

New Horizon College of Engineering										
Department of Mechanical Engineering										
Seventh semester Scheme										
SL no	Course Code	Course	Credit Distribution			Overall Credits	Contact Hours Theory	Marks		
			L	T	P			CIE	SEE	Total
1	XXMEE71	Mechanical Vibrations	2	1	0	3	4	50	50	100
2	XXMEE72	Control Engineering	2	1	0	3	4	50	50	100
3	XXMEE73	Automation Engineering	2	1	0	3	4	50	50	100
4	XXMEE74 X	Professional Elective-PE4	3	0	0	3	3	50	50	100
5	XXMEE75 X	Professional Elective-PE5	3	0	0	3	3	50	50	100
6	NHOPX	Open Electiv-OE2	3	0	0	3	3	50	50	100
7	XXMEL71	Mechanical Vibrations Lab	0	0	1	1	2	25	25	50
8	XXMEL72	Control Engineering Lab	0	0	1	1	2	25	25	50
9	XXMEL73	Automation Engineering Lab	0	0	1	1	2	25	25	50
10	XXMEE76	Main Project- Phase-I	-			2	3	25	25	50
Total						23	29	400	400	800

**** OPEN ELECTIVE SYLLABUS IS AVAILBLE IN SEPARATE BOOK**

Subject Code	Professional Elective-PE4
XXMEE741	Operation Research
XXMEE742	Production And Operational Management
XXMEE743	Research Methodology
XXMEE744	Organizational Behavior & Professional Ethics
XXMEE745	Machine Learning & Artificial Intelligence

Subject Code	Professional Elective –PE5
XXMEE751	Design For Manufacturing & Assembly
XXMEE752	Applied Numerical Techniques And Computing
XXMEE753	Total Quality Management
XXMEE754	Hydraulics And Pneumatics
XXMEE755	Rapid Prototyping

New Horizon College of Engineering**Department of Mechanical Engineering**

Eight semester Scheme

SL no	Course Code	Course	Credit Distribution			Overall Credits	Contact Hours Theory	Marks		
			L	T	P			CIE	SEE	Total
1	XXMEE81X	Professional Elective-PE6	3	0	0	3	3	50	50	100
2	XXMEE82X	Professional Elective-PE7	3	0	0	3	3	50	50	100
3	XXMEE82	Internship	-			4	3	50	50	100
4	XXMEE83	Main Project-Phase-II	-			10	3	200	200	400
Total						20	12	350	350	700

Subject Code	Professional Elective-PE6
XXMEE811	Non-Conventional Manufacturing Technologies
XXMEE812	Foundry Technology
XXMEE813	Agile Manufacturing
XXMEE814	Conventional and Non- Conventional Energy Resources
XXMEE815	Sustainable Energy Sources

Subject Code	Professional Elective-PE7
XXMEE821	Surface NDE Methods
XXMEE822	CNC machining
XXMEE823	Industrial Robotics
XXMEE824	Optimization techniques

MECHANICAL VIBRATIONS

Course code : **XXMEE71**

L:T:P : **2:1:0**

Exam hours : **3 hours**

Credits: **3**

CIE marks: **50**

SEE marks: **50**

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

XXMEE71.1	Utilize the fundamental knowledge of physics and mechanics in understanding the theory behind free & forced vibrations, frequencies, damping, degrees of freedom and vibrations measuring instruments.
XXMEE71.2	Examine and identify the methods for determining the frequencies in cases of free, forced, damped, un-damped, multiple DoF and continuous systems.
XXMEE71.3	Impart the solutions through detailed process, investigations & analysis of vibrations of machines and shafts under distinctive loading conditions and evaluation of vibration of vibration measuring instruments.
XXMEE71.4	Use adequate theory, formula, and analysis techniques to provide vibration solution for mechanical machine elements of specific functions.
XXMEE71.5	Develop feasible engineering components with thorough vibrations investigation & analysis so as to benefit the industry and environment.
XXMEE71.6	Cultivate new products with the fundamental knowledge on vibrations by latest technological advancement in design of vibrating machine parts and components.

Mapping of the course outcome to program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE71.1	3	3												
XXMEE71.2	3	3	3											
XXMEE71.3		3	3	2										
XXMEE71.4		3	3	2										2
XXMEE71.5		3		2		1	1							2
XXMEE71.6			3	2		1	1							2

Module no.	Module content	Hrs	COs
1	Introduction to vibrations: Basic concepts and definitions. Simple harmonic motions, addition by analytical and graphical methods. Types of vibrations, elements of vibrating system. Super position of waves. Beats. Representation of wave forms using Fourier series and work done by a wave (derivations and problems)	8	XXMEE71 .1 XXMEE71 .2
2	Free Vibrations: Differential equation for undamped spring mass system using Newton's, Energy and rayleigh's methods. Natural frequency of simple and compound pendulum, and spring mass system considering the mass of the spring. Determination of natural frequencies of pendulum systems and disc-suspended mass spring systems by newtons method. Types of damping systems, Differential equation for damped spring mass system with solution for under damped, critically damped and over damped systems. Log decrement. Problems on damped systems.	10	XXMEE71 .1 XXMEE71 .2

3	<p>Forced vibrations: Excitation sources, equation of motion for a forced spring mass damper system, rotating and reciprocating unbalanced system response. Absolute and relative motion. Vibrations isolations and transmissibility. Problems on forced vibrations.</p> <p>Vibrations measuring instruments: Vibrometer and accelerometer. Whirling of shafts with and without air damping. Critical speed of a shaft. Problems on a vibrometer and accelerometer. Problems on critical speed of shaft.</p>	9	<p>XXMEE71 .2 XXMEE71 .4</p>
4	<p>Multi degree freedom systems: Introduction, influence coefficients, Maxwell's reciprocal theorem, Determination of natural frequency using Rayleigh's method, Dunkerley's method, Holzer's method, Stodola method and Matrix iteration method.(spring mass systems and torsional systems)</p>	9	<p>XXMEE71 .3 XXMEE71 .4</p>
5	<p>Continuous systems: Introduction to continuous systems, vibrations of a string, longitudinal vibrations of rods, torsional vibrations of rods, Euler's equation of beams. Problems.</p> <p>Signal conditioning and monitoring techniques: Signal analysis and spectrum analyzers, band pass filter, dynamic testing of machines and structures, experimental modal analysis, machine condition monitoring techniques and diagnosis.</p>	8	<p>XXMEE71 .5 XXMEE71 .6</p>

Text books:

1. Mechanical vibrations by V. P Singh, Dhanpat Rai & Co (P) Ltd, 5th edition 2015. ISBN-978-81-7700-031-3
2. Mechanical vibrations by S. S. Rao, Peason Prentice Hall, 6th edition 2016, ISBN-10-0134361307

Reference Books:

- 1) Mechanical vibrations, S. Graham Kelly, Schaum outline series, McGraw-Hill Education, 2016, ISBN- 10: 007034041.
- 2) Mechanical vibrations by Srinath.M.K, Sanguine Technical Publishers Bangalore, 2015. ISBN-978 9383506 48-4

Assessment pattern:

1. CIE- (50 Marks Theory)

SEE – (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	
Apply	5	5	5
Analyze	5	5	5
Evaluate	5		
Create			

Bloom's Category	Tests(theory)
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	5
Create	

CONTROL ENGINEERING

Course Code :XXMEE72
L: T:P : 2:1:0
Exam Hours : 03

Credits : 03
CIE Marks : 50
SEE Marks : 50

Course Outcomes: At the end of the Course, the student will be able to:

XXMEE72.1	Apply various control systems concepts to mechanical models and identify the Control parameters for safe usage of the system.
XXMEE72.2	Analyze and categorise the transient and steady state response of mechanical control systems to interpret the practical problems
XXMEE72.3	Recoil the reduction methods and evaluate the outputs for transfer function of control systems with suitable representations and documentation
XXMEE72.4	Determine the stability conditions and represent the values using graphical methods so as to facilitate the learning process further and recommend improvements if needed
XXMEE72.5	Design and develop system with controlled parameters and compensate the system responses to maintain the optimal functionality.
XXMEE72.6	Formulate, analyze and solve the problem using MAT Lab programming.

Mapping of the course outcome to program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE72.1	1													3
XXMEE72.2		1												3
XXMEE72.3										1				3
XXMEE72.4						2	2							3
XXMEE72.5			1	1										3
XXMEE72.6					2									3

Module No	Module Contents	Hrs.	COs
1	<p>Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers- Proportional, Integral Proportional Integral, Proportional Integral Differential controllers</p> <p>Mathematical Models: Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems, pneumatic system, Analogous systems: Force voltage, Force current, basic state space representation, linearization of non-linear systems, state space canonical form, state space solution and matrix exponential, designing using state space model.</p>	09	XXMEE72 .1 XXMEE72 .2
2	<p>Transient and Steady State Response Analysis: Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.</p>	09	XXMEE72 .2

3	Block Diagrams and Signal Flow Graphs: Transfer Functions definition, function, block representation of systems elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula. MAT lab simple program for representation of block diagrams.	09	XXMEE72 .3 XXMEE72 .4
4	Frequency Response Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M&N circles. Frequency Response Analysis Using Bode Plots: Bode attenuation diagrams, Stability analysis using Bode plots (Graphical method and also MAT Lab programming), Simplified Bode Diagrams	09	XXMEE72 .5
5	Root Locus Plots: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots using graphical representation, relative stability. System Compensation: types of compensation system, design of lead and lag compensator, designing proportional controller for desired angle.	08	XXMEE72 .6

TEXT BOOKS:

1. **Control Engineering**, V.U.Bakshi&U.A.Bakshi, Technical Publications, 2014 edition, ISBN-13: 978-9350996577
2. **Control System Engineering**, I J Nagrath& M Gopal, New Age International Pvt Ltd; Sixth edition (1 January 2017), ISBN – 13: 978-9386070111

REFERENCE BOOKS:

1. **Control Engineering**, D. Ganesh Rao, Pearson Education, 2010 edition, ISBN-13: 978-8131732335
2. **MATLAB: Easy Way of Learning**, S. Swapna Kumar&S. V. B. Lenina, Prentice-Hall of India Pvt.Ltd, 2016 edition, ISBN-13: 978-8120351653
3. **MATLAB: An Introduction with Applications**, Amos Gilat, Wiley; Fourth edition (9 August 2012), ISBN-13: 978-8126537204
4. **MATLAB and Simulink for Engineers**, Agam Kumar Tyagi, Oxford; Pap/Cdr edition (24 November 2011), ISBN-13: 978-0198072447

CIE- (50 Marks Theory)

SEE –(50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	2		
Understand	3		
Apply	5		
Analyze	10	5	5
Evaluate	5	5	5
Create			

Bloom's Category	Tests(theory)
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	5
Create	5

AUTOMATION ENGINEERING

Course Code: XXMEE73

Credits: 03

L: T: P :: 2:1:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE73.1	Understand the concepts through necessary Programming of Automation, Internet of Things and Machine learning in Manufacturing.
XXMEE73.2	Identify and Apply different types of automated flow lines, storage and retrieval systems in Manufacturing.
XXMEE73.3	Interpret the concepts of embedded systems for software development in Industries
XXMEE73.4	Recognize the statistical and mathematical basics of Machine Learning algorithms.
XXMEE73.5	Apply the knowledge of Automation, Machine learning and Internet of Things in real time projects.
XXMEE73.6	Demonstrate the real time projects using Raspberry-Pi

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE73.1	3	3												3
XXMEE73.2	3		3										1	3
XXMEE73.3	3	3	3											3
XXMEE73.4	3		3	1										3
XXMEE73.5	3				1									3
XXMEE73.6	3				1	1						1		3

Ratings: 3 for high, 2 for substantial, 1 for low

Module	Contents of Module	Hrs	Cos
1	Introduction to automation-Definition, types, merits and Criticism, Manufacturing plants and operations-automation strategies, Production concepts, MLT, Mathematical Models & Costs of Manufacturing Operations, Working syntax such as G-Codes and M-Codes for CNC Programming Introduction to concepts of IoT, Overview of IoT-Enabled Manufacturing System. What is Machine Learning, Importance of Machine learning in Automation, machine learning algorithms	9	XXMEE73.1
2	Automated Flow lines, Analysis of Automated Flow Lines, Automated Guided Vehicle, Automated Storage/Retrieval Systems, Product identification system, Automated Assembly Systems, Automated Inspection Principles and Methods, Building Blocks of Automation System	9	XXMEE73.2
3	IoT-Enabled Smart Assembly station: RFID-Based Applications in Assembly line, Assistant services for Assembly Line, Architecture of IoT-Enabled Smart Assembly station , Real-Time status monitoring, Real-Time Production guiding, Real-Time Production data sharing, Real-Time Production Requeuing. Data Acquisition and Control Unit: Hardware: Introduction, Basic Modules, Functional Modules, DACU Capacity Expansion, System Cables, Integrated Assemblies, DACU Construction, Data Exchange on Bus, Summary Data Acquisition and Control Unit: Software:	9	XXMEE73.3
	Introduction, Software Structure, Application Programming, Summary		

4	Describe or summarise a set of data. Measure of central tendency and measure of dispersion. The mean, median, mode, kurtosis and skewness Standard deviation and Variance. Types of distribution. Hypothesis Testing, Basics of Hypothesis Testing, Supervised Learning- Linear Regression, Logistics Regression, Decision Tree.	9	XXMEE73.4
5	IoT and Programming enabled case studies: Smart irrigation using IoT, Weather Monitoring, System using Raspberry Pi , Weather update system with IoT, Home Automation using IoT, Automated Street light using IoT, Smart water monitoring, Facial recognition door	8	XXMEE73.5 XXMEE73.6

Reference Books:

1. Machine Learning, Tom M Mitchel, McGraw Hill Education, July 2017, ISBN: 978-1-25-9096952.
2. Business Analytics, U Dinesh Kumar, Wiley India Pvt Ltd, 2017, ISBN:978-81-265-6877-2.
3. Optimization of Manufacturing systems using Internet of Things, Yingfeng Zhang, Fei Tao, First Edition, 2016, Elsevier, ISBN: 9780128099100
4. Overview of Industrial Process Automation, KLS Sharma, 2016, Elsevier, ISBN: 9780128053546
5. Machine Learning, An Algorithmic Perspective, Stephen Marsland, Chapman and Hall, Nov 2014, ISBN: 978-1466583283.
6. Data Science and Analytics, V. K. Jain, Khanna Publishing, 2018, ISBN-10: 9789386173676
7. "Automation, Production Systems and Computer Integrated Manufacturing"- M.P.Grover, Pearson Education, 4th Edition, 2016, ISBN: 978-9332572492
8. "Computer Based Industrial Control" – Krishna Kant, EEE-PHI, 2nd edition, 2011, ISBN: 978-8120339880
9. Principles and Applications of PLC – Webb John, Mcmillan, 2006, ISBN- 9780024249708
10. Sensor Technology Handbook , Jon S. Wilson, Newnes, 2004

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Taxonomy	Test 25	Assignment 15	Quiz 10
Remember	5		
Understand	5	5	
Apply	5	5	5
Analyze	5	5	5
Evaluate	5		
Create			

SEE – Semester End Examination for theory (50 Marks)

Bloom's Taxonomy	SEE Marks
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5

OPERATIONS RESEARCH

Course Code : XXMEE741
L: T: P : 3:0:0
Exam Hours : 03

Credits : 03
CIE Marks : 50
SEE Marks : 50

Course Outcomes: At the end of the Course, the student will be able to:

XXMEE741.1	Apply mathematical formulations for solving linear part programming problems
XXMEE741.2	Evaluate for optimization using Simplex method, dual simplex method and Big M method
XXMEE741.3	Apply the transportation algorithm and assignment algorithm for real life problems
XXMEE741.4	Analyze and determine the optimal solutions by PERT and CPM
XXMEE741.5	Understand the significance of Game theory and determine the optimal solution
XXMEE741.6	Analyze the sequence of jobs on various machines

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE741.1	3	3	3	3							3	3		3
XXMEE741.2	3	3	3	3							3	3		3
XXMEE741.3	3	3	3	3							3	3		3
XXMEE741.4	3	3	3	3							3	3		3
XXMEE741.5	3	3	3	3							3	3		3
XXMEE741.6	3	3	3	3							3	3		3

Module No	Module Contents	Hrs.	COs
1	INTRODUCTION: Linear programming, Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR, computer software for OR, Mathematical formulation of Linear Programming Problems. Graphical solution methods	08	XXMEE741.1 XXMEE741.2
2	LINEAR PROGRAMMING PROBLEMS: The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method, degeneracy and procedure for resolving degenerate cases	09	XXMEE741.2
3	TRANSPORTATION PROBLEM: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, prohibited route, maximization problems, Applications of Transportation problems ASSIGNMENT PROBLEM: Formulation, Hungarian method, maximization problem, restrictions on assignments unbalanced	09	XXMEE741.2 XXMEE741.3

	assignment problem, Travelling salesman problem		
4	PERT-CPM TECHNIQUES: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks, time-cost trade off procedure	09	XXMEE741.4
5	SEQUENCING: Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule- 'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method GAME THEORY: Formulation of games, Two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property	09	XXMEE741.5 XXMEE741.6

TEXT BOOKS:

1. **Operations Research: An Introduction**, H A Taha, Pearson; 10th edition (17 January 2017), ISBN-13: 978-1292165547
2. **Operation Research**, S D Sharma, KedarNathRamNath publication, 2014 edition, ISBN-13: 1234567142552

REFERENCE BOOKS:

1. **Introduction to Operation Research**, Frederick S. Hillier, Gerald J. Lieberman, McGraw-Hill Education; 10th edition (1 June 2014), ISBN-13: 978-1259253188.
2. **Operation Research**, Gupta Prem Kumar, Hira D.S, S Chand; Revised edition (1 November 2014), ISBN-13: 978-8121902816.

Assessment pattern:

1. **CIE- (50 Marks Theory)**

SEE – (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	2		
Understand	3		
Apply	8	5	5
Analyze	8	5	5
Evaluate	4		
Create		5	

Bloom's Category	Tests(theory)
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	5
Create	5

PRODUCTION AND OPERATIONS MANAGEMENT

Course Code : XXMEE742

Credits: 03

L: T: P : 3:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

XXMEE742.1	Discuss the prominence role played by operations managers in Industries/Corporate and their decision making
XXMEE742.2	Forecasting and its importance in accuracy & health of the business organization
XXMEE742.3	Planning the various stages, departments of business organization & managing inventory
XXMEE742.4	Analysis of operation processes from various perspectives such as efficiency, responsiveness, quality and productivity.
XXMEE742.5	Managing the various stages of Supply chain in a business organization & maintain the things & operations
XXMEE742.6	Managing the various business concepts and functions in an integrated manner.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE742.1	3									3	3			
XXMEE742.2	3	2									3			
XXMEE742.3	3									3	3			3
XXMEE742.4		2							2					3
XXMEE742.5	3									3	3			3
XXMEE742.6											3			3

Module No	Contents	Hr's	CO's
1	Introduction to Production and Operations Management- Functions within business organizations, the operation management function, Productivity, factors affecting productivity, Decision Making: The decision process, characteristics of operations decisions, economic models- break even analysis, decision tree analysis-numerical.	09	XXMEE742.1 XXMEE742.4
2	Forecasting: Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a forecasting technique, elements of a good forecast, Capacity Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives.	09	XXMEE742.2, XXMEE742.3
3	Aggregate Planning: Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques. Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP	09	XXMEE742.3 XXMEE742.6

	– MRP inputs and outputs, MRP processing, numerical, an overview of MRP-II benefits and limitations of MRP.		
4	Inventory Management: Types of Inventories, independent and dependent demand, reasons for holding inventory, objectives of inventory control, requirements for effective inventory management – information, cost, priority system. Inventory control and economic-order-quantity models.	08	XXMEE742.3, XXMEE742.4
5	Maintenance Management: Maintenance Management: Definition of Maintenance Management, Need for Maintenance, Objectives of Maintenance Management, Types of Maintenance Systems, Activities in Maintenance Management. Supply Chain Management (SCM): Introduction, Importance of purchasing and SCM, The procurement process, Concept of tenders, Vendor development, Measures of purchasing and SCM, Make or buy decision, Types of buying, E-procurement.	09	XXMEE742.4 XXMEE742.5

TEXT BOOKS:

- Operations Management**, K R Phaneesh, 6th Edition, Sudhapublications-2014, ISBN- 978-8120329287
- Operations Management**, R K Hegde, 6th Edition, Sapna Publictions-2014, ISBN- 978-8128004360
- Operations Management-Theory and Practice**, B Mahadevan, Pearson Education, 3rd Edition-2017, ASIN: B074RBDGKC

REFERENCE BOOKS:

- Operations Management**, Heizer, Pearson Publication, 11th Edition, 2015, 978-9332586703
- Operations Management for Competitive Advantage**, R.B.Chase, N.J.Aquilino, F. Roberts Jacob; McGraw Hill Companies Inc., 11th Edition-2014, ISBN-978-0070604483
- Production and Operations Management**, William J Stevenson, 10th Ed-2013, Tata McGraw Hill. ISBN- 978-0070091771

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

RESEARCH METHODOLOGY

Course Code: XXMEE743

L: T: P: 3:0:0

Exam Hours: 03

Credits: 03

CIE Marks: 50

SEE Marks: 50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE743.1	Define the significance and suitability of research for various engineering applications
XXMEE743.2	Demonstrate the various processing techniques of research
XXMEE743.3	Apply the research in the development of engineering materials/process
XXMEE743.4	Analyze the properties/process of research through various techniques
XXMEE743.5	Evaluate the influence of design, analysis and testing of research
XXMEE743.6	Develop the art of scholarly writing and evaluate its quality

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE743.1	3													3
XXMEE743.2	3													3
XXMEE743.3	3													3
XXMEE743.4	3	3												3
XXMEE743.5	3	3												3
XXMEE743.6	3		1											3

Ratings: 3 for high, 2 for substantial, 1 for low

Module No	Contents of Module	Hrs	Cos
1	<p>Introduction: Objectives of research, limitations in research, qualities of good research worker, criteria of good research, limitations of research.</p> <p>Types of research and approaches: fundamental, pure or theoretical research, applied research, descriptive research, evaluation research, experimental research, historical research.</p> <p>Literature review: Purpose of review of literature, literature research procedure, sources of literature, importance of review of literature.</p>	9	XXMEE743.1 XXMEE743.2
2	<p>Research Design: Concept and Importance in Research – Features of a good research design, Exploratory Research Design, concept, types and uses, Descriptive Research Designs, concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.</p> <p>Qualitative and Quantitative Research: Qualitative research, Quantitative research, Concept of measurement, causality, generalization, and replication. Merging the two approaches.</p>	8	XXMEE743.3

3	Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.	9	XXMEE743.4
4	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	9	XXMEE743.4 XXMEE743.5
5	Interpretation of Data and paper Writing – layout of a research paper, Journals in Computer Science, Impact factor of Journals, When and Where to publish, Ethical issues related to publishing, plagiarism and Self-Plagiarism References: Encyclopedias, Research Guides, Handbook etc.	9	XXMEE743.5 XXMEE743.6

Text Books:

1. **Kothari, C.R.**, 2018. Research Methodology: Methods and Techniques. New Age International. ISBN-13: 978-8122436235
2. **Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K.**, 2015, An introduction to Research Methodology, RBSA Publishers. ISBN-13: 978-8176111652
3. **Ranjithkumar**, 2014, research methodology, saga publications, 4th edition ISBN-13-978-9351501336

Reference Books:

1. **Anderson, T. W.**, 2011, An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi. ISBN-13: 978-8126524488
2. **Montgomery, Douglas C. & Runger, George C.** (2016) 6/e, Applied Statistics & probability for Engineers (Wiley India) ISBN-13: 978-1118539712
3. **Montgomery, Douglas C.** (2012) 8th edition, Design and Analysis of Experiments (Wiley India) ISBN: 978-1-118-14692-7
4. **Sinha, S.C. and Dhiman, A.K.**, 2012. Research Methodology, EssEss Publications. 2 volumes. ISBN : 81-7000-324-5, 81-7000-334-2

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

ORGANIZATIONAL BEHAVIOUR AND PROFESSIONAL ETHICS

Course Code	: XXMEE744
L: T: P	: 3:0:0

Credits: 03
CIE Mark:50

Exams Hours : 03	SEE Marks: 50
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COURSE OUTCOMES: At the end of the course, the students will be able to:

XXMEE744.1	Understand the importance of organizational behavior, behavior models, personality types, emotions, attitudes and motivation.
XXMEE744.2	Remember the importance of group behaviour and apply the principles for team building.
XXMEE744.3	Apply the concept of leadership, the power of managers and apply for stress management and balancing life and work.
XXMEE744.4	Analyze the human values and practice of ethics in the workplace and apply engineering to social experimentation.
XXMEE744.5	Apply ethics in society, safety, discuss the ethical issues related to engineering
XXMEE744.6	Analyze the responsibilities and rights in the society and understand global issues.

Mapping of Course outcomes to Program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
XXMEE744.1						2	2	2	2	2		2
XXMEE744.2						2	2	2	2	2		2
XXMEE744.3						2	2	2	2	2		2
XXMEE744.4						2	2	2	2	2		2
XXMEE744.5						2	2	2	2	2		2
XXMEE744.6						2	2	2	2	2		2

Module No	Contents of Module	Hrs	Cos
1	FOCUS AND PURPOSE, INDIVIDUAL BEHAVIOUR: Definition, need and importance of organizational behaviour Nature and scope Frame work Organizational behaviour models. Personality types Factors influencing personality Theories Learning Types of learners The learning process Learning theories Organizational behaviour modification. Misbehavior Types Management Intervention. Emotions Emotional Labour Emotional Intelligence Theories. Attitudes Characteristics Components Formation Measurement Values. Perceptions ImportanceFactors influencing perception Interpersonal perception Impression Management. Motivation Importance Types Effects on work behavior.	9	XXMEE744.1
2	GROUP BEHAVIOUR: Organization structure Formation Groups in organizations Influence Group dynamics Emergence of informal leaders and working norms Group decision making techniques	8	XXMEE744.2

	Teambuilding Interpersonal relations Communication Control.		
3	<p>LEADERSHIP AND POWER, DYNAMICS OF ORGANIZATIONAL BEHAVIOUR: Meaning Importance Leadership styles Theories Leaders Vs Managers Sources of power Power centers Power and Politics. Organizational culture and climate Factors affecting organizational climate Importance. Job satisfaction Determinants Measurements Influence on behavior. Organizational change Importance Stability Vs Change Proactive Vs Reaction change the change process Resistance to change Managing change. Stress Work Stressors Prevention and Management of stress Balancing work and Life. Organizational development Characteristics objectives Organizational effectiveness Developing Gender sensitive workplace.</p>	9	XXMEE744.3
4	<p>HUMAN VALUES, ENGINEERING ETHICS, ENGINEERING AS SOCIAL EXPERIMENTATION : Morals, values and Ethics Integrity Work ethic Service learning Civic virtue Respect for others Living peacefully Caring Sharing Honesty Courage Valuing time Cooperation Commitment Empathy Self-confidence Character Spirituality Introduction to Yoga and meditation for professional excellence and stress management. Senses of 'Engineering Ethics' Variety of moral issues Types of inquiry Moral dilemmas Moral Autonomy Kohlberg's theory Gilligan's theory Consensus and Controversy Models of professional roles Theories about right action Self-interest Customs and Religion Uses of Ethical Theories. Engineering as Experimentation Engineers as responsible Experimenters Codes of Ethics A Balanced Outlook on Law.</p>	9	XXMEE744.4
5	<p>SAFETY, RESPONSIBILITIES AND RIGHTS, GLOBAL ISSUES : Safety and Risk Assessment of Safety and Risk Risk Benefit Analysis and Reducing Risk Respect for Authority Collective Bargaining Confidentiality Conflicts of Interest Occupational Crime Professional Rights Employee Rights Intellectual Property Rights (IPR) Discrimination. Multinational Corporations Environmental Ethics Computer Ethics Weapons Development Engineers as Managers Consulting Engineers Engineers as Expert Witnesses and Advisors Moral Leadership Code of Conduct Corporate Social Responsibility.</p>	9	XXMEE744.5 XXMEE744.6

TEXT BOOKS

1. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 15th edition, 2015.
2. Fred Luthans, Organisational Behavior, McGraw Hill, 12th Edition, 2016.
3. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 4TH EDITION, 2014.

REFERENCES

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, 4TH Edition New Jersey, 2017
2. Ivancevich, Konopaske&Maheson, Organisational Behaviour & Management, 7th edition, Tata McGraw Hill, 2014.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2013
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 7th Edition 2013
5. Udai Pareek, Understanding Organisational Behaviour, 2nd Edition, Oxford Higher Education, 2011.

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

Course Code: XXMEE745

L: T: P: 3:0:0

Credits : 03

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE745.1	Recognize the origin and practical applications of machine learning
XXMEE745.2	Identify the applications suitable for different types of machine learning algorithms with appropriate justification
XXMEE745.3	Understand the types of Machine Learning algorithms.
XXMEE745.4	Use and manipulate several core data structures: Lists, Dictionaries, Tuples, and Strings
XXMEE745.5	Understand the significance of artificial intelligence and expert systems in real time environment
XXMEE745.6	Understand the features of neural network and its applications

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE745.1	3													
XXMEE745.2	3	3		3										
XXMEE745.3			1	3										
XXMEE745.4	3				1									
XXMEE745.5		3		3										
XXMEE745.6		3												

Module No	Contents of Module	Hrs	Cos
1	Introduction to Machine Learning: What is Machine Learning? When do we need machine learning? Types of learning, The origins of machine learning, Uses and abuses of machine learning, Ethical considerations, How do machines learn? Abstraction and knowledge representation, Generalization, Assessing the success of learning, Steps to apply machine learning to data, Choosing a machine learning algorithm, the input data, types of machine learning algorithms, Matching data to an appropriate algorithm, Machine Learning Models, Applications of Machine Learning.	9	XXMEE745.1 XXMEE745.2
2	Machine Learning Algorithms: Back Propagation Algorithms, Decision Tree, Bayesian Method - Naïve Bayes Classification, Instance Based Learning – K Nearest Neighbor. Regression - Linear Regression, Logistic Regression, Clustering	9	XXMEE745.2 XXMEE745.3
3	Python Programming: Python Basics: Data Types, Operators, Input/output Statements, Creating Python Programs. Python Flow Control statements Decision making statements, Indentation, Conditionals, loops, break, continue, pass statements Strings	9	XXMEE745.4
4	Introduction to AI: What is AI? Intelligent agents – Agents and Environments, the concept of rationality, the nature of environments, and structure of agents Problem-Solving by Searching: Problem Solving agents – Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic	9	XXMEE745.5

	functions.		
5	Neural Networks(Introduction & Architecture) Auto-associative and hetro-associative memory Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule	9	XXMEE745. 5 XXMEE745. 6

Text Books:

1. Machine Learning, Tom M Mitchel, McGraw Hill Education, July 2017, ISBN: 978-1-25-9096952.
2. Artificial Intelligence - A Modern Approach, Stuart Russell, Pearson Education / PHI, 3rd Edition, 2015, ISBN: 978-9332543515.

Reference Books:

1. Introduction to Machine Learning with Python, Andreas Muller, Shroff/O'Reilly,2016, ISBN: 978-9352134571.
2. Machine Learning, An Algorithmic Perspective, Stephen Marsland, Chapman and Hall, Nov 2014, ISBN: 978-1466583283.
3. Neural Networks – A classroom Approach, Satish Kumar, McGraw Hill Education, 2nd Edition, July 2017, ISBN: 978-1259036166.

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

DESIGN FOR MANUFACTURING & ASSEMBLY

Sub Code : XXMEE751

Credits 03

L: T: P : 3:0:0

CIE Marks 50

Exam Hours : 03

SEE Marks 50

COURSE OUTCOMES: at the end of the course, the students will be able to

XXMEE751.1	Select appropriate manufacturing process to match design tolerances and analyze tolerance by various methods
XXMEE751.2	Assemble the components manufactured by the methods of group tolerance
XXMEE751.3	Development of design for Machinability, accessibility, clampability and assembly requirements
XXMEE751.4	Designing the component to be casted as per feasibility in casting and application of modern computer tools for group technology
XXMEE751.5	Designing the gauges useful in gauging components to be assembled
XXMEE751.6	Identification & modification of the uneconomical design of casting to save the manufacturing cost

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE751.1	3	3											3	
XXMEE751.2	3	3											3	
XXMEE751.3			3											3
XXMEE751.4			3		1									3
XXMEE751.5			3											3
XXMEE751.6	3										1			3

Module No	Contents of Module	Hrs	Cos
1	TOLERANCE ANALYSIS: Introduction Concepts, definitions and relationships of tolerance Matching design tolerances with appropriate manufacturing process manufacturing process capability metrics Worst case, statistical tolerance Analysis Linear and Non-Linear AnalysisSensitivity Analysis Taguchi's Approach to tolerance design.	10	XXMEE7 51.1
2	SELECTIVE ASSEMBLY AND DATUM FEATURES: Selective assembly: Interchangeable part manufacture and selective assembly, Deciding the number of groups -Model-1: Group tolerance of mating parts equal, Model total and group tolerances of shaft equal. Control of axial play-Introducing secondary machining operations, laminated shims, examples Datum features: Functional datum, Datum for manufacturing, changing the datum, examples.	10	XXMEE7 51.2
3	COMPONENT DESIGN -MACHINING CONSIDERATION: Design features to facilitate machining drills milling cutters keyways - Doweling procedures, counter sunk screws - Reduction of machined area-simplification by separation simplification by amalgamation - Design for machinability Design for economy - Design for clampability Design for accessibility Design for assembly.	10	XXMEE7 51.3
4	COMPONENT DESIGN – CASTING CONSIDERATION: Redesign of castings based on parting line considerations Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design group technology Computer Applications for DFMA	08	XXMEE75 1.4 XXMEE75 1.6

5	DESIGN OF GAUGES: Designs of gauges for checking components in assemble with emphasis on various types of limit gauges for both hole and shaft.	06	XXMEE751.5
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Text Books:

1. **Harry Peck**, "Designing for Manufacturing", Pitman Publications, 2017, ISBN-13: 978-0273000075
2. **A K Chitale, RC Gupta**, "Product Design and Manufacturing", PHI, 2014, ISBN-13: 978-8120348738

Reference Books:

1. **ASM Hand book**, "Material selection and Design", Vol. 20, 2012, ISBN-13: 978-0871703866
2. **C.M. Creveling**, "Tolerance Design – A handbook for Developing Optimal Specifications", Addison – Wesley, 2013, ISBN-13: 978-0133052343
3. **James G. Bralla**, "Handbook of Product Design for Manufacturing", McGraw Hill, 2014, ISBN-13: 978-0070071308
4. **Kevien Otto and Kristin Wood**, "Product Design", Pearson Publication, 2012, ISBN-13: 978-8177588217

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

APPLIED NUMERICAL TECHNIQUES AND COMPUTING

Course Code : XXMEE752
L: T: P : 3:0:0

Credits: 03
CIE Mar: 50

Exams Hours : 03

SEEMark: 50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE752.1	Understand the consequences of finite precision and the inherent limits of the numerical methods considered.
XXMEE752.2	Demonstrate the mathematics concepts underlying the numerical methods considered.
XXMEE752.3	Apply these methods to academic and simple practical instances
XXMEE752.4	Show the knowledge of mathematics and computing to the design and analysis of optimization methods
XXMEE752.5	Analyze a problem and identify the computing requirements appropriate for its solution
XXMEE752.6	Design and conduct experiments and numerical tests of optimization methods, and to analyze and interpret their results.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE752.1	3	3												
XXMEE752.2	3	3												3
XXMEE752.3	3	3		3										3
XXMEE752.4			3	3										3
XXMEE752.5		3	3	3										3
XXMEE752.6		3	3	3										3

Module No	Contents of Module	Hrs	Cos
1	ERRORS IN NUMERICAL CALCULATIONS: Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula. INTERPOLATION AND CURVE FITTING: Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, Least squares line, curve fitting, Interpolation by spline functions.	9	XXMEE752.1 XXMEE752.3 XXMEE752.6
2	NUMERICAL DIFFERENTIATION AND INTEGRATION: Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cotes formula, Gauss Quadrature. SOLUTION OF NONLINEAR EQUATIONS: Bracketing methods for locating a root, Initial approximations and convergence criteria, Newton-Raphson and Secant methods, Solution of problems through a structural programming language	9	XXMEE752.2 XXMEE752.6
3	SOLUTION OF LINEAR SYSTEMS: Direct Methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization,	9	XXMEE752.2 XXMEE752.5

	Iterative methods for linear systems, Solution of problems through a structured programming language. EIGEN VALUE PROBLEMS: Jacobi, Given's and Householder's methods for symmetric matrices, Rutishauser method for general matrices, Power and inverse power methods.		XXMEE752.6
4	SOLUTION OF DIFFERENTIAL EQUATIONS: Introduction to differential equations, Initial value problems, Euler's methods, Heun's method, Runge-Kutta methods, Taylor series method, Predictor-Corrector methods, Systems of differential equations, Boundary value problems, Finite-difference method, Solution of problems through a structured programming language	8	XXMEE752.4 XXMEE752.6
5	PARTIAL DIFFERENTIAL EQUATIONS, EIGENVALUES AND EIGENVECTORS: Solution of hyperbolic, parabolic and elliptic equations, The eigenvalue problem, The power method and the Jacobi's method for eigen value problems, Solution of problems through a structural programming language	9	XXMEE752.4 XXMEE752.6

Text Books :

1. Numerical Methods for Mathematics, Science and Engineering by John H. Mathews, PHI New Delhi, 2015, ISBN-13-978-0130652485
2. Applied Numerical Methods – Carnahan, B.H., Luther, H.A. and Wilkes, J.O., Pub.- J. Wiley, New York, ISBN-13-978-0471135074
3. Numerical Methods for Engineers; Steven C. Chapra and Raymond P. Canale, 7th edition, McGraw-Hill, 2017, ISBN-9789356202131

Reference Books :

1. Introduction to Numerical Analysis, S.S. Sastry; Prentice Hall of India, 2015. ISBN-978-81-203-4592-8
2. Numerical Methods for Engineers, Santhosh .K. Gupta, New Age International; 2015. ISBN-978-81-224-3359-3
3. Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York. ISBN-978-0852264324
4. Introduction to numerical analysis, J S TOER and R BULIRSCH, springer 2016, ISBN-13-978-1441930064

Assessment pattern:

Assessment pattern:

1. CIE- (50 Marks Theory)

SEE – (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

TOTAL QUALITY MANAGEMENT

SubCode :XXMEE753

L:T:P : 3:0:0

ExamHours :03

Credits: 03

CIEMarks: 50

SEE Marks: 50

Course Outcomes: At the end of the Course, the Student will be able to do the following:

XXMEE753.1	Understand the concepts of quality for business.
XXMEE753.2	Evaluate process capabilities & customer focus
XXMEE753.3	Analyze the system approach & organization behaviour
XXMEE753.4	Remember& implement the TQM qualities for leadership qualities
XXMEE753.5	Apply the principles of Kaizen & error proofing
XXMEE753.6	Understand and implement six sigma concepts

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE753.1	3													
XXMEE753.2	3	3												
XXMEE753.3	3	3	3											
XXMEE753.4	3	3	3											
XXMEE753.5	3	3	3							2				
XXMEE753.6	3	3	3							2				

SYLLABUS

Module No	Contents of the Module	Hou rs	COs
1	Introduction: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.	9	MEE75 3.1 MEE75 3.2
2	Customer Focus and Satisfaction: Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer — Supplier relationships. Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.	9	MEE75 3.2 MEE75 3.3
3	Organizing for TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Startification, check sheet, Scatter diagram, Ishikawa diagram, paneto diagram, Kepner&Tregoe Methodology.	9	MEE75 3.4

4	TQM PRINCIPLES: Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating, Seven new management tools. Bench marking and POKA YOKE	9	MEE75 3.5
5	Statistical process control and process capability Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability	8	MEE75 3.6

TEXT BOOKS

1. Dale H. Besterfield et al, Total Quality Management, 4th edition, Pearson Education, 2015, ISBN-978-9332534452
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, 2010, ISBN-978-8178662527

REFERENCE BOOKS:

1. ClydeBank Business, Lean Six Sigma, ClydeBank Media LLC; 1 edition, 2014, ASIN: B00ND9OMXG

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

HYDRAULICS AND PNEUMATICS

Course Code: XXMEE754

Credits: 03

L:T:P : 3:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks:50

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

XXMEE754.1	Understand various hydraulic power concepts to mechanical models and identify the Pump parameters for safe usage of the system.
XXMEE754.2	Analyze and categorise the prime movers and using symbolic representations of mechanical systems to interpret the practical problems
XXMEE754.3	Recoil the hydraulics and pneumatic systems to evaluate the outputs for control valves with suitable representations.
XXMEE754.4	Determine the control stability conditions and represent using hydraulic circuits so as to facilitate the implementation process of hydraulic systems
XXMEE754.5	Design and develop system with controlled parameters to maintain the optimal functionality by selection of proper fluids, seals and maintenance system
XXMEE754.6	Formulate, analyze and solve the problem identifying support systems and circuit designs.

Mapping of course outcomes to program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE754.1	1												2	
XXMEE754.2		1											2	
XXMEE754.3										1			2	
XXMEE754.4						1	1						2	
XXMEE754.5			1	1									2	
XXMEE754.6					2								2	

Course syllabus

Module No	Contents	Hrs	Cos
1	<p>Overview to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.</p> <p>The source of Hydraulic Power: Pumps Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, combination pumps, Pump performance characteristics, pump Selection factors, problems on pumps.</p>	9	XXMEE754.1

2	<p>Hydraulic Prime Movers: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators, single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators/problems on cylinders, Installation and mounting of hydraulic cylinders</p>	8	XXMEE75 4.2
3	<p>Outline to Hydraulic & Pneumatic Control: Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated type Load control valves, Special purpose control valves – Exhaust Mufflers</p> <p>Pneumatic Control: Types and construction, use of memory valve, Quick exhaust valve, time delay valve, twin pressure valve, symbols. Structure of Pneumatic Control System, fluid conditioners and FRL unit</p>	9	XXMEE754. 3 XXMEE754. 4
4	<p>Hydraulic Circuit Design And Analysis: Control of Single and Double - Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors-Bleed-off control, Safety circuit, Accumulators, types, construction.</p>	9	XXMEE754. 4 XXMEE754. 5
5	<p>Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Seals & Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting. Maintenance and performance monitoring of hydraulic systems.</p> <p>Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, mounting arrangements- Applications. Rod - Less cylinder's types,</p>	9	XXMEE75 4.6

TEXT BOOKS:

1. **"Fluid Power with Applications"** Anthony Esposito, Seventh edition, Pearson New International Edition, 7th edition 2013, ISBN-13: 9781292023878
2. **'Hydraulics and Pneumatics, A Technician's and Engineer's Guide**, Andrew Parr, 3rd Edition 2011, Butterworth-Heinemann 2011 publication, ISBN: 9780080966748

REFERENCE BOOKS:

1. **'Oil Hydraulic systems', Principles and Maintenance** S. R. Majumdar, Tata McGraw Hill Publishing Company Ltd. – 2001, ISBN-13: 978-0074637487
2. **Principles of Hydraulic Systems Design**, Peter Chapple, 2nd Edition ((Dec 31 2014), Momentum Press publishing, ISBN: 9781606504529
3. **Fluid Power: Hydraulics and Pneumatics**, James R Daines 2nd Edition (Aug 30, 2012), Goodheart-willcox Publication, ISBN: 9781605259369
4. **'Pneumatic Systems'**, S. R. Majumdar, McGraw-Hill Professional; 2004 Publication, ISBN 13: 9780074602317
5. **'Industrial Hydraulic Systems: Theory and Practice**, Joji Parambath, Universal-Publishers (06-Apr-2016), ISBN-13: 978-1627341752,
6. **Hydraulics and Pneumatics, 1/e** Jagadeesha T, I K International publishers (2015), ISBN-13: 9789384588908

Assessment pattern:**1. CIE- (50 Marks Theory)**

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	
Apply	5	5	5
Analyze	5	5	5
Evaluate	5		
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	7
Understand	8
Apply	15
Analyze	15
Evaluate	5
Create	

RAPID PROTOTYPING

Course Code : XXMEE755
L: T: P : 3:0:0
Exams Hours : 03

Credits: 03
CIE Marks: 50
SEE Marks: 50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE755.1	Apply the knowledge of physics and material science in understanding the working principle of additive manufacturing.
XXMEE755.2	Analyze the limitations and advantage of each additive manufacturing technique.
XXMEE755.3	Test the quality of the products built through additive manufacturing technique in soft tooling and hard tooling applications.
XXMEE755.4	Synthesize the information of process parameters with adequate optimization techniques using Internet based software.
XXMEE755.5	Demonstrate the knowledge of additive manufacturing in the application at Medical and product development Industries by executing the projects.
XXMEE755.6	Understand the nature of errors in software and to rectify the same with the knowledge of latest software in terms of software and hardware integration.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE755.1	3												3	
XXMEE755.2	3	2											3	
XXMEE755.3	3	2											3	
XXMEE755.4	3				1								3	
XXMEE755.5	3		1										3	
XXMEE755.6	3				1								3	

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Contents of Module	Hrs	Co's
1	Introduction: Need for the compression in product development, history of RP systems, Survey of applications, 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.	9	XXMEE755.1 XXMEE755.2 XXMEE755.3
2	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.	9	XXMEE755.1 XXMEE755.2 XXMEE755.3
3	Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	9	XXMEE755.1 XXMEE755.2 XXMEE755.3
4	Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems. Rapid Tooling: Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q kelttool, etc. Direct Rapid Tooling Direct. AIM.	9	XXMEE755.3 XXMEE755.4 XXMEE755.6

5	Rapid Tooling: Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. Hard tooling. Software For RP: STL files, Overview of Solid view, magics, imics, magic. Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. communicator, etc. Internet based software, Collaboration tools.	8	XXMEE755.4 XXMEE755.5 XXMEE755.6
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Text Book

1. Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, by Frank W Liou, 2016, ISBN-13: 978-0849334092
2. Rapid Manufacturing, Flham D.T & Dinjoy S.S Verlog London 2015.
ISBN 978-1-4471-0703-3
- 3 . Stereo Lithography and other RP & M Technologies, Paul F. Jacobs: SME, NY 2009.
ISBN-10: 087263467

REFERENCE BOOKS:

1. Rapid prototyping and allied manufacturing techniques, by M S Ganesha Prasad and Nagendra, 2016, ISBN-13: 978-9384893408
2. Rapid Prototyping, Terry Wohlers Wohler's Report 2000" Wohler's Association 2014.

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5		
Apply	15	5	
Analyze		5	10
Evaluate		5	
Create			

2. SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	7
Understand	8
Apply	15
Analyze	15
Evaluate	5
Create	

MECHANICAL VIBRATIONS LAB

Course Code : XXMEL71
 L: T:P : 0:0:1
 Exams Hours : 03

Credits: 01
 CIE Marks: 25
 SEE Marks: 25

XXMEL71.1	Utilize the basic knowledge of physics and mechanics in understanding the working process behind free & forced vibrations, frequencies, damping, degrees of freedom and vibrations measuring instruments.
XXMEL71.2	Experimentally Examine and identify the methods of determining the frequencies in cases of free, forced, damped, un-damped, multiple DOF and continuous systems
XXMEL71.3	Impart the solutions through detailed experimental investigation & analysis of vibrations of machines and shafts under different loading conditions and evaluation of vibration of vibration measuring instruments.
XXMEL71.4	Use adequate theory, formula, software, and analysis techniques to provide vibration solution for mechanical machine elements of specific application.
XXMEL71.5	Develop feasible engineering products with thorough experimental vibrations investigation & mathematical analysis so as to benefit the industry and environment.
XXMEL71.6	Cultivate and evaluate new products with the fundamental knowledge on vibrations by latest technological advancement in design of vibrating machine parts and components.

Mapping of CO v/s PO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEL71.1	3	3	3	3									3	
XXMEL71.2	3	3	3	3									3	
XXMEL71.3	3	3	3	3									3	
XXMEL71.4	3	3	3		3								3	
XXMEL71.5	3	3	3		3								3	
XXMEL71.6	3	3	3		3								3	

Course syllabus

Experiment #	Contents of Laboratory	Hrs	COs
1.	Natural frequency of Simple pendulum	3	XXMEL71.1
2.	Natural frequency of compound pendulum	3	XXMEL71.1
3.	Natural frequency of spring mass system	3	XXMEL71.2
4.	Natural frequency of torsional system	3	XXMEL71.2
5.	Natural frequency for rigid body-spring system	3	XXMEL71.2
6.	Whirling of shafts and critical speed	3	XXMEL71.3
7.	Natural frequency and mode shapes of longitudinal vibrations of rod.	3	XXMEL71.3
8.	Natural frequency and mode shapes of torsional vibrations of rod.	3	XXMEL71.3
9.	lution to natural frequency of Simple pendulum using MATLAB	3	XXMEL71.4
10.	Solution to Natural frequency of compound pendulum using MATLAB	3	XXMEL71.4

11.	Solution to Natural frequency of spring mass system using MATLAB	3	XXMEL71.4
12.	Solution to Natural frequency of torsional system using MATLAB	3	XXMEL71.5
13.	Solution to Natural frequency for rigid body-spring system using MATLAB	3	XXMEL71.5
14.	Solution to Whirling of shafts and critical speed using MATLAB	3	XXMEL71.6

Text books:

3. Mechanical vibrations by V. P Singh, DhanpatRai& Co (P) Ltd, 5th edition 2015. ISBN-978-81-7700-031-3
4. Mechanical vibrations by S. S. Rao, Peason Prentice Hall, 6th edition 2016,ISBN-10-0134361307

Reference Books:

- 3) Mechanical vibrations, S. Graham Kelly, Schaum outline series, McGraw-Hill Education, 2016,ISBN- 10: 007034041.
- 4) Mechanical vibrations by Srinath.M.K, Sanguine Technical Publishers Bangalore, 2015. ISBN-978 9383506 48-4

Assessment pattern:

CIE(25 Marks - LAB)

Bloom's Category	Experiments/Tests	Record	Viva
Marks	10	10	5
Remember			1
Understand			1
Apply		3	1
Analyze	5	3	1
Evaluate	5	4	1
Create			

SEE (25 Marks - LAB)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	5
Analyze	5
Evaluate	5
Create	

CONTROL ENGINEERING LAB

Course Code : XXMEL72
 L: T:P : 0:0:1
 Exams Hours : 03

Credits: 01
 CIE Marks: 25
 SEE Marks: 25

XXMEL72.1	Apply various control systems concepts to mechanical models and identify the Control parameters for safe usage of the system.
XXMEL72.2	Analyze and categorise the transient and steady state response of mechanical control systems to interpret the practical problems
XXMEL72.3	Recoil the reduction methods and evaluate the outputs for transfer function of control systems with suitable representations and documentation
XXMEL72.4	Determine the stability conditions and represent the values using graphical methods so as to facilitate the learning process further and recommend improvements if needed
XXMEL72.5	Design and develop system with controlled parameters and compensate the system responses to maintain the optimal functionality.
XXMEL72.6	Formulate, analyze and solve the problem using MAT Lab programming.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XXMEL72.1	1											
XXMEL72.2		1										
XXMEL72.3										1		
XXMEL72.4						2	2					
XXMEL72.5			1	1								
XXMEL72.6					2							

Course syllabus

Experiment #	Contents of Laboratory	Hrs	COs
1	Matlab Basics	3	XXMEL72.1
2	Matlab Basics	3	XXMEL72.1
3	Matlab Basics	3	XXMEL72.2
4	Matlab Basics	3	XXMEL72.2
5	Determination of number of poles and zeroes for a given transfer function	3	XXMEL72.3
6	Determination of time response of system in steady state	3	XXMEL72.4
7	Determination of time response of system in transient state	3	XXMEL72.5
8	To obtain the roots locus of a given transfer function	6	XXMEL72.5
9	obtain the Bode plot of a given transfer function	6	XXMEL72.6
10	To obtain the polar plot and Nyquist plot of a given transfer function	3	XXMEL72.6
11	Study the effects of controllers in system	3	XXMEL72.6

TEXT BOOKS:

- Control Engineering**, V.U.Bakshi&U.A.Bakshi, Technical Publications, 2014 edition, ISBN-13: 978-9350996577
- Control System Engineering**, I J Nagrath& M Gopal, New Age International Pvt Ltd; Sixth edition (1 January 2017), ISBN – 13: 978-9386070111

REFERENCE BOOKS:

- Control Engineering**, D. Ganesh Rao, Pearson Education, 2010 edition, ISBN-13: 978- 8131732335
- MATLAB: Easy Way of Learning**, S. Swapna Kumar&S. V. B. Lenina, Prentice-Hall of India Pvt.Ltd, 2016 edition, ISBN-13: 978-8120351653
- MATLAB: An Introduction with Applications**, Amos Gilat, Wiley; Fourth edition (9 August 2012), ISBN-13: 978-8126537204
- MATLAB and Simulink for Engineers**, Agam Kumar Tyagi, Oxford; Pap/Cdr edition (24 November 2011), ISBN-13: 978-0198072447

CIE(25 Marks - LAB)

Bloom's Category	Experiments/Tests	Record	Viva
Marks	10	10	5
Remember			1
Understand			1
Apply		3	1
Analyze	5	3	1
Evaluate	5	4	1
Create			

SEE (25 Marks - LAB)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	5
Analyze	5
Evaluate	5
Create	

Automation Engineering Lab

Course Code	XXMEL73
L: T:P	0:0:1
Exams Hours	03

Credits	01
CIE Marks	25
SEE Marks	25

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

XXMEL73.1	Understand the importance of CNC In Automation.
XXMEL73.2	Interpret and demonstrate “G” and “M” codes in CNC Programs
XXMEL73.3	Execute the Raspberry Pi operations in IOT Applications
XXMEL73.4	Apply the basics of Python programming platform to build Machine Learning algorithms
XXMEL73.5	Formulate Regression and Classification models to obtain solutions for data with continuous and discrete output using Python programming

Mapping of CO v/s PO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XXMEL73.1	3	2	2									2
XXMEL73.2	3	2	2									2
XXMEL73.3	3	2	2									2
XXMEL73.4	2	2	2									2
XXMEL73.5	3	2	2									2

Course syllabus

Experiment #	Contents of Laboratory	Hrs.	COs
1	Simulation of CNC Program for profiles with simple plain and step Turning operations.	6	XXMEL73.1
2	Simulation of CNC Program for profiles with grooving and thread cutting operations.	3	XXMEL73.2
3	Simulation of CNC Program for profiles with Drilling operations.	3	XXMEL73.3
4	Simulation of CNC Program for profiles with simple Milling operations.	3	XXMEL73.4
5	Simulation of CNC Program for profiles with combined Milling and Drilling operations.	3	XXMEL73.3
6	Python programming for Raspberry Pi Application - Blinking of LED	3	XXMEL73.3
7	Python programming for Raspberry Pi Application – Working of PIR sensor	3	XXMEL73.2
8	Machine Learning Model Building for Regression – IPL Player Price Prediction	3	XXMEL73.3
9	Machine Learning Model Building for Classification using Logistic regression – German Credit Classification	3	XXMEL73.4
10	Machine Learning Model Building for Classification using Decision Tree – HR Attrition Prediction	3	XXMEL73.5

TEXT BOOKS/REFERENCE BOOKS:

1. Machine Learning, Tom M Mitchel, McGraw Hill Education, July 2017, ISBN: 978-1-25-9096952.
2. Optimization of Manufacturing systems using Internet of Things, Yingfeng Zhang, Fei Tao, First Edition, 2016, Elsevier, ISBN: 9780128099100
3. Machine Learning, An Algorithmic Perspective, Stephen Marsland, Chapman and Hall, Nov 2014, ISBN: 978-1466583283.
4. "Automation, Production Systems and Computer Integrated Manufacturing"- M.P.Grover, Pearson Education, 4th Edition, 2016, ISBN: 978-9332572492
5. "Computer Based Industrial Control" – Krishna Kant, EEE-PHI, 2nd edition, 2011, ISBN: 978-8120339880
6. Principles and Applications of PLC – Webb John, Mcmillan, 2006, ISBN-9780024249708
7. Sensor Technology Handbook , Jon S. Wilson, Newnes, 2004

CIE (25 Marks)

Bloom's Category	Experiments/Tests	Record	Viva
Marks	10	10	5
Remember			1
Understand			1
Apply		3	1
Analyze	5	3	1
Evaluate	5	4	1
Create			

SEE (25 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	5
Analyze	5
Evaluate	5
Create	

EIGHT SEMESTER SYLLABUS

NON-CONVENTIONAL MANUFACTURING TECHNOLOGIES

Course Code	XXMEE811
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

COURSE OUTCOMES: at the end of the course, the students will be able to:

XXMEE811.1	Understand the concept of Non-conventional manufacturing technologies
XXMEE811.2	Analyze the different Non-conventional manufacturing technologies
XXMEE811.3	Evaluate the Non-conventional manufacturing technologies, application and limitations.
XXMEE811.4	Understand the latest trends of Non- conventional manufacturing technologies.
XXMEE811.5	Evaluate the conventional and compare with Non-conventional manufacturing technologies
XXMEE811.6	Apply of the process and extending to industrial usages.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE811.1	3	3										3		3
XXMEE811.2	3	3										3		3
XXMEE811.3	3	3										3		3
XXMEE811.4	3	3										3		3
XXMEE811.5	3	3										3		3
XXMEE811.6	3	3										3		3

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module	Contents of Module	Hrs	Cos
1	Introduction: History, Classification, Need, process selection, comparison between conventional and un-conventional manufacturing Techniques. Ultrasonic Machining (USM): Introduction, Principal, equipment, Process characteristics, Functions and Characteristics of Abrasive Slurry, Tool Feed System and Its Functions, Transducer, Effect of parameter, Advantages, Limitations and Application. Horn design: Shaws model of MRR, other applications of Ultrasonic machining	8	XXMEE811.1 XXMEE811.2 XXMEE811.3 XXMEE811.5 XXMEE811.6
2	Abrasive Jet Machining (AJM): Introduction, Principal, Equipment, Process characteristics, Variables in AJM, Advantages, Limitations and Application. Water Jet Machining (WJM): Introduction, Principal, Equipment, Advantages, Limitations and Application. Abrasive Water Jet Machining (AWJM): Introduction, Principal, Equipment, Advantages, Limitations and Application.	9	XXMEE811.2 XXMEE811.3 XXMEE811.4 XXMEE811.6

3	<p>Electrochemical Machining (ECM): Introduction, Equipment, Process characteristics, Tooling, Advantages, Limitations and Application. Electrochemical Shaping, turning, Grinding, Honing, deburring.</p> <p>Chemical Machining (CHM): Introduction, elements of process, chemical blanking process, chemical milling, process steps –masking, Etching, process characteristics of CHM, Advantages, Limitations and Application.</p>	9	XXMEE811.2 XXMEE811.3 XXMEE811.4 XXMEE811.6
4	<p>Electrical Discharge Machining (EDM): Introduction, Principal, Equipment, Process characteristics, spark generator, Types, Functions and Properties of Dielectric Fluid, Multi Lead EDM, Types And Requirements Of Electrodes. Factors Affecting Electrode Wear, Electrode feed control, Flushing, accessories, Advantages, Limitations and Application., electrical discharge grinding, Traveling wire EDM</p> <p>Ion Beam Machining (IBM): Introduction, Principle, Equipment, Advantages, Limitations and Application.</p>	9	XXMEE811.2 XXMEE811.3 XXMEE811.4 XXMEE811.6
5	<p>Plasma Arc Machining (PAM): Introduction, Principal, Equipment, Process characteristics selection of gas, Safety precautions, Plasma Torch, Generation of Plasma Torch, Advantages, Limitations and Application.</p> <p>Laser Beam Machining (LBM): Introduction, Principal, Equipment, Process characteristics, and parameters, Advantages, Limitations and Application. Lasing process: Types of lasers (Gas and solid state), lasing mediums, laser material processing-cutting, drilling, surface treatment, special applications.</p> <p>Electron Beam Machining (EBM): Introduction, Principle, Equipment, Process characteristics Advantages, Limitations and Application.</p>	9	XXMEE811.2 XXMEE811.3 XXMEE811.4 XXMEE811.6

TEXT BOOKS:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill ,1st Ed, **ISBN:** 9780070965539
2. Production Technology, HMT Tata McGraw Hill, 1st Ed, **ISBN:**9780070964433

REFERENCE BOOKS:

1. Non-Conventional Machining, P.K.Mishra, Narosa Publishing House, **and ISBN-13:** 978-8319138
 2. Nontraditional manufacturing Processes, Gary F Benedict, CRC press, 1st Ed, **ISBN-13:** 978- 0824773526
 3. Advanced methods of Machining, J.A.McGeough, Chapman and Hall, **ISBN:** 9788184898453
 4. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals (ASM) **ISBN-13:**978-08700223 **ISBN-10:**08700220
- Assessment Pattern

CIE(50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember			
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create	5		

SEE (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

FOUNDRY TECHNOLOGY

Course Code	XXMEE812
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

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

XXMEE812.1	Understand special casting techniques
XXMEE812.2	Design and develop the conventional foundries
XXMEE812.3	Analyze casting defects, special moulding techniques
XXMEE812.4	Understand Foundry metallurgy & Design gating system
XXMEE812.5	Evaluate the fettling processes, patterns and mould making
XXMEE812.6	Apply modern tools to develop casting aids

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE812.1	3												3	
XXMEE812.2	3	2											3	
XXMEE812.3	3		3	1									3	
XXMEE812.4	3					1	1						3	
XXMEE812.5	3		3										3	
XXMEE812.6	3	2											3	

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Contents of Module	Hrs	Cos
1	INTRODUCTION: Introduction to casting process and its potential, Chronology of the art of founding, freezing of molten metal's /alloys, grain structure and effect of heat transfer on grain structure and properties FOUNDRY METALLURGY: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals.	9	XXMEE812.1 XXMEE812.2
2	PATTERN AND MOULD MAKING: Pattern - types and materials mould and mould materials, popular casting processes, core and core making, importance of pattern and core on quality and economy of the castings CUPOLA MELTING: Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, cokeless cupola, cupola charge calculations.	9	XXMEE812.1 XXMEE812.5

3	<p>SOLIDIFICATION OF CASTINGS: Crystallization and development of cast structure- nucleation, growth. Feeding of metals / alloys, design of feeder, Chvorinov's rule, casting defects, remedies, Fettling and NDT of castings.</p> <p>CASTING DESIGN: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost and model making as an aid in design.</p>	9	XXMEE812.2 XXMEE812.3 XXMEE812.5
4	<p>ALLOYS HANDLED BY FOUNDRIES: Discussion on foundry practices for cast iron, steel, malleable iron, SG iron and zinc alloys, copper alloys and aluminum alloys with applications.</p> <p>SPECIAL MOULDING TECHNIQUES: Principles, materials used process details and application of no-bake sand systems, vacuum moulding, flask less moulding, and high pressure moulding.</p>	9	XXMEE812.1 XXMEE812.3
5	<p>MELTING OF ALLOYS AND GATING: Melting practices, selection of furnaces, pouring methods, flow of molten metal inside the mould, design of gates and types of gates. A case study using CAD/CAE/CAM(RP) for developing pattern and core box for casting</p>	8	XXMEE812.4 XXMEE812.6

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Casting", Tata McGraw Hill, New Delhi, 2nd Ed, **ISBN:** 9780070993488
2. John Campbell, "Castings", Butterworth Heinemann, Oxford, 2nd Ed, ISBN-13: 978- 0750647908f

REFERENCES:

1. Jain P L, "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 5th Ed, **ISBN:** 9780070151291
2. Elliot R, "Cast Iron Technology", Jaico Publications, 2009.
3. Tiwari, "Cast Iron Technology", CBS Publications, 2007, ISBN: 9788123914893
4. ASM Metals Handbook - Castings, Vol. 15, ASM Int. Metals Park, OHIO, 2008.

Assessment Pattern

CIE (50 Marks – Theory)

SEE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember			
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create	5		

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

AGILE MANUFACTURING

Course Code	XXMEE813
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

XXMEE813.1	Understand and develop the concepts of Agile Manufacturing.
XXMEE813.2	Analyze the Product/Process development and its application in Agile Manufacturing.
XXMEE813.3	Understand Supply Chain Management and its link with Agile Manufacturing.
XXMEE813.4	Apply the Computer Control in Agile Manufacturing.
XXMEE813.5	Apply Corporate Knowledge of Management in Agile Manufacturing.
XXMEE813.6	Understand the Skill & Knowledge in Agile Manufacturing.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
XXMEE813.1	3												3	
XXMEE813.2	3												3	
XXMEE813.3	3										1		3	
XXMEE813.4	3				1								3	
XXMEE813.5	3										1		3	
XXMEE813.6	3												3	

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Module Contents	Hrs	Cos
1	Agile Manufacturing: Definition, business need, conceptual framework, characteristics, generic features. Developing Agile Manufacturing: Enterprise, Strategies, integration of organization, workforce and technology, reference models, examples.	08	XXMEE813.1
2	Integration Of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches. Application Of It/Is Concepts In Agile Manufacturing: Strategies, Management of complexities and information. Flow approaches, applications of multimedia to improve agility in manufacturing, system concepts.	10	XXMEE813.2

3	Agile Supply Chain Management: Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and Leanness – comparison of concepts.	08	XXMEE813.3
4	Computer Control Of Agile Manufacturing: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, and	08	XXMEE813.4
5	Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in Agile manufacturing, Role of standards. Design Of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements. (parametric approach only)	10	XXMEE813.5 XXMEE813.6

TEXT BOOKS:

- Agile Manufacturing -Forging new Frontiers** - Paul T. Kidd - Addison Wesley- Publication Amagow Co. UK, ISBN-13: 978-0201631630
- Agile Manufacturing**, A Gunasekharan, the 21st Century Competitive strategy, ISBN: 9780080435671, Elsevier Press, India
- Agile Manufacturing -Proceeding of International Conference on Agile Manufacturing** Dr. M.P Chowdiah (Editor), TATA McGraw Hill Publications 2014, ASIN: B01NBY3E8K

REFERENCE BOOKS:

- Concurrent Engg** - Paul T Kidd – Addison Wesley Publication -2014. Not listed
- World Class manufacturing** - Paul T Kidd – Addition Wesley Pub – 2014. Not listed
- O Levine Transitions to Agile Manufacturing**-Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee, Wisconsin, USA, ISBN-13: 978-0873893473
- Agile Development for Mass Customization**-David M Anderson and B Joseph Pine, Irwin Professional Publishing, Chicago, USA, ISBN-13: 978-07863150

Assessment Pattern

CIE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember			
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create	5		

SEE (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

CONVENTIONAL AND NON-CONVENTIONAL ENERGY RESOURCES

Course Code	XXMEE814
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

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

XXMEE814.1	Understand the basic working principles of non-conventional power plants like Nuclear, Solar, Geo-thermal, Tidal and Ocean Thermal Energy power plant.
XXMEE814.2	Evaluate cycle efficiency and performance of Various Power Plants.
XXMEE814.3	Distinguish the various types of fuels used in power plants and estimate their heating values.
XXMEE814.4	Analyze the applications of Bio Mass and Hydrogen energy.
XXMEE814.5	Investigate the ways to increase the thermal efficiency of power plant by the use of accessories.
XXMEE814.6	Discuss the working principle and basic components of Diesel and hydro electric power plants and the economic principles and safety precautions involved with it.

Mapping of Course outcomes to Program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
XXMEE81 4.1	3						2						3	
XXMEE81 4.2	3												3	
XXMEE81 4.3	3												3	
XXMEE81 4.4	3						2						3	
XXMEE81 4.5	3												3	
XXMEE81 4.6	3												3	

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping

Module No	Contents of Module	Hrs	Cos
1	<p>Steam Power Plant: Layout of steam power plant, Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace.</p> <p>A Brief Account Of Benson, Velox, Schmidt Steam Generators. Chimneys: Natural, forced, induced and balanced draft. Cooling towers and Ponds. Accessories for the Steam generators such as Super heaters, De-super heater, control of super heaters, Economizers, Air pre heaters and re-heaters.</p>	9	<p>XXMEE814.1 XXMEE814.2</p>

2	<p>Diesel Engine Power Plant: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, intake and exhaust system, Layout of diesel power plant.</p> <p>Hydro-Electric Plants: Hydrographs, flow duration and mass curves, unit hydrograph and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.</p>	9	XXMEE814.6
3	<p>Solar Energy: Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion (Numerical Examples).</p> <p>Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills.</p>		XXMEE814.2 XXMEE814.3
4	<p>Nuclear Power Plant: Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types- Pressurized water reactor, Boiling water reactor, Sodium graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio-active waste disposal.</p> <p>Hydrogen Energy : Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production, bio-chemical production.</p>	9	XXMEE814.3 XXMEE814.4
5	<p>Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy.</p> <p>Tidal Power: fundamental characteristics of tidal power, harnessing tidal energy, limitations.</p> <p>Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, problems associated with OTEC.</p> <p>Energy from Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, problems involved with bio-gas production.</p>	9	XXMEE814.4 XXMEE814.5

TEXT BOOKS:

1. Non-Conventional Energy Sources by *G.D Rai K*, Khanna Publishers, 5th Ed, ISBN: 97881- 7409-073-8
2. Solar energy, by *Subhas P Sukhatme*– Tata McGraw Hill, 3rd Ed, ISBN: 9780070260641
3. **Power Plant Engineering**, P. K. Nag Tata McGraw Hill ,4th Ed, ISBN: 9789339204044
4. **Power Plant Engineering**, Domakundawar, Dhanpath Rai sons.

REFERENCE BOOKS:

1. **Power Plant Engineering**, R. K. Rajput, Laxmi publication, 5th Ed, ISBN: 9788131802557
2. **Principles of Energy conversion**, A. W. Culp Jr., McGraw Hill, 2nd Ed, ISBN-13: 978- 0070435599
3. Renewable Energy Sources and Conversion Technology by *N.K.Bansal, Manfred Kleeman & Mechael Meliss*, Tata McGraw Hill, 2001.

Assessment Pattern

CIE (50 Marks - Theory)

SEE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

SUSTAINABLE ENERGY SOURCES

Course Code	XXMEE815
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

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

XXMEE815.1	Understand The principles that underlie the ability of various natural phenomena to deliver solar energy
XXMEE815.2	Analyze the technologies that are used to harness the power of solar energy
XXMEE815.3	Analyze The positive and negative aspects of solar energy in relation to natural and human aspects of the environment.
XXMEE815.4	Evaluate the challenges of designing, promoting and implementing renewable energy solutions
XXMEE815.5	Understand their role in lifelong learning, social responsibility, and professional and ethical responsibilities in implementing sustainable engineering solutions.
XXMEE815.6	Apply the major 'big picture' questions in the area of energy resources

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XXMEE815.1	2	3	2								3	
XXMEE815.2	2	3	2								3	
XXMEE815.3	2	3	2								3	
XXMEE815.4	2	3	2								3	
XXMEE815.5	2	3	2								3	
XXMEE815.6	2	3	2								3	

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Contents of Module	Hrs	Cos
1	INTRODUCTION: Energy demand growth and supply : Historical Perspectives ; Fossil fuels: Consumption and Reserve ; Environmental Impacts of Burning of Fossil fuels ; Sustainable Development and Role of Renewable Energy BIOMASS ENERGY: Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers.	9	XXMEE815.1 XXMEE815.2
2	SOLAR ENERGY BASICS: Solar geometry; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages. Low temperature applications: solar water heating, space heating, drying.	9	XXMEE815.3

3	SOLAR THERMAL ELECTRICITY GENERATION: Solar concentrators and tracking; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants; Solar Ponds.	9	XXMEE815.3
4	SOLAR PHOTOVOLTAIC SYSTEMS: Basic principle of power generation in a PV cell ; Band gap and efficiency of PV cells ; Manufacturing methods of mono- and polycrystalline cells ; Amorphous silicon thin film cells, Single and multi junction cells ; Application of PV ; Brief outline of solar, PV stand-alone system design ; Storage and Balance of system.	9	XXMEE815.4
	GEOTHERMAL ENERGY: Geothermal sites in India; High temperature and Low temperature sites; Conversion technologies- Steam and Binary systems; Geothermal power plants.		
5	WIND Energy Systems: Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Wind farms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate. OCEAN ENERGY: Tidal power plants: single basin and two basis plants, Variation in generation level; Ocean Thermal Electricity Conversion (OTEC); Electricity generation from Waves: Shoreline and Floating wave systems.	8	XXMEE815.5 XXMEE815.6

TEXT BOOKS:

1. Twidell J and Weir T., Renewable Energy Resources, Taylor & Francis ,2nd Ed, **ISBN- 13: 978-0419253303**
2. Godfrey Boyle, Renewable energy, Oxford Press , 3rd Ed, **ISBN-13: 978-0199545339**
3. V.V.N. Kishore, Renewable Energy engineering and Technology: Principles and Practice, TERI Press. **ISBN-13: 978-89930939**
4. Rai G.D., Non-Conventional Energy Sources, Khanna publication, 5th Ed, ISBN 13- 978-81- 7409-073-8

Assessmen Pattern

CIE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes	External participation
Marks	25	10	5	10
Remember				
Understand	5			
Apply	5	5	5	5
Analyze	5	5		5
Evaluate	5			
Create	5			

SEE (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

SURFACE NDE METHODS

Course Code :XXMEE821

Credits: 03

L: T: P : 3:0:0

CIE Marks: 50

Exams Hours : 03

SEE Marks: 50

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

XXMEE821.1	Apply the knowledge of quality inspection method using Non destructive Technique (NDT).
XXMEE821.2	Analyze nature of defects and microstructure of component s using NDT technique.
XXMEE821.3	Evaluate and document the detailed analysis report of the tested components
XXMEE821.4	Apply the latest techniques like radiography, thermal inspection, holography, ultrasonic etc. towards the development of inspection methods for industrial applications
XXMEE821.5	Select appropriate NDT techniques for product evaluation based on materials, nature of defects and their environmental conditions
XXMEE821.6	Analyze the process and Monitor the changes with passage of time

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE821.1	3				3									
XXMEE821.2	3	3												2
XXMEE821.3				1						1			3	
XXMEE821.4		3	1		3									2
XXMEE821.5		3			3		1						3	
XXMEE821.6	3	3	1	1	3								3	

Module No	Contents of Module	Hrs	Cos
1	Introduction to Non destructive Testing: Introduction, defects in manufacturing process, comparison of destructive and non destructive test, advantages and limitations, Non destructive evaluation: selection of ND methods, flaw detection and evaluation, types of flaws, types of leaks, methods of leak testing, techniques, visual inspection, replication microscopy techniques for Non destructive Evaluation: specimen preparation, replication techniques, micro structural analysis.	8	XXMEE821.1 XXMEE821.2 XXMEE821.3 XXMEE821.4 XXMEE821.5 XXMEE821.6
2	Radiography Inspection: principles, methods of inspection, uses of radiography, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications. Computed tomography: introduction, principles, equipment capabilities, detection, application	9	XXMEE821.2 XXMEE821.3 XXMEE821.4 XXMEE821.6
3	Thermal inspection: introduction, principles, heat transfer mechanisms, characteristics, thermal inspection, inspection method, application Optical Holography: introduction, principles, Basics of Holography, recording and reconstruction - Acoustical Holography: systems and techniques applications.	9	XXMEE821.2 XXMEE821.3 XXMEE821.4 XXMEE821.6

	Eddy Current Inspection: introduction, principles, operation variables, procedure, functions of eddy current system, inspection coils, and detectable discounts by the method. Eddy current instruments, read out instruments, Microwave Inspection: Microwave holography, applications and limitations Ultrasonic Inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks	9	XXMEE82 1.2 XXMEE82 1.3 XXMEE82 1.4 XXMEE82 1.6
5	Acoustic Emission Inspection: Introduction, basic principle, relationship to other test methods, Acoustic emission waves and propagation, factors in source location and typical AE measurements, AE sensors, Instrumentation principles, Signal detection and emission counts, Hit-driven AE systems, data displays. Fundamentals of image processing and enhancement: Introduction, NDE digital image enhancement systems, work station configuration, image capture and acquisition system, image processing, image enhancement, contouring and thresholding, Color models, image display	9	XXMEE821. 2 XXMEE821. 3 XXMEE821. 4 XXMEE821. 6

Text Books:

1. **Introduction to Nondestructive Testing**, Paul E Mix, Publisher: John Wiley (original), ISBN: 9780471420293, 0471420298.2005
2. **Non Destructive Testing**, Barry Hull and Vernon John, Publisher: Springer 2012 ISBN-13: 978-1468462999.

REFERENCE BOOKS:

1. **Non Destructive Testing and evaluation of materials**-J Prasad and C G K Nair, McGraw hill 2017 ISBN: 978-0070707030.
2. **Non-Destructive Testing Technique**, Laodeno Rem N, Yoshida Kenichi , Publisher: LAP Lambert Academic Publishing, 2013, ISBN-13: 978-3659335587.
3. **Non Destructive Evolution and Quality Control** - volume 17 of metals hand book 9 edition Asia internal.

Assessment pattern:

1. CIE- (50 Marks Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

SEE – (50 Marks)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

CNC MACHINING

Course Code : XXMEE822
 L:T: P : 3:0:0
 Exam Hours : 03

Credits : 04
 CIE Marks : 50
 SEE Marks : 50

Course Outcomes: At the end of the Course, the student will be able to:

XXMEE822.1	Understand the concepts of CNC machines in manufacturing
XXMEE822.2	Empathize the construction details of CNC machines
XXMEE822.3	Analyze the various parameters used in CNC machining such as co-ordinate system, dimensions, datum point, compensations etc.
XXMEE822.4	Recognizing the different G and M codes used in CNC machining
XXMEE822.5	Create the part programs using the codes for various contours during turning, milling and drilling
XXMEE822.6	Evaluate the part programs for any errors

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE822.1	3												3	
XXMEE822.2	3												3	
XXMEE822.3	3	1											3	
XXMEE822.4	3												3	
XXMEE822.5	3												3	
XXMEE822.6	3												3	

Module No	Module Contents	Hrs.	COs
1	Introduction to NC and CNC, Basics and need of CNC machines, Types of CNC machines, Parts of CNC Machine, Advantages of CNC machines, Applications of CNC machines in manufacturing.	08	XXMEE822.1
2	Constructional Details of CNC Machines: Machine structure ,Slide – ways ,Motion transmission elements , Swarf removal and safety considerations ,Automatic tool changers and multiple pallet systems, Sensors and feedback devices in CNC machines ,Constructional detail of CNC turning centre and CNC machining centre. Tooling requirements of CNC machines, Pre-set and qualified tools, Work and tool holding devices in CNC machines.	09	XXMEE822.2
3	CNC Co-ordinate System, Dimensioning System, Dimension Instruction, axes designation, Interpolation concepts, cutter compensation Datum point & Reference point, Datum point shift, Spindle control, Tool offset & length.	09	XXMEE822.2 XXMEE822.3
4	Basic Programming in Turning, Introduction to G & M Codes, ISO Program format, Sample Program on Facing, Plain Turning ,Create Programming for Step Turning, Contour Program, Taper Turning, Drilling, Grooving, Boring, Threading and parting.	09	XXMEE822.2 XXMEE822.3 XXMEE822.4

5	Basic Programming in Milling, Create Programming for Components, Contour Program Using ATC, Standard Milling, Pocket Milling, Slot milling, Circular Pocketing, drilling (Pecking), mirror image	09	XXMEE822.4 XXMEE822.5 XXMEE822.6
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TEXT BOOKS:

1. CAD/ CAM/CIM, P Radhakrishnan, S. Subramanyan, V. Raju, New age International Publishers
2. CNC Programming Hand Book, Peter smid, Industrial Press inc
3. CNC Technology, Samuel Raja, Dhanpat Rai Publication
4. CNC Machines, Pabla, B.S. & Adithan, New Age Publishers, New Delhi
5. Programming of Computer Numerically Controlled Machines, Ploywka, John & Gabrel, Stanley, Industrial Press Inc., New York.

REFERENCE BOOKS:

1. T.K Kundra, P.N. Rao and N.K. Tewari, “ Numerical control and computer Aided Manufacturing” Tata Mc Graw Hill Company, 1995.
2. Yoram Koren, “Computer control of Manufacturing Systems”,TMH, 2009

CIE- Continuous Internal Evaluation 50 Marks (Theory):

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5		2
Understand	5	5	
Apply	5	5	5
Analyze	5	5	3
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	15
Analyze	10
Evaluate	05
Create	

INDUSTRIAL ROBOTICS

Course Code	XXMEE823
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

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

XXMEE823.1	Understand the knowledge about robots, its needs, importance and applications.
XXMEE823.2	Apply the robot drives and components in practical cases.
XXMEE823.3	Understand the basics of robotic dynamics.
XXMEE823.4	Analyze how robots use sensors and sensing.
XXMEE823.5	Distinguish the methods and types of robot programming
XXMEE823.6	Understand the roles, advantages and application of robotics in industries.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
XXMEE823.1		3												3
XXMEE823.2	3		3											3
XXMEE823.3		3												
XXMEE823.4		3	3		3									3
XXMEE823.5	3		3		3									3
XXMEE823.6		3	3			1								

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Contents of Module	Hrs	Cos
1	Introduction: definition of robot, Need and importance, Type of robots, Robot Classifications: degrees of freedom; degrees of movements, robot configuration; accuracy and repeatability, robot Applications.	08	XXMEE823.1 XXMEE823.2
2	Drives and component systems: Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.	10	XXMEE823.2 XXMEE823.3
3	Sensors and sensing: Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing, Linear position and displacement sensing, Image processing and object recognition.	10	XXMEE823.4
4	Robot Programming: Teaching of robots, Manual, walk through, teach pendant, Methods - languages - Capabilities and limitation.	09	XXMEE823.5
5	Industrial Applications : Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.	08	XXMEE823.6

TEXT BOOKS:

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, **ISBN-13: 978-8120308428**
2. Mikell P. Groover, Mitchell Weiss, "Industrial robotics, technology, Programming and Applications ", McGraw Hill International Editions, 2nd Ed, **and ISBN: 9781259006210**

REFERENCE BOOKS:

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, **and ISBN-13: 978-8120308428**
2. K.S. Fu., R.C.Gonalez, C.S.G.Lee, "Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1st Ed, **ISBN: 9780070265103**

Assessment Pattern

CIE (50 Marks - Theory)

SEE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

OPTIMIZATION TECHNIQUES

Course Code	XXMEE824
L: T: P	3:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

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

XXMEE824.1	Summarize the concepts of design optimization and problem formation procedures.
XXMEE824.2	Compute the solution for single variable unconstrained optimization problems
XXMEE824.3	Determine the solution for multivariable unconstrained optimization problems
XXMEE824.4	Find the solution for the constrained non-linear optimization problems
XXMEE824.5	To provide input on non-traditional optimization techniques to solve engineering problems
XXMEE824.6	Apply non-traditional optimization techniques to solve engineering problems

Mapping of Course outcomes to Program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 1	PO 2
XXMEE824.1	1													2
XXMEE824.2		2												2
XXMEE824.3			3											2
XXMEE824.4					2									2
XXMEE824.5			3	2										2
XXMEE824.6			3	2										2

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Contents of Module	Hrs	Cos
1	INTRODUCTION Introduction to design optimization-Historical development, the design process, Conventional Vs Optimum design process - Statement of an optimization problem- Optimum design problem formulation - process steps, Problem formulation for engineering applications - Two-bar bracket, Design of coil springs-Classifications of optimization problems.	08	XXMEE824.1 XXMEE824.2
2	SINGLE VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS Optimality criteria - Unimodal function - Eliminating methods - Exhaustive search, Dichotomous search, Interval halving method, Fibonacci search method, Golden section search method. Point estimation method (Powell's algorithm) - Gradient-based methods - Newton-Raphson method (Taylor's series expansion), Bisection method, Secant method, Cubic search method.	10	XXMEE824.2 XXMEE824.3
3	MULTI VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS Optimality criteria - Unidirectional search - Direct search methods - Evolutionary optimization method, Random search methods, Simplex search method, Hooke-Jeeves pattern search method, Indirect search (gradient) methods- Cauchy's (steepest descent) method, Newton's method, Conjugate gradient method.	10	XXMEE824.4

4	CONSTRAINED NONLINEAR OPTIMIZATION ALGORITHMS AND SPECIALIZED PROGRAMMING Introduction, Characteristics - Indirect search methods - Transformation methods, Penalty function method, Method of multipliers - Sensitivity analysis - Kuhn-Tucker conditions, Theorems. Test problems on three-bar truss, welded beam design. Direct search minimization methods- Variable elimination method, Complex search method and Random search methods - Feasible direction method. Integer programming - Penalty function method, Branch and Bound method.	09	XXMEE824.5
5	NONTRADITIONAL OPTIMIZATION TECHNIQUES Genetic Algorithms (GA)- principle, difference and similarities between GA and traditional methods, constrained optimization, GA operators, Real-coded and Advanced GAs - Simulated Annealing - Neural Network based Optimization	08	XXMEE824.6

Reference(s)

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice, Fourth Edition, Wiley India Pvt Ltd, Delhi, 2009
2. Kalyanmoy Deb, Optimization for Engineering Design- Algorithms and Examples, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
3. Jasbir Singh Arora, Introduction to Optimum design, Third Edition, Elsevier India Pvt. Ltd, New Delhi, 2011.
4. R. Saravanan, Manufacturing optimization through intelligent techniques, First Edition, Taylor & Francis Publications, CRC Press, New Delhi, 2006.
5. Optimization Techniques and Applications with Examples, Xin-She Yang, Wiley India Pvt Ltd, Delhi, 2018.

Assessment Pattern

CIE (50 Marks - Theory)

SEE (50 Marks - Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	25	15	10
Remember			
Understand	5		
Apply	5	5	5
Analyze	5	5	5
Evaluate	5	5	
Create	5		

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	