properties relationship.
2. Understand importance of phase diagrams in micro structure design.
3. Analyze, interpret and solve scientific materials data/ problems.
4. Apply principles of heat treatments of steels.
5. Understand processing and applications of polymers and composites.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	Introduction to engineering materials & their properties. Crystalline versus noncrystalline solids, Unit cell, Crystal systems, Bravais lattice, Fundamental reasons behind classification of lattice, Miller indices for directions & planes, Close -packed planes & directions, Packing efficiency, Interstitial voids, Role of X -ray diffraction in determining crystal structures.	**06**
2	Deformation of metals, Understanding of some material -properties independent of interatomic bonding forces/energies, Stiffness versus modulus, Theoretical/ideal strength versus actual strength of metals, Crystal defects, Role of dislocations in deformation, Strengthening Mechanisms, Role of Cottrell atmosphere.	**06**
3	Objectives & classification, System, Phases & structural constituent of phase diagram. Temperature–Pressure phase diagram of iron & Clausius –Clapeyron equation for boundary between phase regions of temperature -versus-pressure phase diagrams, Gibbs phase rule, Lever rule, Solid solutions, Hume-Rothery rules, Isomorphous, Eutectic, Peritectic & Eutectoid system, Equilibrium diagrams for non -ferrous alloys.	**07**
4	Experimental methods of determining phase diagrams, Iron –Carbon equilibrium diagram, Steels & Cast -irons. Gibbs free-energy curves for pure system, Solidification of pure metals, Nucleation, Growth, Growth of the new phase, Solidification of alloys, Nucleation -, growth- & overall transformation - rates, TTT & CCT diagrams.	**07**
5	Definition, Purpose & classification of heat treatment processes for various types of steels, Bainite & Martensite formation, Introduction & applications of various case hardening & surface hardening treatments, Precipitation Hardening, Heat treatment defects.	**07**
6	Polymers as a class of engineering materials – comparison with metals and ceramics - classification of polymers Polymerization – mechanisms processing and applications of polymers– polymer processing – basic methods and recent developments Introduction to composites – classification of composites – emphasis on polymer based composites – bonding and failure criteria – micro mechanics approach Reinforcing materials – overview of different processing methods – technical and economic aspects – novel applications of composite materials.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

1. V. Raghvan, Materials Science and Engineering, Prentice Hall of India Publishing, 5th Edition, 2006.
2. W. D. Callister, Materials Science and Engineering, 8th Edition, 2006.

Reference Books:

1. Askland & Phule, Material Science & Engineering of Materials, 4th Edition.
2. Reed Hill, Physical Metallurgy, 4th Edition, 2009.
3. S. H. Avner, Introduction to Physical Metallurgy, 2nd Edition, 1974.
4. D. A. Porter & K.E. Easterling, Phase Transformations in Metals & Alloys, 3rd Edition, 1992.
5. Billmeyer F, Textbook of Polymer Science, Wiley Interscience, 1994
6. Anthoney Kelly, Concise Encyclopedia of Composite Materials, Pergamon, 1994

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: World Class Manufacturing</td><td colspan="3">Course Code: DJ19MEPGE102</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Production Management.
2. Industrial Engineering.
3. Quality Assurance.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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**
2	**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.	**06**
3	**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**
4	**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**
5	**Typical Characteristics of WCM Companies:** Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy.	**07**
6	**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.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

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

Reference Books:

1. Adam and Ebert, "Production and Operational Management", 5th Edition, Prentice Hall learning Pvt. Ltd., New Delhi
2. Ron Moore, "Making Common Sense Common Practice – Models for manufacturing Excellence", Butter worth Heinmann
3. Jeffrey K. Liker "The Toyota Way – 14 Management Principles", Mc-Graw Hill, 2003.
4. Chase Richard B., Jacob Robert., Operations Management for Competitive Advantage", 11th Edition, McGraw Hill Publications, 2005.
5. Moore Ron, "Making Common Sense Common Practice", Butterworth-Heinemann, 2002

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Maintenance Management</td><td colspan="3">Course Code: DJ19MEPGE103</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Basics of maintenance.
2. Managing planning and scheduling.

Objectives:

1. To discuss the role of maintenance management for competitive advantage.
2. To structure the maintenance function.
3. To discuss the role of preventive, predictive and productive maintenance strategies and policies for managing operations, productivity, quality and growth.

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

1. Develop a maintenance plan for a technical system.
2. Develop a performance management system for maintenance.
3. Apply maintenance approaches to achieve continuous improvement.
4. Apply problem-solving models to maintenance.
5. Model reliability and availability of system.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	Objective of Maintenance; Maintenance Policies; case studies on Assessment of reliability.	**06**
2	Availability, Maintainability and Effectiveness of equipment; Quantitative aspects of maintenance.	**06**
3	Various aspects of preventive, predictive, productive and Total Productive Maintenance (TPM); Replacement policies; Maintenance budgeting and cost control.	**07**
4	Concept of World Class Maintenance to enable the organization make its products and services competitive in terms of price, quality, on –time delivery and total customer support.	**07**
5	Maintenance Audit; Computer aided maintenance management system; Case studies on total productive Maintenance; Markov Model and Application of Markov Processes in Maintenance.	**07**
6	Maintenance Performance Indicators; Application of reliability theory in Maintenance.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

1. Nakijima S., TPM Development Programme: Implementing total Productive Maintenence, Productivity Press,Canbridge
2. Terry W., Computerised Maintenance Management Systems, Industrial Press, New York
3. Suzuki T., TPM in process industries, Productivity Press, Portland, Oregon
4. Lindley R. Higgins & R. Keith Mobley, "Maintenance Engineering Handbook", McGraw Hill, 2002
5. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", Tata McGraw Hill, 2000
6. K Venkataraman, Maintenance Engineering and Management, Prentice Hall of India, 2007.Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe (2014), Total Quality Management, Pearson Education
7. K. Shridhara Bhat (2010), Total Quality Management: Text and Cases, Himalaya Publishing House
8. R. R. Lakhe, M. Singhal, R. L. Shrivastava, B. E. Narkhede and K. Dharkar(2018), ISO9001:2015 Quality Management System: Requirements, Interpretation and Implementation, Educreation Publishing
9. Shyam Talwadekar (2002), World of Kaizen, A publication of Quality Management Systems ISBN 81-900725-8-7
10. Seiichi Nakajima(1989), TPM Development Program: Implementing Total Productive Maintenance, Productivity Press
11. Michael Hammer and James Champy (2001), Reengineering the Corporation: A Manifesto for Business Revolution, Nicholas Brealey Publishing

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Design of Experiments</td><td colspan="3">Course Code: DJ19MEPGE104</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Applied Statistics.
2. Regression and Analysis of Variance.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction:** Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	**06**
2	**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.	**06**
3	**Two-Level Factorial Designs and Analysis:** The 2^2 Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^k Design, The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split Plot Designs.	**07**
4	**Two-Level Fractional Factorial Designs and Analysis:** The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	**07**
5	**Conducting Tests:** Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.	**07**
6	**Taguchi Approach:** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Reliability Engineering</td><td colspan="3">Course Code: DJ19MEPGE105</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Probability theory and distribution curves

Objectives:

1. To familiarize with theory and laws of probability.
2. To acquaint with reliability and its concepts.
3. To acquaint with various methods to evaluate the system reliability of simple and complex systems.
4. To familiarise with the various aspects of Maintainability, Availability and FMEA.

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

1. Understand and apply the theory and laws of Probability to solve 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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Probability theory**: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions**: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion**: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	**06**
2	**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.	**06**
3	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems. **Reliability Improvement**: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set and Tie-set method, Success Path method, Decomposition method.	**07**
4	**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.	**07**
5	**Failure Mode, Effects and Criticality Analysis**: Failure mode effects analysis (FMEA), severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis (FTA) and Event tree Analysis (ETA).	**07**
6	**Applications:** Nuclear Power plants, Marine power plant, Computer system and General complex system.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

1. L. S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985
2. E. Balagurusamy, Reliability Engineering, Tata McGraw-Hill

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Cyber Security and Laws</td><td colspan="3">Course Code: DJ19OMEC1021</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Cryptography and System Security.
2. Computer Network

Objectives:

1. To understand and identify different types cybercrime and cyber law.
2. To learn various tools and methods used in cybercrime.
3. To recognized Indian IT Act and its latest amendments.
4. 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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Cybercrime:** Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism ,Virus & Worm's ,Email Bombing ,Pornography ,online gambling ,Forgery ,Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation ,Software Piracy, Electronics/ Digital Signature.	**04**
2	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber Bulling & stalking, Email Fraud ,E-mail Spoofing ,Cyber café and Cybercrimes, , Botnets, Attack vector, Cloud computing & its security, Attack on Mobile Phone.	**08**
3	**Tools and Methods Used in Cybercrime:** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) .	**08**
4	**The Concept of Cyberspace:** Domain Name abuse, Campaign – Targeted Phishing, Malicious Code and Security Risks, Denial of Service attacks, Cognitive Election Hacking, Public Voters Information Sources, Intercepting Voice Communication.	**07**
5	**Indian IT Act:** Cyber Crime and Cyber Security : The Legal Perspectives, Introduction ,Why do we Need Cyber laws : The Indian Context , The Indian IT Act, ,Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act.	**08**
6	**Information Security Standard compliances:** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	**04**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

Reference Books:

1. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
2. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
3. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
4. Kennetch J. Knapp, *Cyber Security* & *Global Information Assurance* Information Science Publishing.
5. William Stallings, *Cryptography and Network Security*, Pearson Publication

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

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<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: System Dynamics</td><td colspan="3">Course Code: DJ19OMEC1022</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Organizational behaviour
2. Supply chain dynamics
3. Causes of project delay and cost overruns

Objectives:

1. To understand systems concept and systems approach to engineering problems of long term nature.
2. To develop perspective of strategic decision making and long range planning in industries.

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

1. Demonstrate understanding of system concepts, system thinking and system archetypes.
2. Demonstrate understanding of sources of system complexity and counterintuitive behavior.
3. Verify and validate selected models.
4. Apply system dynamics concepts to real world problems.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	System Concepts, holism, Synergy and Emergence	**06**
2	System thinking, System Archetypes, Subsystem and suprasystem	**07**
3	Sources of system complexity, counterintuitive behavior, causal structure and feedback loops, positive and negative feedback loops, Causal loop diagram and stock-flow diagram	**07**
4	Level, rate and auxiliary variables, physical and information flows, nonlinearity and delay, exponential smoothing, first order and higher order systems	**07**
5	Table function and multipliers, discussion of industrial case problems, model verification and validation	**06**
6	Sensitivity analysis and policy experimentations. Application to real world problems	**06**

Books Recommended:

Text Books:

1. John Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw-Hill, 2000

Reference Books:

1. Michael R. Goodman, Study Notes in System Dynamics, Pegasus Communications (1989)
2. Sushil, System Dynamics: A Practical Approach for Managerial Problems, Wiley Eastern, 1993.
3. R.G. Coyle, System Dynamics Modeling: A Practical Approach, Chapman & Hall/CRC, 1996.
4. Craig W. Kirkwood, System Dynamics: A Quick Introduction, Arizona State University, 1998

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
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Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

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<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Operation Research</td><td colspan="3">Course Code: DJ19OMEC1023</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
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Pre-requisite: Knowledge of

1. Fundamental concepts of Mathematical statistics

Objectives:

1. To formulate a real-world problem as a mathematical programming model.
2. To understand the mathematical tools that are needed to solve optimization problems.
3. To use mathematical software to solve the proposed models.

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

1. Convert a real-world problem in to a Linear Programming Problem and Interpret the solution obtained using Simplex method or other algorithms.
2. Understand reasons of formation of queues, Classify various queuing systems and Apply performance parameters defined for various queuing systems for decision making in real life situations.
3. Describe concept of simulation and Apply Monte Carlo Simulation technique to systems such as inventory, queuing and Develop solutions for them.
4. Explain the need for replacement of components or machines in most economical way and Infer optimal replacement age.
5. Identify the decision situations which vary with time and Analyse them using principle of dynamic programming to real life situations.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Operations Research (OR)**: Decision situations, Decision making process, Concept of Optimization, Mathematical Models. Linear Programming: Linear Programming Problem - Mathematical Formulation, Finding Optimal solution using Graphical method, Simplex method, Big-M method, Special cases, Principle of Duality, Case studies in Resource allocations, Production Scheduling	**09**
2	**Transportation problem:** Formulation - Finding Optimal solution, Degeneracy. **Assignment problem:** Formulation - Finding Optimal solution. **Sequencing:** Processing of n Jobs through Two Machines and m Machines, Graphical Method for processing of n Jobs through Two Machines	**06**
3	**Queuing Models:** Introduction - Poisson arrivals - Exponential service time. Single Channel – Single server - Infinite population and finite population models, Multichannel - Single server - Infinite population models. Constant Service rate - Single Channel – Single server - Infinite population **Replacement Models:** Introduction - Replacement of items that deteriorate with time – when value of money does not change with time and changes with time. Replacement of items that fail suddenly – Individual and Group replacement.	**06**
4	**Game Theory:** Introduction - Minimax (Maximin) Criterion and optimal strategy - Solution of games with saddle points – 2 x 2 games - dominance principle - m x 2 & 2 x n games, Iterative Method **Inventory Models:** Introduction - Single item - EOQ – Overview of Deterministic models Stochastic models - demand may be discrete variable or continuous variable	**06**
5	**Simulation:** Definition - Methodology of simulation – Monte Carlo Simulation Technique - applications to Inventory and Queuing problems – Advantages and Limitations of Simulation. Simulation Languages.	**06**
6	**Dynamic programming:** Introduction - Bellman's Principle of optimality - Applications of dynamic programming to capital budgeting, inventory, employment smoothening, cargo loading and shortest path problem – Minimum Spanning Tree.	**06**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

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(Academic Year 2019-2020)

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<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Wavelets</td><td colspan="3">Course Code: DJ19OMEC1024</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Signals & Systems
2. Digital Signal Processing

Objectives:

1. To familiarize with wavelet theory, its implementation and representation.
2. To understand the fundamentals of multirate signal processing and its applications.
3. To study the theory and construction of wavelets and its practical implementations.

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

1. Implement multiphase and polyphase representation.
2. Classify various wavelet transform and explain importance of it.
3. Describe Continuous Wavelet Transform (CWT) and Discrete Wavelet Transform (DWT).
4. Explain the properties and application of wavelet transform.
5. Develop and realize computationally efficient wavelet based algorithms for signal and image processing.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to multirate systems and wavelets:** Fundamentals of multirate systems: Basic multirate operations and their spectral representation, Fractional Sampling rate alteration, Interconnection of building blocks, Noble identities, polyphase representations, Efficient structures for decimation and interpolation filters. Wavelets as a mathematical tool, Classification: continuous and discrete wavelet transforms	**09**
2	**Discrete wavelet transform and orthogonal wavelet decomposition:** Approximations of vectors in nested linear vector subspaces, Multi-resolution Analysis of L^2(R), Haar Scaling function Haar wavelet, Haar wavelet decomposition, Haar wavelet packets and application.	**08**
3	**MRA Ortho-normal wavelets and their relationships to filter** banks: Construction of an ortho-normal MRA, Wavelet basis for the MRA Digital filtering interpretation, Examples of orthogonal basis generating wavelets, Interpreting ortho-normal MRA for discrete time signals, Generating scaling functions and wavelets from filter coefficients.	**07**
4	**Continuous wavelet transform :** Definition of CWT, Continuous wavelet transform and short time Fourier transform, Scaling functions and wavelet functions, Uncertainty principle and time-frequency tiling	**09**
5	**Biorthogonal wavelets:** Biorthogonality in vector space, Biorthogonal Wavelet systems, Construction of biorthogonal wavelet systems. Frequency domain approach for designing wavelets: derivation of Daubechies wavelets, Wavelet Packets	**08**
6	**Wavelength Transform and applications:** DTWT for image compression, audio compression,JPEG 2000 standard, Wavelet based de-noising, Speckle removal, Edge detection and object isolation, Image fusion, Object detection.	**07**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text Books:

1. Sanjit k. Mitra Digital signal processing 4th edition.
2. K. P. Soman, K. I. Ramachandran, N. G. Resmi, PHI-2006, Insight into wavelets From theory to practice.
3. S. V. Narasimhan, Nandini Bassumalick, S.Veena ,Narosa publication Introduction to Wavelet Transform.

Reference Books:

1. P. P. Vaidyanathan, Multirate Systems & Filter banks, Prentice Hall.
2. Raguveer M.Rao and AjitS.Bopardikar-Wavelet Transforms –Introduction and applications-Pearson Education, 2008.
3. Mallat S,Academic press 1996 -Wavelet signal Processing.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Digital Marketing</td><td colspan="3">Course Code: DJ19OMEC1025</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">--</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Basics of marketing.

Objectives:

1. To learn the fundamentals of Digital marketing.
2. To understand the use of content strategy and social media marketing and email marketing.
3. To understand the role of Search Engine Optimization.
4. To apply techniques in display advertising.

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

1. Apply B2B and B2C contexts to plan content marketing.
2. Develop and measure impact of content that works well for your target audience.
3. Manage social media presence, and create effective content for each platform.
4. Optimize search engine presence through on-site and off-site activities, develop target keyword list, optimize website UX and design, and execute a link building campaign.
5. Create, execute, and optimize an effective Ad campaign. Display and set up advertising works.
6. Create an email marketing strategy, create and execute email campaigns, and measure the results.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Marketing Fundamentals:** Welcome to Digital Marketing, The Digital Marketing Framework, What: Your Business Welcome to Digital Marketing, The Digital Marketing Framework, What: Your Business Who & When: Your Customer, Where: Marketing Channels, Why: Marketing Objectives & KPIs.	**08**
2	**Content Strategy:** Plan Your Content Strategy, Create Content, Distribute & Promote Content, Optimize Website UX & Landing Pages, Measure Impact	**08**
3	**Social Media Marketing :** Social Media Marketing (Organic), Social Media Landscape , Social Media Channels, Social Media Content, Implement & Monitor Campaigns, Measure Impact, Social Media Advertising (Paid), Intro to Social Media Advertising, Platforms for Social Ads, Facebook – Getting Started, Facebook - Create Ad Sets, Facebook - Create and Manage Ads	**06**
4	**Search Engine Optimization (SEO):** Search Engine Marketing with AdWords (SEM), How Search Works Keywords, On-Site SEO: Optimize UX & Design, Off-Site SEO:Link-building, SEO Audit & Future of SEO, Adwords & Keyword Selection, Create Text Ads, CPC Bidding, Navigate AdWords, SEM Metrics & Optimization	**06**
5	**Display Advertising:** How Do Display Ads Work? Display Ads &Targeting, Sales Models, Display Ads in AdWords, Video Advertising	**06**
6	**Email Marketing:** Email List Generation, Create an Effective Email Campaigns, Create an Email Plan, Measure Results.	**05**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester I (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text Books:

1. B2B Digital Marketing: Using the Web to Market Directly to Businesses – Miller
2. Digital Marketing: An Integrated Marketing approach –Star Bussiness series.2019
3. Social Media Marketing All-In-One for Dummies By Jan Zimmerman and Deborah Ng, 2017
4. Google Adwords for Beginners: A Do-It-Yourself Guide to PPC Advertising

Reference Books:

1. Digital Marketing for Dummies By Ryan Deiss and Russ Hennesberry, 2017
2. Digital Marketing Handbook: A Guide to Search Engine Optimization – Shivani Karwal
3. Introduction to Programmatic Advertising By Dominik Kosorin, 2016
4. The Webinar Way: The Single Most Effective Way to Promote Your Services, Drive Leads & Sell a Ton of Product By Sherri Rose, 2012

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: II</td></tr>
<tr><td colspan="8">Course: Industrial Automation</td><td colspan="4">Course Code: DJ19MEPGC201</td></tr>
<tr><td colspan="8">Course: Industrial Automation Laboratory</td><td colspan="4">Course Code: DJ19MEPGL201</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of

1. Manufacturing systems.
2. Mechanical measurements and control
3. Industrial electronics

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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**
2	**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	**06**
3	**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**
4	**Programmable and Logic Controller:** PLC configuration and selection, PLC Basic components and their symbols Control transformers and fuses - Switches and Indicator lamps, Relays and time delay relays PLC Programming - Fundamentals of Ladder Programming, Ladder programming for logic gates and latching, Sequencing ,counters ,timers, shift register and Master & Jump control, Introduction to Supervisory control and data Acquisition	**06**
5	**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	**06**
6	**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**

List of Experiments / Tutorials:

1. Using live data from separate case studies, complete analysis of minimum three topics. Every student is expected to do individual and different three case studies.

2. Use of modern software for complete analysis of data from experimentation or a Field / online survey questionnaire. One full report may be submitted mentioning all its objectives, methodologies, inferences etc.
3. Assignment based on each module.

Books Recommended:

Reference Books:

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.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: II</td></tr>
<tr><td colspan="8">Course: Advanced Quantitative Techniques</td><td colspan="4">Course Code: DJ19MEPGC202</td></tr>
<tr><td colspan="8">Course: Advanced Quantitative Techniques Laboratory</td><td colspan="4">Course Code: DJ19MEPGL202</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Basic Knowledge of Algebra, Probability and Statistics.

Objectives:

1. 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. Identify real-world problems as special cases of Linear Programming Problem and Solve the decision problem by choosing appropriate algorithm.
3. Recognize the limitations of simplex method in deriving integer solution to LPP and Employ suitable algorithm to obtain integer solution.
4. Analyse various decision making situations, Outline decision alternatives and Select the best alternative.
5. Describe a real-world problem as a Non-Linear Programming Problem and Distinguish local, global extreme points and point of inflection.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction:** Managerial Decision Making Problems, Analytical approach to Problem solving, Operations Research, Concept of Optimization, Mathematical Models **Linear Programming:** Linear Programming Problem - Mathematical Formulation, Overview of Simplex method, Big-M method, Two-phase method for finding optimal solution, Dual Simplex, Revised simplex method, Sensitivity Analysis	**07**
2	**Assignment Problems:** Hungarian Method **Travelling Salesman Problem:** Branch and Bound method **Transportation problem:** Least cost method, VAM and MODI method **Transhipment Problem** **Network Models: S**hortest Path, Minimum Spanning Tree, and Maximum Flow Problems	**06**
3	**Integer Programming Problem**: Gomory's cutting plane Algorithm, Branch and Bound Technique. 0-1 model of IPP. Introduction to Decomposition algorithms **Linear Goal programming**	**06**
4	**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).	**06**
5	**Markov chains & Decision Processes** **Metaheuristics**: Tabu, Simulated Annealing & Genetic algorithm **Network Models**: Shortest Path, Minimum Spanning Tree, and Maximum Flow Problems	**06**
6	**Nonlinear programming problems (NLPP):** Convex programming Unconstrained NLPP: Search Algorithm and Gradient method, Constrained NLPP: Kuhn-Tucker Conditions, Geometric Programming, Separable Programming, Quadratic programming, Stochastic Programming	**08**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

List of Experiments / Tutorials:

1. Exercises on LPP Software, AHP Software's & others.
2. Exposure to other OR & Simulation software.
3. Live case studies / Assignments based on each module

Books Recommended:

Reference Books:

1. Operations Research - An Introduction; Taha, H.A.; Prentice Hall
2. Operations Research: Principles and Practice; Ravindran, A, Phillips, D. T and Solberg, J. J.; John Willey and Sons
3. Introduction to Operations Research; Hiller, F. S. and Liebermann, G. J.; Tata McGraw Hill
4. Operations Research Principles and Practice; Pradeep Prabhakar Pai; Oxford University Press
5. Operations Research; S. D. Sharma; Kedar Nath Ram Nath -Meerut
6. Operations Research; Kanti Swarup, P. K. Gupta and Man Mohan; Sultan Chand & Sons

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the topics discussed during laboratory/tutorial sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work shall consist of at least one assignment from each unit and each assignment shall involve solving at least four examples/ case studies. Students are expected to use softwares available online to solve some of the problems.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: II</td></tr>
<tr><td colspan="8">Course: Strategic Manufacturing for Sustainability</td><td colspan="4">Course Code: DJ19MEPGC203</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
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</table>

Pre-requisite:

1. Exposure to environmental science and engineering.
2. Knowledge on engineering materials and new age materials.
3. Knowledge of product design and Product life cycle management.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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	**04**
2	**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**
3	**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**
4	**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**
5	**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**
6	**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**

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: II</td></tr>
<tr><td colspan="8">Course: Manufacturing Systems Design</td><td colspan="4">Course Code: DJ19MEPGC204</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="5">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="5">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Different manufacturing processes.
2. Production planning and Control.
3. Important software tools for design and manufacturing.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Manufacturing system fundamentals:** Basic concepts and definition of system, system design, structural and transformational aspects of manufacturing systems, integrated manufacturing and management systems.	**04**
2	**Process systems for manufacturing:** Logistics planning and design, Product planning and design, Process planning and design, Layout planning and design.	**06**
3	**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.	**08**
4	**Management systems for manufacturing:** Managerial information flow, Aggregate production planning and scheduling, Inventory management, Production control, Quality control.	**08**
5	**Automation systems for manufacturing:** CAD, CAM, CIM, FMS, Computer integrated automation systems- concept of ghost factory, overview of industry 4.0	**06**
6	**Information system for manufacturing:** MIS (Management information systems), SIS (Strategic information systems), Parts oriented production information systems, Online production control systems, Computer based production management systems.	**07**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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, Katsundo Hitomi, Viva Books Pvt. Ltd.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: II</td></tr>
<tr><td colspan="8">Course: Logistics and Supply Chain Management</td><td colspan="4">Course Code: DJ19MEPGE201</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Engineering Physics.
2. Materials Technology.
3. Strength of Materials.

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. Analyze the manufacturing operations of a firm
2. Apply sales and operations planning, MRP and lean manufacturing concepts
3. Apply logistics and purchasing concepts to improve supply chain operations
4. Apply quality management tools for process improvement

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction:** Evolution of SCM, Understanding Supply Chain. Historical developments in supply chain management. Issues in SCM, linkages within the value chain, strategic Supply Chain Management (SCM) decision phases, and Scope of Logistics, philosophy and concept work of logistics. Mission of logistics management, logistics & competitive strategy. Service-driven logistics systems.	**04**
2	**Supply Chain performance:** Customer driven strategies in production & distribution systems. Customer focus in SCM, management of supply sources. Drivers & obstacles, Different performance measures. Different multi-objective decision making and application of AHP. Measuring logistics costs & performance	**06**
3	**Planning Demand & Supply in SC:** Demand forecasting, Aggregate Planning, Planning & managing inventories in SC, Distribution network designs. Factors influencing network designs, distribution networks in practice frame work for network design decision. Network design in uncertain environment.	**08**
4	**Supply Chain Management:** Transportation in SC, Coordinating SC, Integrated production & distribution networks, source decision in SC. Network Design &IT in SC, SCM in the context of JIT, Total Quality Control and product innovation across the supply chain. Metrics for measurement of supply chain performance. Mathematical programming and other models for supply chain decisions. Measuring Logistics costs & performance.	**08**
5	**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.	**06**
6	Leading edge logistics, IT application in freight logistics. Case studies from the literature & practice. Basic familiarity with mathematical modelling & optimization.	**07**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Data Science</td><td colspan="3">Course Code: DJ19MEPGE202</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Basic Knowledge of Algebra, Probability and Statistics.

Objectives:

1. To equip the students with the specialist knowledge and technical skills needed to apply the powerful tools and insights of data-science.

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

1. Analyse the data using the popular pandas data science library and jupyter notebooks as their working environment, along with the effective use of functions for handling data.
2. Develop programming abilities using python libraries.
3. Demonstrate concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis etc.
4. Develop the ability to build and assess data-based models.
5. Demonstrate data manipulations and run basic inferential statistical analyses.
6. Demonstrate skills in prediction and time series forecasting

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Data Science:** Objectives, Components- Machine learning, Big data and Business intelligence, Tools like R programming, Python programming, MS Excel, Hadoop Platform, API	**04**
2	**Data Preprocessing and Data Wrangling**: Introduction to Data Mining, Data Cleaning, Steps in Pre-processing, Tasks of Data Wrangling, Data Management:Data Acquisition (Import & Export), Indexing, Selection and Filtering, Sorting & Summarizing, Combining and Merging Data Frames, Removing Duplicates, Discretization and Binning. Introduction to NoSql,MongoDB, Hive.	**07**
3	**Python for Data Science:** Syntax and Semantics, Conditional Statement, Data Structures, Control & Loop Statements, Functions & Classes:Python Libraries and Packages: Numpy, Pandas, Seaborn, Scikit-Learn, Scipy, BeautifulSoup, Bokeh, Urllib, PandaSQL, SciPy Stack: NumPy, pandas and matplotlib **Data Analysis and Visualisation:** Plotting libraries using plot, matplotlib, seaborn in Python and ggplot2 in R, Tableau	**07**
4	**Exploratory Data Analysis:** Basic concepts in statistics like mean, median, mode, variance, standard deviation. Statistical Methods for decision making: Probability distributions such as Normal distribution, Poisson's distribution. Bayes' theorem, Central limit theorem, Hypothesis testing, One Sample T-Test, Anova and Chi-Square	**07**
5	**Linear and Logistic Regression:** Multiple linear regression, Fitted regression lines, AIC, BIC, Model Fitting, Training and Test Data **Logistic Regression:** Introduction to Logistic regression, interpretation, odds ratio, AUC, R-Square **Introduction to forecasting:** Time Series**:** Trend and seasonality, Decomposition, Smoothing (moving average), SES, Holt & Holt-Winter Model, AR, Lag Series, ACF, PACF, ADF, Random walk and Auto Arima	**10**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

1. Noreen Burlingame and Lars Nielsen, A Simple Introduction to DATA SCIENCE, 2012
2. Wes McKinney, Python for Data Analysis, 2nd Edition, 2017.
3. Chantal D. Larose, Daniel T. Larose, Data Science Using Python and R
4. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.
5. Anderson D.R., Sweeney D.J., Williams T.A., Statistics for Business and Economics

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Additive Manufacturing and Rapid Prototyping</td><td colspan="3">Course Code: DJ19MEPGE203</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Computer-aided design & computer-aided manufacturing

Objectives:

1. To acquaint with various rapid prototyping and additive manufacturing technologies.
2. To familiarize with the various Rapid tooling techniques.

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

1. Demonstrate an importance of rapid prototyping/additive manufacturing techniques.
2. Select appropriate Rapid tooling techniques for a particular case.
3. Demonstrate use and importance of rapid tooling and modelers.
4. Design and develop of products using additive manufacturing technology.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Additive Manufacturing:** Additive Manufacturing (AM) need, definition, generic AM process steps, Classification of AM Processes, Metal Systems, Operations Management issues of AM, Impact of AM on operations and Supply chain management.	**07**
2	**Need for Additive Manufacturing:** Need for time compression in product development, traditional Vs. Rapid Prototyping, applications, Related Technologies like CNC & reverse Engineering, Rapid Tooling, Design for AM and Guidelines for Process Selection.	**06**
3	**Stereo Lithography Systems & Selective Laser Sintering Fusion Deposition Modelling:** Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.	**07**
4	**Solid Ground Curing & Introduction to Concept Modelers:** Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application. Concept Modelers - Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra systems.	**08**
5	**Rapid Tooling:** Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, Direct Rapid Tooling, Direct AIM. Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.	**07**
6	**Softwares For RP:** STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools. (One case study using any of the above said techniques)	**04**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

1. Ian Gibson, David Rosen Brent Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition, Springer, 2015
2. Adedeji B. Badiru, Vhance V. Valencia, David Liu, Additive Manufacturing Handbook: Product Development for the Defense Industry, CRC Press; 1 edition, CRC Press, 2017.
3. Li Yang, Keng Hsu, Brian Baughman, Donald Godfrey, Francisco Medina, Mamballykalathil Menon, Soeren Wiener, Additive Manufacturing of Metals: The Technology, Materials, Design and Production, 1st edition, Springer, 2017.
4. Rapid Prototyping, Principles and Applications by Rafiq I. Noorani, Wiley & Sons
5. Rapid Prototyping: Principles and Applications by Chua C. K., Leong K. F. and Lim C. S., 2nd Edition, World Scientific
6. Rapid Manufacturing – An Industrialrevolution for the digital age by N. Hopkinson, R. J. M. Hauge, P. M., Dickens, Wiley
7. Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping by Ian Gibson, Wiley
8. Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography byPaul F.Jacobs, McGraw Hill
9. Rapid Manufacturing by Pham D. T. and Dimov S. S., Springer Verlog

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Micro and Nano Manufacturing</td><td colspan="3">Course Code: DJ19MEPGE204</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
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</table>

Pre-requisite: Fundamental knowledge of

1. Conventional machining processes.
2. Non-conventional machining processes.

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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.	**04**
2	**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**
3	**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**
4	**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**
5	**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	**07**
6	**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	**07**

	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	

Books Recommended:

Reference Books:

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. Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
4. V. K. Jain, Micro-manufacturing Processes, CRC Press, 2012.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Technology and Innovation Management</td><td colspan="3">Course Code: DJ19MEPGE205</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Product life cycle
2. Innovation process

Objectives:

1. To help students get insights on management of technology and innovation for attaining sustained competitive advantage.

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

1. Demonstrate understanding of concepts of Technology management
2. Explain the need for managing technology and how it is different from innovation management
3. Demonstrate firm level of perspective towards progressive management strategies.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	Why Managing technology and innovation is essential? Who is a technology management professional?	**04**
2	Understand technology and Innovation process, Definition of technology, Innovation, Management of Technology	**09**
3	Types of innovations, Types of technologies – competence enhancing vs competence destroying, Innovation process types	**10**
4	Product and Technology life cycle	**05**
5	Technology Strategy, Technology Audit, making money from innovations	**06**
6	Adoption and Diffusion	**04**

Books Recommended:

Text books:

1. L. V. K. Narayanan, Managing Technology and Innovation for Competitive Advantage, Pearson Education Asia, 2001

Reference Books:

1. Tarek Khalil, Management of Technology, McGraw Hill, 2000
2. Lowell Steele, Managing Technology, McGraw Hill, 1989

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course : Project Management</td><td colspan="3">Course Code: DJ19OMEC2021</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Objectives:

1. Identify key areas of concern over Project Life Cycle (PLC) and use of project management principles across all the phases of PLC.
2. Make them understand the importance and necessity of project plan.
3. Make them understand the importance of team and how to work as a team member, share best project management practices.

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

1. Assess a project by establishing a business case and accordingly prepare a project proposal.
2. Develop a project plan.
3. Identify task inter-dependencies, construct and analyze a network diagram
4. Monitor and control the performance of the project.
5. Demonstrate Team work and team spirit and resolve conflicts.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**An overview of Project Management:** What is project? Characteristics of project, Project Vs Operations, Project Goals, Project Life Cycle (typical & atypical), Evolution of Project Management, Need of Project Management, Different forms of Project Management, Project Environment, PMBOK.	**05**
2	**Project Initiation and Planning:** Project Feasibility, Request for Proposal (RFP), Business Case, Project selection and approval process, Project Proposal, Project Contracting. Planning steps, Project Management Process, Project Charter, Project Planning Framework, Work Breakdown Structure (WBS), Linear Responsibility Chart, Gantt Chart.	**05**
3	**Project Time Management**: Network Diagrams (AOA & AON), Critical Path, PDM network, PERT, CPM, Resource Loading, Resource Leveling, Goldratt's Critical Chain.	**08**
4	**Project Cost Management:** Cost estimating, Cost escalation, Cost estimating and system development cycle, Cost estimating process, Elements of budgets and estimates, Top down and bottom up budgeting, Project cost accounting and MIS, Budgeting using cost accounts, Cost schedules and forecasts.	**04**
5	**Project Human Resource Management:** Formal & Informal organization, project team, multidisciplinary teams, project leadership, ethics in projects, multicultural projects, Role of project manager. The nature of change, the change management plan, dealing with resistance and conflicts.	**06**
6	**Project Communication Management:** Monitoring and controlling the project, the project communications plan, project metric – Earned Value Management, data collection and reporting, reporting performance and progress, information distribution.	**04**
7	**Project Risk Management:** Basic concepts, Identification, Assessment, and Response plan.	**04**
8	**Project Procurement Management and Project Closure:** Introduction, project procurement management, outsourcing. Project implementation, administrative closure, project evaluation.	**04**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text books:

1. John M. Nicholas, Project Management for Business and Technology, 4th edition, Pearson Education.
2. Jack T. Marchewka, Information Technology Project Management, 4th edition, Wiley India, 2009.

Reference Books:

1. E-Book – A Guide to Project Management Body of Knowledge (PMBOK ® Guide), 5th edition, Project Management Institute PA, USA.
2. Claudia M. Baca, Patti M. Jansen, PMP: Project Management Professional Workbook, Sybex Publication.
3. S. J. Mantel, J. R. Meredith and et al., Project Management 7th edition, Wiley India, 2009.
4. Joel Henry, Software Project Management, A real-world guide to success, Pearson Education, 2008.
5. Gido and Clements, Successful Project Management, 2nd edition, Thomson Learning
6. Hughes and Cornell, Software Project Management, 3rd edition, Tata McGraw Hill
7. Joseph Phillips, IT Project Management, end edition, Tata McGraw Hill
8. Robert K. Wyzocki, Effective Project Management, 5th edition, Wiley
9. Brown, K. A. Project Management, McGraw Hill, 2002.
10. Dinsmore, P. C. (Ed.), The AMA Handbook of Project Management. AMACOM, 1993.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="5">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="5">Semester: II</td></tr>
<tr><td colspan="5">Course: IPR and Patenting</td><td colspan="5">Course Code: DJ19OMEC2022</td></tr>
<tr><td colspan="5">Course: --</td><td colspan="5">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
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</table>

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

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

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

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications.

Reference Books:

1. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights
2. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
3. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
4. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
5. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
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Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Remote Sensing Concepts</td><td colspan="3">Course Code: DJ19OMEC2023</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Digital Image Processing.

Objectives:

1. To The basic Objective of this course is to teach concepts of remote sensing and apply these concepts to applications such as watershed management, environmental engineering and forest management.

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

1. Comprehend the basics of remote sensing
2. Apply image processing concepts in Remote Sensing
3. Apply the concepts of remote sensing for ecological applications

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction and Basic Concepts:** Definition and Overview of Remote Sensing, Airborne and space born sensors, Passive and active remote sensing. Electromagnetic Radiation, Terms and Definitions, Laws of Radiation, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves. Physical basis of spectral signatures of the objects and Spectral Signature for Vegetation, Soil, Water and Snow.	**07**
2	**Remote Sensing Systems:** Airborne and space born sensors, Passive and active remote sensing. Spectral, radiometric and spatial resolutions, Temporal resolution of satellites. Satellites and orbits, Polar orbiting satellites, Multispectral, thermal and hyperspectral sensing, Some remote sensing satellites (LANDSAT, SPOT, IRS, IKONOS) and their features. Principles of Thermal Remote Sensing including its uses	**07**
3	**Digital Image Processing - Image Restoration:** Geometric corrections, Co-registration of Data, Ground Control Points (GCP), Image Quality & Structures; Non -sun synchronous satellites Atmospheric corrections, Solar illumination corrections.	**07**
4	**Digital Image Processing - Image Enhancement:** Concept of color, Color composites, Contrast stretching – linear and non-linear stretching Filtering techniques, Edge enhancement Density slicing, Thresholding, Intensity-Hue-Saturation (IHS) images, Time composite images, Synergetic images.	**07**
5	**Digital Image Processing - Information Extraction:** Multispectral classification, Ground truth collection- use of radiometers, and spectrophotometers, etc, Change detection analysis, Ratio images, Vegetation indices.	**07**
6	**Remote Sensing Applications:** Watershed management, Forest mapping & monitoring, Rainfall-runoff modeling, Irrigation management, Flood mapping, Drought assessment, Environmental monitoring.	**04**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Text Books:

1. 'Introduction to Remote Sensing - Principles and Concepts' by Paul J Gibson, Routledge - Taylor & Francis, 2000.
2. 'Introduction to Remote Sensing - Digital Image Processing and Applications' by Paul J Gibson and Clare H Power, Routledge - Taylor & Francis, 2000.
3. 'Remote Sensing - Principles and Interpretation', F.F. Sabins Jr, W.H. Freeman & Co., New York, 1986.
4. 'Remote Sensing - Models and Methods for Image Processing', R.A. Schowengerdt, Elsevier India Pvt. Ltd., New Delhi, 2006

Reference Books:

1. Lillesand Thomas M. & Kiefer Ralph: Remote Sensing and Image Interpretation, Third Edition
2. John Wiley. Campbell John B.: Introduction to Remote Sensing, Taylor & Francis

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
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Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
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<tr><td colspan="8">Course: Product Life Cycle Management</td><td colspan="3">Course Code: DJ19OMEC2024</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Product development process
2. Environmental science

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.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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	**06**
2	**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**
3	**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	**06**
4	**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**
5	**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	**06**
6	**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**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

<table>
<tr><td colspan="8">Program: First Year M. Tech. Mechanical Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Research Methodology</td><td colspan="3">Course Code: DJ19OMEC2025</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="3">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">--</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">3</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Pre-requisite: Knowledge of

1. Research concepts

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

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**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	**06**
2	**Types of Research:** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	**07**
3	**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	**06**
4	**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	**07**
5	**Formulating Research Problem:** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**06**
6	**Outcome of Research:** Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	**07**

Syllabus for First Year M. Tech. Program in Mechanical Engineering (Manufacturing Systems Engineering): Semester II (Autonomous)
(Academic Year 2019-2020)

Books Recommended:

Reference Books:

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.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for First Year M. Tech. Mechanical Engineering (Manufacturing Systems Engineering)
Semester III and IV (Autonomous) - Academic Year 2019-2020

<table>
<tr><td colspan="8">Program: Second Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: III</td></tr>
<tr><td colspan="8">Course: Special Topic Seminar</td><td colspan="4">Course Code: DJ19MEPGS301</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="5">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="5">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="5">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">06</td><td rowspan="2">--</td><td rowspan="2">3</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>50</td><td>--</td><td>--</td><td>--</td><td>50</td><td>100</td></tr>
</table>

Guidelines for Seminar:

1. Seminar should be based on thrust areas in Mechanical Engineering.
2. Students should do literature survey, identify the topic of seminar and finalize it with consultation of Guide/Supervisor.
3. Students should use multiple literatures (at least 10 papers from Refereed Journals/conferences) and understand the topic and research gap.
4. Students should present one paper from refereed journal as a case study.
5. Students should compile the report in standard format and present in front of Panel of Examiners.
6. It is advisable that students should publish at least one paper based on the work in reputed International/National Journal/Conference.

Syllabus for First Year M. Tech. Mechanical Engineering (Manufacturing Systems Engineering)
Semester III and IV (Autonomous) - Academic Year 2019-2020

<table>
<tr><td colspan="8">Program: Second Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: III</td></tr>
<tr><td colspan="8">Course: Dissertation I</td><td colspan="4">Course Code: DJ19MEPGD301</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">24</td><td rowspan="2">--</td><td rowspan="2">12</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>50</td><td>50</td><td>100</td></tr>
</table>

Guidelines for Dissertation I

Students should do literature survey and identify the problem for Dissertation and finalize it 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 report should be compiled strictly as per the standard report writing guidelines.

Guidelines for Assessment of Dissertation I

1. Dissertation-I should be assessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute.
2. Dissertation-I should be assessed based on the 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

Syllabus for First Year M. Tech. Mechanical Engineering (Manufacturing Systems Engineering) Semester III and IV (Autonomous) - Academic Year 2019-2020

<table>
<tr><td colspan="8">Program: Second Year M. Tech. Mechanical Engineering</td><td colspan="4">Semester: IV</td></tr>
<tr><td colspan="8">Course: Dissertation II</td><td colspan="4">Course Code: DJ19MEPGD401</td></tr>
<tr><td colspan="8">Course: --</td><td colspan="4">Course Code: --</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="3">--</td><td rowspan="3">30</td><td rowspan="3">--</td><td rowspan="3">15</td><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">200</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>100</td><td>--</td><td>--</td><td>50</td><td colspan="2">50</td><td>100</td></tr>
</table>

Guidelines for Dissertation II

Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution is to be validated with proper justification and the report should be compiled strictly as per the standard report writing guidelines. The presentation and the report should highlight the following points of the project:

- Specialization
- Research and Design
- Execution
- Experimental and Simulation results
- Conclusion and future work
- Published material

Guidelines for Assessment of Dissertation II

1. The final dissertation should be submitted for assessment only after the evaluation and approval by the Research Approval Committee (RAC) of the institute.
2. Dissertation II should be assessed through a presentation jointly by a Panel of Examiners (Pair of Internal and External examiners appointed by the Head of the Department/Institute).
3. The assessment should be based on the final presentation and the thesis.

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