MALNAD COLLEGE OF ENGINEERING, HASSAN

An Autonomous Institution Affiliated to VTU, Belagavi

Autonomous Programme

BACHELOR of ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS (2020 Admitted Batch)
VII AND VIII SEMESTERS
(4th YEAR)

Academic Year 2023-24

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Department of Mechanical Engineering

Vision of The Department:

To emerge as department of high repute in Mechanical Engineering and allied fields through effective teaching, learning process and research activities, operating with a sense of professional and social responsibility.

Mission of The Department:

1. Empower students to scale high in their professional career through upskilling.
2. Effective association with higher institutes of learning, industry and research laboratories with emphasis on multi-disciplinary approach.
3. Encourage students to participate in sustainable projects.
4. Inculcate professional and ethical norms in all activities.

Program Educational Objectives:

PEO 1: Graduates will be able to apply engineering principles to develop products, processes or knowledge to solve mechanical and associated engineering problems for successful careers in mechanical engineering/higher education/research.

PEO 2: Graduates will acquire leadership qualities with strong communication skills along with professional and ethical values.

PEO 3: Graduates will be able to become entrepreneur / innovators to design and develop manufacturing systems and services to address social, technical and business challenges.

PEO 4: Graduates will be lifelong learners.

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PROGRAM OUTCOMES [POs]:

Mechanical Engineering students shall be able to,

PO1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12:	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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PROGRAM SPECIFIC OUTCOMES [PSOs]

PSO1:	Apply the knowledge of design engineering skills to manufacture an engineering mechanical system.
PSO2:	Model, simulate, analyze and optimize mechanical systems / processes through application of software.

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Scheme of Evaluation (Theory Courses)

	Portions for CIE	Mode of Evaluation	Weightage in Marks
CIE - 1	Syllabus to be decided by the course coordinators such that all the COs shall be covered.	Descriptive Test	15
CIE - 2		Descriptive Test	15
CIE - 3		Descriptive Test	10
Activity	Minimum of two activities to be conducted	Assignment / Case study/Practical/ Working model /Quiz	**10**
		Total	**50**

Scheme of Evaluation (Laboratory Courses)

Level	**Evaluation Type**	**Evaluation modules**	**Marks**
1	Continuous internal Evaluation in every lab session by the Course coordinator	conduct of experiments	10
		observation and tabulation of results	10
		record writing	10
2	Laboratory CIE conducted by the Course coordinator	conduction of experiments	10
		observation and tabulation of results,	05
		viva voce	05
		Total	**50**

Note: The marks distribution to be made based on the rubrics for a particular laboratory course.

Examination	**Maximum marks**	**Minimum marks to qualify**
CIE	**50**	**20**
SEE	**50**	**20**

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Scheme for 2020 Admitted Batch (IV Year)
B.E. – Mechanical Engineering
Academic Year 2023-24

VII Semester B.E. Mechanical Engineering							
Course Type	**Course Code**	**Course Title**	**Credits**			**Total Credits**	**Contact Hours**
			L	T	P		
PC	20ME701	Control Engineering	2	1	0	**3.0**	4
PC	20ME702	Finite Element Method	2	1	0	**3.0**	4
HSM	20ME703	Operations Research	3	0	0	**3.0**	4
PC	20ME704	CAM and CAEA Laboratory	0	0	1.5	**1.5**	3
PC	20ME705	Design Laboratory	0	0	1	**1.0**	2
PC	20ME706	Heat Transfer Laboratory	0	0	1	**1.0**	2
PE	20ME77X	Program Elective – III	3	0	0	**3.0**	3
PE	20ME78X	Program Elective – IV	3	0	0	**3.0**	3
IN	20ME709	Internship	0	0	1.5	**1.5**	3
OE	20OEXXXX	Open Elective	3	0	0	**3.0**	3
PC	20SW02	SWAYAM Course – 02 (Mandatory Audit course)	0	0	0	**0.0**	0
Total			**16**	**02**	**05**	**23**	**31**

Program Elective – III		**Program Elective – IV**	
20ME 771	Non-Destructive Testing	20ME 781	Lean Manufacturing
20ME 772	Nanotechnology	20ME 782	Machine Learning with Python
20ME 773	Fundamentals of Industry 4.0and Industrial IoT	20ME 783	Micro-Electromechanical System (MEMS)
20ME 774	Concurrent Engineering	20ME 784	Product Design and Manufacturing
20ME 775	Electric Vehicle Technology	20ME 785	Foundations of Robotics

OPEN ELECTIVES			
20OEME71	Principles of Manufacturing	20OEME73	Project Management
20OEME72	Industrial Engineering and Ergonomics	20OEME74	Occupational Health and Safety Engineering

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Course Title	**CONTROL ENGINEERING**		
Course Code	**20ME701**	**LTPC**	**2-2-0-3**
Exam	**03 Hours**	**Hours / Week**	**04**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To build and regulate mechanical systems through mathematical modeling and analysis so as to obtain desired output.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	mathematically model and analyze block diagrams and signal flow graphs for physical systems	1,2,3	-
2.	determine the response of first&second order systems to applied inputs and understand the concept of control action and types of controllers	2,3	-
3.	analyse control system using root locus and Nyquist plots	2, 3	-
4.	analyse control system using Bode plots and apply basics of state space techniques for control systems	2,3	-

Course Contents:

Module – 1	**10 Hrs.**
System Dynamics: System transfer function, Mathematical modelling of mechanical, electrical, thermal, hydraulic and pneumatic systems. **Feedback control systems:** Physical modelling, Areas of vital role, classification of control system, requirements of automatic control system, Block diagram algebra, Signal flow graphs	
Module – 2	**10 Hrs.**
Transient Response and Stability: First order and second order system response to step, ramp and sinusoidal inputs, system types, steady state error, Routh - Hurwitz criterion. **Controllers:** Controllers, Concept of proportional control, Integral control, Proportional plus integral (P-I) control, Proportional plus derivative (P-D), Proportional- integral- differential control.	
Module – 3	**10 Hrs.**
Root Locus Method: introduction, Root locus plots. Illustrations, General rules for Constructing root loci, Root locus analysis of control system **Nyquist (polar) plots:** Theory, Nyquist stability criterion, System analysis using Nyquist diagrams.	

Module - 4	**10 Hrs**
Bode Plot: Frequency Response, Basic factors, Construction of Bode attenuation diagrams, Stability using Bode plots. **Introduction to State Variable Techniques:** Introduction to state concepts, state equation of linear continuous data system, Matrix representation of state equations, Observability and Controllability	
SELF STUDY: To prepare and present a report on the following topics: 1. Concept of system compensation, 2. Lead, Lag, Lag-Lead compensation.	
TEXT BOOKS: 1. Dhanesh. N. Manik, Control Systems, Seventh Edition, Thomson Press (India) Limited, 2012. ISBN – 8131518124, 9788131518120. 2. K. Ogata, Modern Control Engineering, Prentice Hall (India), Pearson Education 2010. ISBN: 0136156738, 9780136156734	
REFERENCE BOOKS: 1. Farid Golnaraghi, Benjamin C. Kuo, Automatic Control systems**,** Ninth Edition, Wiley, 2009. ISBN: 0470048964, 9780470048962. 2. F. H. Raven, Automatic Control system, Third Edition, McGraw Hill,2010. ISBN: 0070512280, 9780070512283. 3. I. J. Nagrath and M. Gopal, Control Systems Engineering, Fifth Edition, Anshan Publishers, 2008. ISBN: 1848290039, 9781848290037. 4. Harrison and Bollinger, Introduction to Automatic Controls, Second Edition, International Text Book. Co 2007. ISBN: 13-978-0-9676897.	

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Course Title	**FINITE ELEMENT METHOD**		
Course Code	**20ME702**	**LTPC**	**2 -2 -0 -3**
Exam	**03 hours**	**Hours / Week**	**04**
SEE	**50 marks**	**Total hours**	**40**

Course objectives: To make students familiar with the application of Finite Element Method enabling them to formulate and find solutions for structural, thermal and fluid flow problems.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	enumerate the procedure, importance of matrix algebra in finite element method and its applications.	**1,2**	**-**
2	formulate one dimensional elements in structural, thermal & fluid flow engineering using direct/variational/Galerkine's approaches.	**1,2**	**-**
3	apply appropriate procedure in discretization and handle various boundary conditions for solving structural, thermal & fluid flow problems.	**2,5**	**2**
4	create shape functions for various elements in local, natural coordinate systems and explain their role, significance in Finite element formulation.	**1,2**	**-**

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Need for use of FEM, General steps for FEM, Applications of FEM, Matrix algebra, Eigen values and Eigen vectors, Gaussian Quadrature. **Potential Energy Approach:**To derive Spring Element equations, numerical on spring assemblage using PE approach. **Stiffness (Displacement) Method**: Definition of Stiffness Matrix, Derivation of Stiffness Matrix for Spring element, Spring assemblage, Assembling Total Stiffness Matrix, Boundary conditions. Approaches used for handling specified displacement boundary conditions, numerical on spring assemblage using stiffness method.	
Module – 2	**10 Hrs.**
Discretization of domain: Basic element shapes-one, two, three and axisymmetric elements, discretization process. Interpolation polynomials **Shape functions**: For one dimensional linear, quadratic and cubic element, shape functions in natural coordinates, Convergence criteria, selection of the order of the interpolation polynomial, Pascal triangle and Pascal tetrahedron, nodal degrees of freedom, aspect ratio. **Development of Truss Equations:** Derivation of Stiffness Matrix for a Bar Element in local coordinates, Approximate functions for Displacements, Transformation of vectors in Two dimensions, Global Stiffness Matrix, Computation of Stress, and Solution of a Plane Truss, numerical on bars and trusses	

using stiffness method.

Module – 3	**10 Hrs.**

Development of Beam Equations: Beam Stiffness, Assemblage of Beam Stiffness Matrices, Beam Analysis using the Direct Stiffness Method, Distributed Loading, Potential Energy approach, Galerikin's Method for Deriving Beam element equations, numericals on beams with different kinds of supports and loading**.** Finite Element Method applied to Heat Transfer problems: Basic Differential Equations of Heat Transfer, Heat transfer with convection, One Dimensional steady state heat conduction. Finite Element Formulation using variational Method and Galerkin's formulation. Heat transfer by conduction and convection – The one-dimensional fin, the composite wall.

Module – 4	**10 Hrs.**

Finite Element method applied to Fluid flow problems: Basic differential equations – fluid flow in pipes and around solid bodies- One dimensional finite element formulation. Simple problems.

Higher order and Isoparametric Elements: Lagrangian interpolation, Higher order one dimensional elements- quadratic, cubic elements and their shape functions, properties of shape functions, shape functions for 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions- linear, quadratic, shape function of beam element. Hermitshape functions of beam element.

SELF STUDY:

1. Practice and submit analytical solution for structural/thermal/fluid flow problem using any one of the analysis software available.
2. Derive shape functions for higher order 1D and 2D elements.
3. Derive Galerikin's Method for deriving beam element equations.

TEXT BOOK:

1. Daryl L. Logan, A First Course in Finite Element Method, 3rd Edition, 2001, Thomson Brookes/Cole. ISBN: 0495668273 / ISBN -13:9780495668275.

REFERENCE BOOKS:

1. Chandrupatala and Belegunda, Introduction to Finite Elements in Engineering,Pearson education,2002.ISBN -13:978-0-13-21624-6

2. J. N. Reddy, Finite Element Method, Tata McGraw-Hill edition 2002. ISBN: 0071244735.

3. Hutton, Fundamentals of Finite Element Method,McGraw-Hill, 2004.ISBN: 0-07-239536-21

4. Robert Cook, Concepts &applications of FEA,John Wiley & Sons 2002.ISBN:0-471-35605-0

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Course Title	**OPERATIONS RESEARCH**		
Course Code	**20ME703**	**LTPC**	**3-0-0-3**
Exam	**3Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To apply the fundamental techniques of Operations Research to formulate and solve problems involving Linear Programming and heuristic approaches.

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	formulate real-world problems as a linear programming problem and obtain the optimal solutions using graphical and analytical methods.	1,2,3	-
2.	formulate and solve transportation and assignment problems using appropriate method.	2, 4,6	-
3.	design and solve simple models of CPM, PERT and queuing to improve decision making and develop critical thinking and objective analysis of decision problems.	3,5,6,11	-
4.	select the best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models.	3,5,6,11	-

Course Contents:

Module - 1	**10 Hrs.**
Introduction: Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR, Mathematical formulation of L.P. Problems, Graphical solution methods. **Linear Programming Problems:** The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method.	
Module - 2	**10 Hrs.**
Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems **Assignment Problem:** Formulation of Assignment Problem, unbalanced assignment problem, Applications of Assignment Problem, Traveling salesman problem and its applications.	

Module - 3	**10 Hrs.**
PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion. **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.	
Module - 4	**10 Hrs.**
Queuing Theory: Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analysing of M/M/ 1 and M/M/C queuing model **Sequencing:** Johnsons algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs m machines without passing sequence, 2 jobs n machines with passing, Graphical solutions priority rules.	
SELF STUDY: **1.** Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method, demonstrate the solution process by hand and solver. **2.** Perform sensitivity analysis to identify the direction and magnitude of change of a linear programming model's optimal solution as the input data change. **3.** Formulate specialized linear programming problems, namely transportation and assignment problems and describe theoretical workings of the solution methods for transportation and assignment problems, demonstrate solution process by hand and solver.	
TEXTBOOKS: 1. Taha H. A, Operations Research and Introduction**,** Pearson Education edition, 8th edition, 2007, ISBN: 9780131889231. 2. Operations Research, S. D. Sharma –Kedarnath Ramnath & Co, 2002, ISBN: 1234567142552	
REFERENCE BOOKS: 1. AM Natarajan, P. Balasubramani and A Tamilaravari, Operation Research, Pearson 2005 2. 9788131700006. 3. Hiller and Liberman, Introduction to operation research, McGraw Hill. 5th edition 2001, ISBN: 978-0077298340. 4. Ravindran, Phillips and Solberg, Operations Research: Principles and practice: Wiley India ltd, 2nd Edition 2007 ISBN: 9788126512560 5. Prem Kumar Gupta, D S Hira, S Chand Publications,Operations Research, New Delhi, 2007, ISBN: 9788121941006	

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**-**	**3**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO4	**-**	**-**	**2**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Course Title	**CAM AND CAEA LABORATORY**		
Course Code	**20ME704**	**LTPC**	**0-0-3-1.5**
Exam	**3Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**39**

Course objectives: To provide the students with the knowledge of Computer Aided Manufacturing and Engineering through the use of modeling and analysis tools enabling them to acquire skills to carryout manufacturing process simulation and analysis of structural, thermal and fluid flow problems.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}
Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	write APT programs manually and execute them in the CAM software to visualize machining operations	2, 5	2
2.	develop competence in Modelling the machine parts with the tool nomenclature, materials and generate CNC program using CAM software	2, 5	2
3.	construct FE model of the given problem using basic aspects of FEM, apply BC's and obtain solution using CAE software	2, 3, 5	2
4.	conduct structural analyses, normal modes/natural frequency analysis, steady-state heat conduction analysis, fluid flow analysis using finite element software	2, 3, 5	2

Part-A: CAM

1. Writing of manual part programming using ISO codes for machining of simple parts by using turning and thread cutting. Use of radius compensation, canned cycles and macrons.
2. **CNC turning:** Execution of part program for turning operation.
3. **CNC Milling:** Execution of part program for contour milling operation.

Part-B: CAE

Finite element Analysis (using FEM Package) of:

1. Structures such as Bars, Trusses, Beams and Plates.
2. Heat transfer problems – Conduction, conduction with convection, one dimensional, two-dimensional problem.
3. Fluid flow problems.
4. Harmonic analysis of a Fixed-Fixed Beam and Axial Bar.
5. Modal analysis of a Fixed- Fixed Beam.

Activity: Components to be produced using CNC Centre

Scheme of Examination:

One question from Part-A	-15 marks
Two questions from Part-B	- (10+15) marks
Viva-voce	- 10 marks

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Course Title	**DESIGN LABORATORY**		
Course Code	**20ME705**	**LTPC**	**0 – 0 – 2 - 1**
Exam	**03 hours**	**Hours / Week**	**02**
SEE	**50 marks**	**Total hours**	**26**

Course objectives: To provide students with the necessary skills to conduct experiments, collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures to evaluate kinematic and dynamic characteristics of machine elements.

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	determine the behavior of undamped & damped system for longitudinal, torsional and forced vibrations in a single degree freedom system.	**1,2**	**-**
2	conduct experiments on governors, gyroscope, balancing of rotating masses and pressure distribution around journal bearing.	**1,2**	**-**
3	determine the stresses & strains in a member subjected to combined Loading using rosettes and photo elasticity.	**1,2**	**-**

Course Contents:

1. Determination of equilibrium speed, sensitiveness, power and effort of centrifugal governors.
2. Conduct experiments on gyroscope.
3. Experiment on Balancing of rotating masses.
4. Determination of pressure distribution in journal bearing
5. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree freedom system.
6. Experiments on longitudinal, Torsional and forced vibrations.
7. Determination of critical speed of a rotating shaft.
8. Determination of principal stresses and strains in a member subjected to combined loading using rosettes.
9. Demonstration of stress concentration using photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2 D crane hook.
10. Determination of fringe constant of photo elastic material using
    a) Circular disc subjected to diametral compression.
    b) Pure bending specimen (four-point bending).

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Course Title	**HEAT TRANSFER LABORATORY**		
Course Code	**20ME706**	**LTPC**	**0-0-2-1**
Exam	**3Hours**	**Hours / Week**	**02**
SEE	**50 Marks**	**Total hours**	**26**

Course objective: To demonstrate the concepts of modes of heat transfer through collection of data, analysis and interpretation of results for drawing valid conclusions

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs
1.	conduct experiments on conduction, convection and radiation modes of heat transfer: collect data, perform analysis and interpret results to draw valid conclusion through standard test procedures.	1,2,4,7,8,9,10,12
2.	estimate the thermal properties and performance of refrigeration and heat exchanger.	1,2,4,7,8,9,10,12

Course Contents:

1. Determination of Thermal conductivity of a Metal rod.
2. Determination of Thermal conductivity of liquid
3. Determination of overall heat transfer coefficient of a Composite Wall.
4. Determination of Heat Transfer co-efficient in a free convection wall.
5. Determination of Heat Transfer co-efficient in a forced convention flow through a pipe.
6. Experiments on Boiling of liquid and condensation of vapour
7. Determination of efficiency and Effectiveness of the fin by natural convection using pin fin apparatus
8. Determination of efficiency and Effectiveness of the fin by forced convection using pin fin apparatus.
9. Determination of Stefan Boltzmann constant
10. Determination of emissivity of a surface.
11. Determination of LMTD and effectiveness in a parallel flow and counter flow Heat exchanger.
12. Performance Test on a Vapour Compression Refrigerator.

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Course Title	**NON-DESTRUCTIVE TESTING**		
Course Code	**20ME771**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: The objective of this course is to impart knowledge on various non-destructive evaluation and testing methods, theory and their industrial applications.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the basic theory and principles of NDT methods.	1	-
2.	Identify the scope, limitations and applications of the NDT methods	1	-
3.	Apply procedures followed in various NDT techniques	1, 3	-
4.	Identify common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.	1, 6	-

Course Contents:

Module - 1	**10 Hrs.**
Non-Destructive Testing: Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. NDT Versus Mechanical testing, Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection – Unaided and Aided. **Liquid Penetrant Testing:** Physical principles, Procedure for penetrant testing, Penetranttesting materials: Penetrants, emulsifiers, solvent cleaner and developers. Penetrant testing methods, applications and limitations**.**	
Module - 2	**10 Hrs.**
Magnetic Particle Testing: Introduction, principle of magnetic particle inspection, procedure for testing, methods used for magnetization, magnetic particles and suspending liquids, applications and limitations. **Radiographic Inspection:** Introduction, basic principle, methods used for radiographic inspection, X-ray and Gamma – ray radiography, image conversion and recording medias, real time radiography and film radiography. Advantages, limitations and applications (inspections of flat surfaces, weldments and tubular sections).	

Module - 3	**10 Hrs.**
Eddy Current Inspection: Introduction, principles, Instrumentation for eddy current testing Techniques operating variables, inspection coils. Advantages, limitations and applications of eddy current inspection. **Ultrasonic Testing:** Introduction, principle, characteristics of ultrasonic waves, wave propagation, attenuation of ultrasonic beams, variables in ultrasonic inspection, equipments, transducer elements, search units and basic inspection methods.	
Module - 4	**10 Hrs.**
Acoustic Emission Inspection: Introduction, Principle, characteristics of acoustic emission inspection, techniques, sensors, instrumentation, acoustic emission waves and propagation, signal detection and emission counts. Applications of acoustic emission inspection. **Thermal Inspection:** Introduction, principles, heat transfer mechanisms, thermal inspection methods, equipments, Techniques and applications of thermal inspection methods.	
SELF STUDY: The students need to make a survey and report on the following: 1. Defects in Cast and welded components 2. Defects in Formed components. 3. Defects in Machined components etc.	
TEXTBOOKS: 1. Raj Baldev, T. Jayakumar & M. Thavasimuthu, Practical Non-Destructive Testing, Publishing House, Second Edition, Narosa Publishing House, New Delhi, 2002. ISBN: 1-85573-600-4.	
REFERENCE BOOKS: 1. Prasad J &C G Krishnadas Nair, Nondestructive Test & Evaluation of Materials, Tata McGraw-Hill, New Delhi, 2008.ISBN: 978-0-07-062084-1. 2. Boyer, H.E, and T.L. Gall, Metals Handbook, American Society for Metals, 1988.	

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Course Title	**NANOTECHNOLOGY**		
Course Code	**20ME772**	**LTPC**	**3-0-0- 3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**10**

Course Objective: This course is to address the most exciting, novel and interdisciplinary issues in nano science and engineering and particular attention will be on carbon.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	explain the scope and application of Nanoscience and Nanotechnology	1	
2.	analyze physics of nanostructured systems, their current roles in technology and future impact	1, 2, 3	
3.	identify the structure and properties of carbon materials and characterization methods in nanotechnology	1, 3, 4	
4.	describe the manufacturing processes and applications of carbon materials	1, 3	

Course Contents:

Module – 1	**10 Hrs.**
An overview of Nanoscience & Nanotechnology: Historical background, nature, scope and content of the subject, multidisciplinary aspects – industrial, economic and societal implications. **Experimental Techniques and Methods:** Investigating and manipulating materials in the nano scale, electron microscope, scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction.	
Module – 2	**10 Hrs.**
Fullerenes: Synthesis and purification, chemistry of fullerenes in the condensed phase, orientational ordering, pressure effects, conductivity and superconductivity, ferromagnetism, optical properties. **Carbon Nanotubes:** Synthesis and purification, filling of nanotubes, mechanism of growth, electronic structure, transport properties, mechanical and physical properties & applications. **Self-assembled Monolayers:** Monolayers on gold, growth process, phase transitions, patterning monolayers, mixed monolayers – applications. **Gas Phase Clusters:** History of cluster science, formation and growth, detection, and analysis – type and properties of clusters – bonding in clusters.	

Module – 3	**10 Hrs.**
Semiconductor Quantum Dots: Synthesis, electronic structure of nanocrystals, how quantum dots are studied, correlation of properties with size – uses. **Shell Nanoparticles:** Method of preparation, characterization, properties, functionalized metal nanoparticles – applications.	

Module – 4	**10 Hrs**
Nanosensors: Nanoscale organization for sensors, characterization, nanosensors based on optical properties, nanosensors based on quantum size effects, electrochemical sensors, sensors based on physical properties, nano biosensors, sensors of the future. **Molecular Nanomachines:** Covalent and non-covalent approaches – molecular motors and machines – other molecular devices – single molecular devices – practical problems involved.	

SELF-STUDY:

1. Production of Nanomaterials
2. Bioengineered Nanomaterials
3. Case studies on nano materials performance with respect to mechanical engineering.

TEXTBOOKS:

1. T Pradeep (Professor, IIT Madras); NANO: The Essentials – Understanding Nanoscience and Nanotechnology; Tata McGraw-Hill India (2007) ISBN: 9780070617889.
2. Richard Booker & Earl Boysen; Nanotechnology, Wiley (2005). ISBN: 1118054504, 9781118054505.

REFERENCE BOOKS:

1. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology], Di Ventra, et al (Ed); Springer (2004) ISBN: 1402077203, 9781402077203.
2. Linda Williams & Wade Adams, Nanotechnology Demystified, McGraw-Hill (2007) ISBN: 0071460233, 978-0071460231
3. Charles P Poole Jr, Frank J Owens, Introduction to Nanotechnology, Wiley India Pvt. Ltd., New Delhi, 2007.ISBN: 0471079359, 9780471079354.

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**FUNDAMENTALS OF INDUSTRY 4.0 AND INDUSTRIAL IOT**		
Course Code	**20ME773**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**42**

Course Objective:

The course is designed to offer fundamentals of Industry 4.0, IoT and their applications in the business world. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges, especially in the field of Mechanical Engineering.

Upon successful completion of this course, the student shall be able to:

COs	Statement	POs
1.	Knowing fundamentals of Industry 4.0, Industrial revolution and challenges being faced	1, 6
2.	Information on sensors and actuators used in Industry 4.0, Smart Manufacturing and other cyber-physical related attributes.	1, 5
3.	Studying various aspects of IoT, IIoT, current technologies that are driving industries in manufacturing and management.	1, 5
4.	Applications and Case Studies of IoT and IIoT in various streams	1, 4

Course Contents:

Module – 1	**10 Hrs**
Unit 1: Industry 4.0 Introduction, Various Industrial Revolutions, Fourth Revolution, Drivers, Enablers and Challenges for Industry 4.0. **Unit 2:** Lean Production System, Smart Factories, Smart and Connected Business Perspectives, Collaboration Platform and Product Life-Cycle Management.	
Module – 2	**10 Hrs**
Unit 3: Cyber-Physical Systems (CPS) and Next Generation Sensors, Industrial Sensing and Actuation, Smart Manufacturing, Smart Devices and Products, Smart Logistics. **Unit 4:** Automation and Robotics in Industry, Artificial Intelligence, Support system for Industry 4.0, Opportunities in future and strategies for competing in Industry 4.0 era.	
Module – 3	**10 Hrs**
Unit 5: Industrial IoT Introduction, Internet of Things (IoT), Industrial IoT, Industrial Processes, Advanced technologies: Software Defined Networking and Security in IIoT. **Unit 6:** Key Enablers of IIoT: Sensing, Connectivity, Processing & Process control, IIoT Analytics and Data Management: Machine Learning and Cloud computing (Brief description only)	

Module – 4	**10 Hrs**
Unit 7: Applications of IIoT: Inventory Management & Quality Control, Plant Security and Safety, Facility Management, Oil-Chemical & Pharmaceutical Industry, UAVs in Industries, Factories and Assembly Line, Food Industry, **Unit 8:** Case Studies for Industry 4.0 and IIoT: Milk Processing & Packaging Industries, Manufacturing Industries, Virtual Reality Lab, Steel Technology Lab.	
SELF-STUDY: 1. Advanced robotic applications in various industries. 2. Programming of Raspberry Pi and other similar microcontrollers	
ACTIVITY: 1. Developing simple working models using IoT platform.	
TEXTBOOK: 1. Oliver Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key Applications and Protocols", Wiley Publications, 2011. ISBN: 1119966701. 2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 1st Edition, 2017. ISBN: 1484220463. 3. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", Wiley Publications, 2019. ISBN: 8126578378.	

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**					**2**								
CO2	**3**				**2**									
CO3	**3**				**2**									
CO4	**3**			**2**										

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**CONCURRENT ENGINEERING**		
Course Code	**20ME774**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course Objective: The objective is to introduce the students with a systematic approach to the integrated,concurrent design of products and their related processes including manufacture and support and to learn principles of Concurrent Engineering and its applications to reduce product development time.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	discuss the new paradigm areas of concurrent engineering for process and Methodologies to meet manufacturing competitiveness and sustainability with financial management.	1, 11	-
2.	analyze the effect of technological changes by concurrent activities to reduce product development time and life cycle management of a product.	2, 12	-
3.	identify and apply the appropriate C.E principles considering cultural, societal, and environmental factors to arrive at reduction of cost.	3	-
4.	model the information to simulate and communicate the various options to make informed decisions early in the process.	1,10	-

Course Contents:

Module - 1	**10 Hrs**
Introduction: Review of Historical Events. Push and pull for New Paradigms. Areas of Manufacturing Competitiveness. Product and Services. **Process and Methodologies:** Performance Indicators, Manufacturing competitiveness.	
Module - 2	**10 Hrs**.
Life-Cycle Management: Shrinking Life Cycle. Life-Cycle Management, New Product Introduction, Strategic Technology Insertions, Managing Continuity, Managing Revision Changes. **Life-Cycle Cost:** Drivers, Life-Cycle Management Tools, Sequential Versus Concurrent Engineering, Life-Cycle Management	
Module - 3	**10 Hrs**.
Concurrent Engineering Definitions: Introduction, CE Definitions. Basic Principles of CE. Components Of CE. **Concurrency and Simultaneity:** Modes of Concurrency. Modes of Cooperation. Benefits of	

Concurrent Engineering.

Module - 4	**40 Hrs.**

Information Modeling: Information Modeling. Modeling Methodology. Foundation of Information Modeling. Concurrent Engineering Process Invariant.
Enterprise Model: Class, Specification Model-Class, Product Model-Class, Process Model- Class Cognitive Models, Merits and Demerits.

SELF-STUDY:

1. Survey of CE Success: key to Japanese success.
2. Future concurrent engineering.
3. Case studies of Quality Function Deployment.
4. Case studies of successful C.E Applications**.**

TEXT BOOK:

1. Prasad. B, Concurrent Engineering Fundamentals-Integrated product and process organization- Vol. I, PHI, 1996. ISBN: 0131474634, 9780131474635.

REFERENCE BOOKS:

1. Johan.R. Hartely, Concurrent Engineering-Shortening lead times, Raising Quality and Lowering Costs, Taylor and Francis, 1998. ISBN: 1563271893, 9781563271892.
2. Carter DE and Baker BS, Concurrent Engineering-The Product Development Environment for the 1990's,Addison Wesley Publishing Company.
3. I mad Moustapha, Concurrent Engineering in Product Design and Development, 2006, New Age International Publishers, ISBN:81-224-1309-9.

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**ELECTRIC VEHICLE TECHNOLOGY**		
Course Code	**20ME775**	**LTPC**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course Objective: To equip students with fundamental knowledge of Electric Vehicle design and technology, energy storage, charging and discharging, BLDC Motor and controller and calculations.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	apply basic laws and working principles of Electric vehicle system	1,2,3	-
2.	select appropriate motor and converter for EV application.	2,3	-
3.	analysis and selection of batteries and battery indication system for EV vehicles	2,3,7	-
4.	evaluate the parameters for charging the battery charge	2,3,7	-

Module – 1	**10 Hrs.**
Introduction to EV: History of EV Vehicles and basic concepts, social and environmental importance of EV vehicles, EV Vehicles components, batteries, different methods of charging.	
Module - 2	**10 Hrs.**
EV Vehicles Motors: Introduction of Motors (DC,Induction,BLDC)-Types, basic principle and Construction of motor, Electric Drive Trains (EDC), power rating design,peak power source(PPS),Torque coupling and speed coupling, basic structure, drive controller design.	
Module - 3	**10 Hrs.**
Energy Storage System: Batteries-Lead acid, Nickel based, Sodium based, Lithium based, I-ion and Li-poly,Metal air, Zinc chloride, Ultra capacitors, Lithium phosphate,Titanate Batteries, comparison of different batteries. Solar energy storage system.	
Module - 4	**10 Hrs.**
Design and Calculation of EV Vehicles: Drag forces, Rolling resistance, internal resistance, force and torque, Speed,weight,power calculations.	
SELF STUDY: 1. Basic Working Principles of motors	

2. Energy charging and discharging
3. BMS(Battery Management System)

TEXT BOOKS:

1. Electric and Hybrid vehicles by A.K.Babu, khanna publications
2. Electric vehicle and the end of ICE age by Anupam Singh

REFERENCES BOOKS:

1. Electric and Hybride vehicles by Tom Denton ISBN 978-1-138-84237-3
2. Modern ekectric, hybrid electric and fuel cell vehicles by Mehrdad ehsani, Yimingao, stdfanolongo, kambizebrahimimi. ISBN 0-8493-3154-4
3. M.Ehsani,Y, Gao, S. Gay and Ali Emadi: Modern Electric and Hyubride Vehicle and Fuel cell vehicle, Fundamental theory and design CRC Press,2005
4. Iqbal Husain: Electric and hybride vehicle design and fundamentals.
5. James larmine, john lpwry: Electric vehicle technology explained

E-Books / Web References:

www.wiley.com/go/electricvehicle2e

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**1**	**1**											
CO2		**3**	**1**											
CO3		**3**	**1**				**2**							
CO4		**3**	**1**				**2**							

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**LEAN MANUFACTURING**		
Course Code	**20ME781**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objective: To impart the knowledge of constant mode of continuous improvement technique by maximizing the product value and minimizing losses in form of waste reduction during manufacturing process.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	explain lean manufacturing essentials and concepts to meet the global competition	1,6	-
2.	discus Japanese manufacturing techniques and work standards for process improvement	3,7	-
3.	analyze workflow using effective tools for better product efficiency	2, 5	-
4.	provide management practices to control inventory level	3,11	-

Course Content:

Module - 1	**10 Hrs**
Introduction: The rise and fall of mass production, rise of lean production, the origin of lean production, objectives of Lean manufacturing, principles and implications of Lean Manufacturing, Traditional Versus lean Manufacturing **Lean Manufacturing Concepts and Principles:** Lean Manufacturing definition, value creation and Waste elimination, Seven forms of wastes, Benefits of Lean Manufacturing, House of Lean.	
Module - 2	**10 Hrs**
Japanese Manufacturing Techniques: Industrial management in Japan and the world, Just in Time with Total Quality Control, Quality circles, Work Improvement, and standardization **Lean Manufacturing Essentials:** Standard work, standard work and flexibility, visual controls, quality at the source, preventive and breakdown maintenance, TQM and TPM, changeover /setup time-Batch size production-production leveling.	
Module - 3	**10 Hrs**
Value Stream Mapping and Work Cell: The as-is diagram-current and future state map application to the factory simulation scenario-line of balancing Preparation of value stream mapping, Example of Value stream mapping **Lean Manufacturing Tools and Techniques:** Pull versus push system, Kanban, kaizen, 5S, haijunka, Jidoka, Andon, Bottle neck analysis, JIT, KPI, OEE, Poka-Yoke, Root cause analysis,	

SMED. Standardized work Pareto charts.	
Module - 4	**10 Hrs**
Lean Inventory Management: Types of inventory, Lean Inventory Management and their attributes. Limitations of lean Inventory Management. Implementation of Lean Inventory System. **Implementing Lean practices:** Customer focus, areas needed to improve to achieve higher productivity, workplace organization. Road map senior management involvement and best practices.	
SELF-STUDY: 1. Identify the waste in manufacturing industry through route cause analysis. 2. Selection of lean tools requirement 3. Implementation of Lean tools to improve the manufacturing efficiency	
TEXT BOOK: 1. **Simplified Lean Manufacture**, Gopalakrishnan N, PHI Learning Pvt Ltd, 2010 2. **Lean Production Simplified**: A Plain-Language Guide to the World's Most Powerful Production System, Pascal Dennis, (Second edition), Productivity Press, New York.	
REFERENCE BOOKS: 1. **The Machine that changed the World,** James P. Womack, Daniel T. Jones and Daniel Roos, Simon and Schuster. 2. **Toyoto production system –An integrated approach to just in time**, Yasuhiro Modern – Engineering and Management press – Institute of Industrial Engineers Norcross Georgia.	

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**					**2**								
CO2			**3**				**2**							
CO3		**3**			**2**									
CO4			**2**								**3**			

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**MACHINE LEARNING WITH PYTHON**		
Course Code	**20ME 782**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**39**

Course Objective: to provide students with basic skills of python programming an in-depth introduction to two main- areas of machine learning: supervised and unsupervised**.**

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	interpret the basic constructs and OOPS concepts of python language	1,2,5	-
2.	describe variety of machine learning concepts and applications, data modeling & evaluation techniques,	2, 5	-
3.	demonstrate the supervised and unsupervised machine learning algorithms	2, 5	-

Course Content:

Module – 1	**10 Hrs**
Python Basics: The way of Programming, Variables, Expression and Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, **Flow control**: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules.	
Module – 2	**10 Hrs**
Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, List-like Types: Strings and Tuples, **Tuples and Dictionaries and Structuring Data**: The Dictionary Data Type, Pretty Printing. **Introduction to NumPy, Pandas and Matplotlib:** Create arrays using NumPy, perform various operations on arrays and manipulate them, Read & write data from text/CSV files into arrays and vice-versa, Create Series and Data Frames in Pandas, Data structures & index operations in pandas, Importing and exporting data, Reading and Writing data from Excel/CSV formats into Pandas, Create simple plots in matplotlib.	
Module – 3	**10 Hrs**
Introduction to Machine learning: Human learning and its types, Machine learning and its types, Applications, tools and issues in machine learning, Activities in machine learning, Exploring structure of data, Data quality and Preprocessing.	

Modeling and Evaluation: Introduction, selecting a model, training a model, model representation and interpret ability, Evaluating performance of a model.

Module – 4	**10Hrs**

Supervised Learning: SVM ,Regression-Simple linear regression, Multiple linear regression, Assumptions in Regression analysis.

Unsupervised Learning: Supervised Vs Unsupervised, Application, clustering, finding pattern using Association rule.

Programming Exercises:

1. Develop a program to read the student details like Name, USN, and Marks inthree subjects. Display the student details, total marks and percentage with suitablemessages.
2. Develop a program to generate Fibonacci sequence of length (N). Read N fromthe console.
3. Write a function to calculate factorial of a number. Develop a program tocompute binomial coefficient (Given N and R).
4. Read N numbers from the console and create a list. Develop a program to printmean, variance and standard deviation with suitable messages.
5. Write a program to search an element using linear search.

TEXTBOOKS:

1. Al Sweigart,"Automate the Boring Stuff with Python",1 st Edition, No Starch Press,2015. (Available under CC-BY-NC-SA license at https://automateheboringstuff.com/)for lambda functions use this link: https://www.learnbyexample.org/python-lambda- function/
2. Flach, Peter. Machine learning: the art and science of algorithms that make sense of data. Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Mohri, Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of machine learning. MIT press, 2018.
2. Richert, Willi. Building machine learning systems with Python. Packt Publishing Ltd, 2013.
3. Rogers, Simon, and Mark Girolami. A first course in machine learning. CRC Press, 2016.
4. Bowles, Michael. Machine learning in Python: essential techniques for predictive analysis. John Wiley & Sons, 2015.

Course Articulation Matrix

Cos\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	3	-	-	-	-	-	-
CO2	-	2	-	-	3	-	-	-	-	-	-
CO3	-	2	-	-	3	-	-	-	-	-	-

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**MICROELECTROMECHANICAL SYSTEMS**		
Course Code	**20ME783**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course Objective: To study various MEMS fabrication technologies and applications of various Micro sensors and Micro actuators.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	explain the micromachining techniques for specific MEMS fabrication process	1,5	-
2	explain the working principles of micro sensors, actuators, motors, valves, pumps, and fluidics used in Microsystems	1, 5	-
3	explain the applications of Thermal Sensors and Actuators	1,12	-
4	explain the recent developments in micro-optical systems	1, 5	-

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Background and Introduction, Production Engineering, Precision and Ultra-Precision Engineering, Integrated circuits, Micro electromechanical systems. M**icro Machining:** Introduction, Photolithography, structural and sacrificial materials, other lithography methods, thin film deposition, impurity doping, etching, problems with bulb micromachining, surface micromachining, wafer bonding.	
Module – 2	**10 Hrs.**
Mechanical Sensors and Actuators: System on A Chip, Passive Electronic and Mechanical Systems, Principles of Sensing and Actuation, Beam and Cantilever, Micro plates, Capacitive effects, piezo electric materials as sensing and actuating elements, Shear mode piezo actuator, griping piezo actuator, inchworm technology.	
Module – 3	**10 Hrs.**
Thermal Sensors and Actuators: Introduction, micro machined thermo couple probe, Peltier effects heat pumps, thermal flow sensors, micro plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys, U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.	
Module – 4	**10 Hrs.**
Micro-Opto-Electromechanical Systems: Fundamental principle of MOEMS technology, review on	

properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device, light detectors, grating light valve, optical switch, wave guide and tuning
SELF STUDT: Prepare a report on the following: 1. Magnetic Sensors and Actuators 2. Radio Frequency MEMS 3. Micro Fluidic, Chemical and Bio-Medical Micro Systems
Activity: Students to present the MEMS devices/ components used in various applications
TEXT BOOK: Mahalia, NitaigourPremchand, Micro – ElectromechanicalSystems, Tata McGraw Hill Publishing Company Ltd 2007. ISBN:13-938-0-07-063445-9
REFERENCE BOOKS: Tai-Ran Hsu, MEMS and Microsystems- Design, Manufacture and Nanoscale Engineering, John Wiley & Sons, INC. 2008. ISBN: 978-0-470-08301-7.

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**PRODUCT DESIGN AND MANUFACTURING**		
Course Code	**20ME784**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To impart the basic concepts and the knowledge of product development processes, concept generation and tool selection.

Course Outcomes (CO's) {with mapping shown against the Program Outcomes (PO's)}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	identify the importance of successful product development, product planning and customer requirements	1,2	-
2.	explain the techniques of concept generation, selection and impact of the industrial design in product development	1	-
3.	summarize the importance of design for manufacturing and robust design	1, 2	-
4.	recommend design solutions for different engineering problems	3, 10, 12	-

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Characteristics of Successful Product Development, Design and Development of Products, Duration and Cost, Challenges of Product Development, Product Development Process – Five Phases, Concept Development: Front End Process, Adapting the Generic Product Development Process, AMF Development Process, Product development organizations. **Product Planning**: Product Development Process Flows, Product Planning Process –Product planning process, Identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, Complete pre-project planning, Reflect all the results and the process.	
Module – 2	**10 Hrs.**
Identifying Customer Needs: Gather Raw Data from Customers, Interpret Raw Data, Organize the needs into a Hierarchy; establish the relative importance of the needs, Reflect on the results and the process. **Product Specifications:** Specifications, Establishing Target Specifications, Setting the final Specifications. **Concept Generation:** Activities of concept generation, Clarify the problem, search externally and internally, explore systematically, Reflect on the solutions and the process. **Concept Selection:** Overview of methodology, Concept screening, Concept scoring and caveats.	

Module – 3	**10 Hrs.**

Concept Testing: Define the purpose of the concept test, choose a survey population, choose a survey format, Communicate the concept, Measure customer response, Interpret the results, Reflect on the results and the process.

Industrial Design: Assessing the need for industrial design, Impact of industrial design, Industrial design process, Management of industrial design process, Assessing the quality of industrial design.

Module – 4	**10 Hrs**

Design for Manufacturing: Definition, Overview of the DFM process – Estimating manufacturing cost, Reducing component and assembly cost, Reducing the cost of supporting production, Impact of DFM decisions on other factors.

Robust Design: Definition of robust design, Robust Design Process.

Patents and Intellectual Property: Importance and Protection of Intellectual Property Rights, Brief summary of Patents.

SELF STUDY:

1. Prototyping: Objectives, concepts, types-rapid prototyping,and applications.
2. 3D- Modling using cad package and Part Programming.

TEXT BOOKS:

1. Karl. T. Ulrich, Steven D Eppinger, Product Design and Development, McGraw-Hill Education, 2015, 6th Edition, ISBN: 0078029066, 9780078029066.
2. Geoffery Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacture and Assembly, 3rd edition 2002 ISBN=1420089285

REFERENCE BOOKS:

1. A C Chitale and R C Gupta, Product Design and Manufacturing, PH1, 3rd Edition, ISBN=8120333179 2003.
2. Tim Jones and Butterworth Heinmann, New Product Development, Oxford. UCI -1997 ISBN-0750624272, 9780750624275

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**FOUNDATIONS OF ROBOTICS**		
Course Code	**20ME785**	**LTPC**	**3–0–0- 3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**10**

Course objectives: To impart concepts of structure of industrial robots, kinematics, actuators, sensors, intelligent robot, robot applications and programming

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	apply the basic concepts to analyze the structure of industrial robot	1,2	-
2	compare, recommend and justify usage of robotic systems with relevant sensors and vision systems	2, 3	-
3	incorporate the concepts of robot programming and work-cell design for a variety of industrial applications	1, 2	-
4	apply basic principles of robotic design, analytical techniques and D.H method to solve kinematics problems	1, 4	-

Course Contents:

Module - 1	**10 Hrs.**
Basic concepts in robotics: Introduction,Historical development, Automation and Robotics, Robot Anatomy, classification, Basic Configurations of robots, Robot links and joints, Robot specifications: resolution, accuracy & repeatability, compliance, speed of response an stability, work volume, simple numerical problems, Joint notation schemes, PTP and continuous path system, wrist/Gripper/End Effectors Motions, Robot drive systems: hydraulic, pneumatic and electric drive systems, Selection Criteria for Drives. End effectors, types of end effectors, mechanical grippers, methods of constraining parts in grippers, types of gripper mechanisms, simple numerical problems, vacuum cups, magnetic grippers, adhesive grippers, hooks, scoops and other gripper devices, tool as end effectors.	
Module - 2	**10 Hrs.**
Sensors and Robot vision System: Desirable characteristics and classification of sensors, Use of Sensors and Sensor Based System in Robotics, Machine vision system: functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, Object recognition, robotic machine vision applications, inspection, identification, visual surveying and navigation.	

Module - 3	**10 Hrs.**

Robot Programming and workcell Design: A Robot Program as a Path in Space, Motion Interpolation, Robot Language Structure, Methods of robot programming, online lead through teaching, offline programming languages: syntax, structure and statements, Typical Programming Examples such as Palletizing, Loading a Machine.

Robot Workcell design: Robot cell layouts, work cell control and interlocks, Error detection and Recovery, Industrial robots applications.

Module - 4	**10 Hrs.**

Robot Kinematics: Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis, links, joints and their parameters,
Denavit-Hertenberg (D-H) Representation: application of D-H matrices: D.H Convention 3-Axis arm, 3-axis wrist, 6-axis manipulator for PUMA & SCARA Configurations only.

SELF-STUDY:

Students have to perform the following exercises in Robotics laboratory

1. Teaching of robot for palletizing application.
2. Online training of Robot for pick and place application.
3. Robot teaching for component stacking application.
4. Identifying degrees of freedom and their configuration based on observing the structure of the given Robot.
5. Robot teaching for point-to-point application for a spot-welding task.
6. Robot teaching for material handling applications.

TEXT BOOKS:

1. Fu, Lee and Gonzalez, Robotics Control Vision, and Intelligence, McGraw Hill International. ISBN: 0070226253.
2. MikellP. Groover, Industrial Robotics, Weiss, Nagel, McGraw Hill International ISBN: 9780071004428

REFERENCE BOOKS:

1. YoramKoren, Robotics for Engineers, McGraw Hill International. ISBN: 9780070353992,
2. Rafael C. González, C. S and George Lee, Robotics control, sensing, vision and intelligence, McGraw-Hill, 1987. ISBN: 0070226253, 9780070226258
3. Schilling R. J., Prentice-Hall, Fundamentals of Robotics, Analysis and Control, Publications, Eastern Economy edition, ISBN:978-8120310476.

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**INTERNSHIP**		
Course Code	**20ME709**	**LTPC**	**0-0-0-1.5**
CIE	**100 Marks**	**Total hours**	**39 Hrs**

Course Objectives: The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	analyze the impact of engineering solutions in a global, economic, environmental and societal context	2, 6,7, 8	-
2.	comprehend contemporary issues, communicate effectively and to work in teams	2, 9, 10	-
3.	develop the ability to engage in research and to involve in life-long learning	12	-

Course Contents:

An internship is the form of experiential learning that integrates knowledge and theory learned in the classroom with practical application and skills development in a professional setting. The students can opt for Internship in any industry/ /R&D/PSU/Government or semi-government organizations. This caters students, the opportunity to gain valuable applied experience and explore networks in professional fields they are considering for career paths; and give employers the opportunity to guide and evaluate talent. Internship to be carried out for duration of 4 weeks and to be engaged during the semester break starting after second year i.e., after 4th semester examinations.

Contents: Four Weeks of work at industry site. Supervised by an internal guide and expert at the industry.

Mode of Evaluation: work dairy, Internship Report, Presentation, Review on self-evaluation and viva voice

Industry / Organization of Internship	
Work Dairy	1**5**Marks
Report	30 Marks
Presentation	30 Marks
Self-Evaluation	1**0**Marks
Viva Voce	15 Marks
Total Marks	**10**0 Marks

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

OPEN ELECTIVES

Course Title	**PRINCIPLES OF MANUFACTURING**		
Course Code	**20OEME71**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To equip students of other engineering disciplines with the fundamental aspects of manufacturing processes and their applications

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	realize the role of manufacturing processes in other engineering branches and learn principles of different metal forming processes	1, 12	-
2	comprehend the basic principles and recent developments of modern manufacturing processes	1, 12	-
3	realize the significance of various joining and assembly techniques	1, 12	-
4	infer the basic concepts and applications of rapid prototyping	1, 12	-

Course Contents:

Module – 1	**10 Hrs.**
Introduction and overview of manufacturing: History and concepts of manufacturing, Materials in manufacturing, Classification of manufacturing processes. **Fundamentals of metal forming:** Overview of metal forming, working principle, advantages, limitations and applications of rolling, forging, extrusion, wire and bar drawing, sheet metal operations – shearing, blanking and punching, bending operations – V and Edge bending, drawing, bending of tube stock.	
Module – 2	**10 Hrs.**
Fundamentals of material removal: Traditional vs. Non-traditional machining process, working principle, advantages, limitations and applications of ultrasonic machining, abrasive jet machining, electrochemical machining – deburring, grinding and honing, chemical machining, laser beam machining, electron beam machining.	

Module – 3	10 Hrs.
Fundamentals of joining and assembly processes: Working principle, advantages, limitations and applications of electron beam welding, laser beam welding and ultrasonic welding. **Adhesive bonding:** Materials and their properties, advantages, limitations and applications. **Coatings:** Painting, paint application methods, chemical conversion coatings, electroplating, anodizing, electroless plating, mechanical plating, porcelain enameling, clad materials.	
Module – 4	**40 Hrs.**
Rapid Prototyping: Fundamentals of rapid prototyping, rapid prototyping technologies, application issues in rapid prototyping. **Applications of rapid prototyping:** Processing of integrated circuits, electronics assembly, and packaging, micro fabrication technologies, nanofabrication technologies.	
SELF-STUDY: 1. Modern manufacturing processes through online virtual labs. 2. Case studies on rapid prototyping applications in different industrial sectors.	
TEXT BOOK: 1. Mikell, P. Groover. Fundamentals of modern manufacturing: materials, processes and systems. JOHN WILEY, 2019.	
REFERENCE BOOKS: 1. Black, J. Temple, and Ronald A. Kohser. DeGarmo's materials and processes in manufacturing. John Wiley & Sons, 2017. 2. Pham, Duc, and Stefan S. Dimov. Rapid manufacturing: the technologies and applications of rapid prototyping and rapid tooling. Springer Science & Business Media, 2012. 3. Production Technology, HMT TATA McGraw Hill 2001 ISBN-0070764432. 4. Adityan, Modern Machining Process, 2002. ISBN-85143774 -11.	

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**											**1**		
CO2	**3**											**1**		
CO3	**3**											**1**		
CO4	**3**											**1**		

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**INDUSTRIAL ENGINEERING AND ERGONOMICS**		
Course Code	**20OEME72**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To provide the basic knowledge of productivity and method study, work measurement and ergonomics in various sectors and its effectiveness in improvement of productivity.

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	explain the fundamental concepts of productivity and work study	1, 6	-
2.	compare and prepare the charts for the existing method andnew / proposed method to identify the unnecessary movements.	2, 6	-
3.	apply the concepts of work measurement to solve problems related to work measurement and performance of workers	2, 6	-
4.	apply the ergonomic concepts in design of new systems, displays and controls	3, 6	-

COURSE CONTENTS:

Module – 1	**10 Hrs.**
Productivity & work study: Definition of productivity, individual enterprises, task of management. Productivity of materials, land, building, machine and power. Measurement of productivity, Factors affecting the productivity, Productivity improvement programmes (Simple Problems). Basic work content. Definition, objective and scope of work-study. Human factors in work study. Work study and management, work study and supervision, work study and worker	
Module – 2	**10 Hrs.**
Method Study and Tools for Method study: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts (Problems). Charts to record moment at workplace – principles of motion economy, classification of moments, two handed process chart, SIMO chart, (Problems)	

Module – 3	**10 Hrs.**
Work Measurement: Definition, objectives, techniques of work measurement, work sampling, need of confidence levels, sample size determination, random observation with simple problems. **Time study:** Definition, time study equipments, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, standard time determination.	
Module – 4	**10 Hrs.**
Ergonomics and Design of Man-Machine System: Introduction, areas of study under ergonomics, System approach to ergonomics model, Man-machine system. Components of man-machine system and their functions Quantitative, qualitative representation and alphanumeric displays. Controls and their design criteria, Control types, Relation between controls and displays. Design of workplace.	
SELF STUDY: 1. Study of occupational loads 2. Study in detail about working space and working environment. 3. Working environment factors 4. Anthropometry and its importance 5. Risk factors for musculoskeletal disorders in the workplace 6. Predetermined motion time system techniques and development of PMT system	
TEXT BOOKS: 1. Work study, ILO, 3rd edition, 2006. ISBN 81-204-0602-8 2. Work Study & Ergonomics, Suresh Dalela& Saurabh, standard publishers & distributors, 1999. ISBN 9780850660085	
REFERENCE BOOKS: 1. Introduction to Ergonomics, R. C. Bridger, McGraw Hill Publications. ISBN 978-0-8493-7309-0 2. Industrial Design for Engineers, Mayall W. H. London Hiffee Books Ltd., 1988. ISBN -10-0592042057 3. Human Factor Engineering: Sanders & McCormick McGraw Hill Publications. ISBN 08403 16240	

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	-	-	-	-	2	-	-	-
CO2	-	3	-	-	-	2	-	-	-	-	2	-	-	-
CO3	-	2	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	2	-	-	-	-	-	-	-	-

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**PROJECT MANAGEMENT**		
Course Code	**20OEME73**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To impart comprehensive understanding of how to plan, optimize and efficiently manage projects (or tasks) to implement products, services or developments.

Course Outcomes (COs){with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	demonstrate the knowledge of project management, lifecycle, tools and techniques for the success of project	**9, 11**	**-**
2	infer the important steps of project planning and provide accurate cost estimates to plan various activities	**10, 11**	**-**
3	identify the resources required for a project and to produce a work plan for the application of project scheduling tools and techniques	**2, 11**	**-**
4	assess the project performance by companies using various techniques for better project management	**11**	**-**
5	demonstrate the skills and roles of project managers for software efforts and strategy used to deal with the development of software	**5, 11**	**-**

Course Contents:

Module – 1	**10 Hrs.**
Introduction to Project Management: Concept of project, characteristic features of a project, various definitions of project management, classification of projects, phases of project management, project manager and his responsibilities, selection of project manager, The 7S of project management. **Project Planning and Estimation:** Project planning steps, objectives and goals of the project, Feasibility reports, preparation of cost estimation, evaluation methods for project profitability.	
Module – 2	**10 Hrs.**

Organizing and Staffing the Project Team: Authorities of project manager, organizationalstructure and types, accountability in project execution, contracts, 3'R's of contracting, tendering and selection of contractors.

Project Scheduling Tools and Techniques: Gantt chart, bar chart for combined activities, Critical path method (CPM) and Project evaluation and review technique (PERT), Numerical problems

Module – 3	**10 Hrs.**

Coordination and Control: Project direction, communication in a project, PMIS, project coordination control, schedule control.

Performance Measures in Project Management: Performance indicators, performance improvement, The CM & DM companies for better project management, project management environment.

Module – 4	**10 Hrs.**

Software project management: Introduction, computerized project management, managing software projects, overview of capability maturity model (CMM), project management and the CMM.

Case studies on project management: Case studies on project planning, scheduling, tools and techniques, performance measurement.

SELF STUDY:

1. History and Evolution of Project Management
2. Group of students to take up one mini project and apply various phases of project management. Prepare a report on it.
3. Make survey of various software project management tools and use any one tool.

TEXT BOOK:

1. Project Management a System approach to planning Scheduling & Controlling- Harold Kerzner, 10th edition 2009, John Wiley & sons.
2. Chaudhry S, Project Execution Plan- Plan for project Execution interaction, 2001

REFERENCE BOOKS:

1. Software Project Management in Practice-PankajJalote,Pearson education
2. Fundamentals of Project Management: Rory Burke, 2010, Burke Publishing.
3. Project planning scheduling & control, James P.Lawis, Meo Publishing Company, 5th edition 2010.
4. A Management Guide to PERT and CPM, WEIST & LEVY -Eastern Economy of PHI 2002.

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**OCCUPATIONAL HEALTH AND SAFETY ENGINEERING**		
Course Code	**20OEME74**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To apply the basic concept of occupational health and safety standards in work place scenario.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces.	6, 11	-
2.	apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.	6, 7, 11	-
3.	identify fire safety hazard and risk in the work place & report deficiencies.	6, 11	-
4.	ApplyOSHA exposure limits and work place standard to health hazard.	6, 11	-

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws. Indian Acts – Labour Act,Factories Act, OSHA.	
Module – 2	**10 Hrs.**
Occupational Hazard and Control: Hazard Analysis, Human Error and Fault Tree Analysis, Emergency Response. Hazards and their control in different manufacturing and processing industries	
Module – 3	**10 Hrs.**
Fire Prevention and Protection: Types of Fire, Fire Development and its Severity, Effect, Extinguishing Fire, Electrical Safety, Product Safety	
Module – 4	**10 Hrs.**
Occupational Health: Health Safety Considerations, Personal Protective Equipment. Health problems in different types of industries – construction, textile, steel and food processing, pharmaceutical, occupational Health and Safety considerations in Wastewater Treatment Plants.	

SELF STUDY: Prepare a report on: workplace ergonomics, fire safety, workplace violence prevention, employee health resources, environmental safety
TEXT BOOK: Goetsch D.L., "Occupational Safety and Health for Technologists", Engineers and Managers", Prentice Hall.
REFERENCE: 1. Heinrich H.W., "Industrial Accident Prevention", McGraw Hill Publication, Network. 2. Colling D.A., "Industrial Safety Management and Technology", Prentice Hall, New Jersey. 3. Della D.E., and Giustina, "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc. 4. CPHEEO, Manual on Sewerage and Sewage Treatment, M/s.Jain Book Agency, c-9, Connaught place, New Delhi. 5. National Safety Council and Associate (Data) Publishers Pvt. Ltd., "Industrial Safety and Pollution Control Handbook"

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						**3**					**1**			
CO2						**3**	**1**				**1**			
CO3						**3**					**1**			
CO4						**3**					**1**			

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Academic Year 2023-24

VIII Semester B.E. Mechanical Engineering							
Course Type	**Course Code**	**Course Title**	**Credits**			**Total Credits**	**Contact Hours**
			L	T	P		
SR	20ME801	Seminar on Advanced topics	0	1	0	**1.0**	2
PW	20ME802	Project Work	0	0	9	**9.0**	18
HSM	20ME803	Financial Management and Engineering Economics	3	0	0	**3.0**	3
PE	20ME84X	Program Elective – V	3	0	0	**3.0**	3
Total			**6**	**1**	**9**	**16.0**	**26.0**

Program Elective – V	
20ME 841	Fundamentals of Tribology
20ME 842	Composite Materials
20ME 843	Industrial Engineering and Management
20ME 844	Engineering System Design
20ME 845	Occupational Health and Safety Engineering

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**SEMINAR**		
Course Code	**20ME801**	**LTPC**	**0-0-4-2**
CIE	**100 Marks**	**Hours / Week**	**04 Hrs.**

Course Objectives: To upgrade technical presentation and communication skills through literature survey, review and documentation.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	carry out the required literature survey on any topic of research and developments in mechanical engineering	2, 4	-
2.	prepare a technical report based on the literature survey on given topic of the domain of mechanical engineering	2,10	-
3.	acquire presentation skill on any given technical topic	9, 10	-

Course Contents: Seminar shall be either on topics in Mechanical Engineering (not covered under the syllabus) or industrial visit / internship.

SCHEME FOR SEMINAR EVALUATION

Sl. No.	Particulars	Distribution of Marks
1.	Topic	20
2.	Report	20
3.	Presentation Skill	40
4.	Viva Voce	20
	Total	**100**

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**PROJECT WORK**		
Course Code	**20ME802**	**LTPC**	**0-0-9-9**
Exam	**03Hours**	**Hours / Week**	**18 Hrs.**
SEE	**50 Marks**	**Total hours**	**-**

Course Objectives: To take part in group to demonstrate the acquired skill & knowledge gained to identify, formulate, analyze, evaluate and to provide meaningful engineering solutions to Industrial/societal needs.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	identify a problem from the available literature and societal needs	4,7	-
2.	apply principles of mechanical engineering in designing and conducting experiments, data acquisition and interpretation towards meaningful analysis of identified problem	1, 2, 4, 5	-
3.	use their analytical, teamwork and leadership skills in designing and development of products and find solution	4, 5, 6, 8, 9, 10, 11, 12	-
4.	prepare a detailed project report and present the work	10,12	-

SCHEME OF EVALUATION

FIRST PHASE		**MAX MARKS: 10**
Sl. No.	**Particulars**	**Distribution of Marks**
1.	Literature Survey (Team)	5
2.	Presentation skill (Individual)	3
3.	Viva voce (Individual)	2

SECOND PHASE		**Max Marks: 15**
Sl. No.	**Particulars**	**Distribution of Marks**
1.	Problem formulation (Team)	5
2.	Methodology followed (Team)	5
3.	Presentation skill (Individual)	3
4.	Viva voce (Individual)	2

THIRD PHASE		**Max Marks: 25**
Sl. No.	**Particulars**	**Distribution of Marks**
1.	Observations / modelling/Study etc. (Team)	6
2.	Results & Discussion (Team)	6
3.	Conclusions (Team)	5
4.	Presentation skill (Individual)	5
5.	Viva voce (Individual)	3

SEE is conducted for 50 marks by internal and external examiners appointed by the Dean (Exams) on recommendations of the HOD.

Examination	Maximum marks	Minimum marks to qualify
CIE	**50**	**20**
SEE	**50**	**20**

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title	**FINANCIAL MANAGEMENT & ENGINEERING ECONOMICS**		
Course Code	**20ME803**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objective:

To apply the fundamental concepts of financial management and engineering economics to carryout a comparative study based on costs and revenues of engineering operations.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

COs	Statement	Pos
1.	apply the concepts of financial management to solve engineering problems	2, 11,12
2.	apply basic concepts of accounting and finance and thus can implement while working in an organization at managerial position.	2, 11,12
3.	apply the fundamental concepts of economics while solving problems related to economic feasibility of an investment and making decision.	2, 11,12
4.	analyse the impact of inflation, taxation and depreciation on an engineering project.	2, 6,11,12

COURSE CONTENT:

Module -I	**10 Hrs.**
Financial Management: Finance and Related Disciplines, Scope & Objectives of Financial Management. **Volume-Cost-Profit Analysis:** Introduction, Break-even Analysis, Simple Numerical. **Budgeting and Profit Planning:** Introduction, Profit planning, Objectives & essentials of profit planning, Budget planning process, Budget administration, type of budgets, preparation of budgets, advantages, dangers of budgeting, Simple Numerical.	
Module -II	**10 Hrs.**
Book-keeping and Accounting: Book keeping – systems of bookkeeping, Definition of Accounting, Accounting equation, Important accounting terminology- Assets, Liabilities, Drawings, Debit, Credit, Debtors, Creditors, Capital, Investment, loans, shares, debentures and bonds, Journal and Ledger posting, Simple Numerical. **Statements of Financial Information**: Source of financial information, financial statements, Preparation of Trial balance, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account, Simple Numerical.	

Module -III	**10 Hrs.**

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis, Simple Numerical.

Present-Worth Comparisons: Cash flow diagram**,** Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Numerical problems.

Module -IV	**10 Hrs.**

Equivalent Annual-Worth Comparisons and Rate-Of-Return Calculations: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Rate of return, Minimum acceptable rate of return, IRR, Numerical problems.

Depreciation and Taxation: Depreciation meaning, Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, Inflation: Causes, Consequences and Control of Inflation, Inflation in Economic Analysis.

SELF-STUDY:

1. Refer published financial statement of public sector manufacturing company and to interpret company's financial position.
2. Select any one product and estimate cost of manufacturing per unit.

TEXT BOOKS:

1. **Financial Management: Text, Problems & Cases,** M. Y. Khan &P. K. Jain, Sixth Edition, Tata McGraw Hill Education, 2011, ISBN: 978-0-07-106785-0
2. **Engineering Economics,** James L.Riggs, David D.Bedworth and Sabah U.Randhawa, McGraw Hill Education, Fourth edition, 2015, ISBN: 978-0-07-058670-3

REFERENCE BOOKS

1. Chandra, Prasana: Financial Management; Tata McGraw Hill, New Delhi, 2008.
2. R.L.Gupta, V.K.Gupta : Fundamentals of Accounting : Sultan Chand & Sons : Year of Publication 1993
3. Basics of Engineering Economy, Leland Blank & Anthony Tarquin, McGraw Hill Publication (India) Private Limited
4. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title		**FUNDAMENTALS OF TRIBOLOGY**	
Course Code	**20ME841**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Prerequisites: ME 302, ME603

Course objectives: To impart the knowledge of basic principles of friction, wear and lubrication and its importance in selection of machine elements.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	describe basic phenomena related to friction, wear and lubrication	1, 2	-
2.	analyze the effects of friction, wear, and lubrication in metal working process	1,2	-
3.	evaluate possible relationships between tribological response and involved mechanisms.	1,2	-
4.	identify and operate the measuring instruments for tribology	1,9	-

Course Contents:

Module - 1	**10 Hrs.**
Introduction to Tribology: Definition and History of Tribology**,** industrial significance of tribology, Significance of Micro/Nanotribology. **Friction:** Material properties influencing friction, laws of friction, causes/theories of friction, Types of friction, effects of friction. **Wear:** Causes/sources of wear, types of wear (adhesive, abrasive, and corrosive, erosive, fretting), effects of wear, steps for wear prevention/resistance, Wear measurement.	
Module - 2	**10 Hrs.**
Lubrication: Lubrication principles/types **Hydrodynamic Lubrication:** Pressure development mechanism, converging and diverging film, Petroff's equation, Reynolds 2D and 3D equations, Numerical examples on determining rate of flow and coefficient of friction. **Hydrostatic Lubrication**: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity & oil flow through the hydrostatic step bearing, Numerical examples on determining rate of flow and coefficient of friction. **Elastohydrodynamic lubrication**: Introduction, Generation of Elastohydrodynamic Films, Lubrication Regimes in EHL	

Module - 3	**10 Hrs**
Tribology in Metal Working Process: Effect of friction in metal working, Wear and lubrication in rolling, Wear and lubrication in extrusion, Wear and lubrication in forging, Wear and Lubrication in Metal cutting. **Future directions of Tribology:** Nanotribology- basic concepts, Applications of nanotribolgy, Principles of Green Tribology, Areas of Green Tribology. Biotribology, Environmental implications of tribology.	
Module - 4	**10 Hrs.**
Friction and wear measurements: Laboratory experiments/demonstrations: Evaluation of Friction and wear behavior using Pin on Disc Tribometer (ASTM G99), Evaluation of Corrosion properties of Lubricants using Copper Strip Corrosion Method (ASTM D130), Evaluation of Tool wear using Tool Maker's Microscope. Evaluation of Slurry erosion behavior of materials using slurry jet erosion test rig.	
SELF-STUDY: **Scientific Article Review:** An article review is both a summary and an evaluation of another writer's article. This activity is assigned to introduce students to the work of Researchers/Academicians in the field of Tribology.	
TEXTBOOKS: • Stachowiak, Gwidon, and Andrew W. Batchelor. Engineering tribology. Butterworth-Heinemann, 2013. ISBN: 7506-7836-4 • Bharat Bhushan. Principles and Applications of Tribology., John Wiley & Sons, 2013Ltd. ISBN: 9781119944546 • Sushil Kumar Srivastava. Tribology in Industries: S. Chand & Company Ltd. 2001. ISBN 81-219-2045-0	
REFERENCE BOOKS: • B.C. Majumdar, Introduction of Tribology of bearings, Wheelers, and company Pvt. Ltd., 2011-12. ISBN:81-219-29870	

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)

Course Title		**COMPOSITE MATERIALS**	
Course Code	**20ME842**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**10**

Course objectives: Equip the students with knowledge of advanced composite materials, their applications and fabrication techniques along with the standard methods to evaluate them.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	recognize and explicate the types of composite materials and their distinctive features	**1**	**-**
2.	comprehend and explain different fabrication and testing methods employed in manufacturing of composite materials	**1, 9**	**-**
3.	discern various methods used in scrutinizing various defects in composite materials	**1**	**-**
4.	identify the applications of composites in engineering and commercial applications	**1, 7**	**-**

Course Contents:

Module – 1	**10 Hrs**
Introduction to composite materials: Historical development, Basic concept, Classification, Types and effects of reinforcements and matrices, Characteristics of composites, Selection criteria of composite materials, Fillers, Laminates, Prepegs, Sandwich construction, Nano composites, Composites vs. metals, Weight and volume fraction, Advantages, limitations and applications of composites.	
Module – 2	**10 Hrs**
Fabrication and Testing of Polymer Reinforced Composites: Classification of fibers, Natural and synthetic fibers, Polymers – thermoplastic and thermosets, Hand layup method, vacuum bagging technique, filament winding, pultrusion, injection molding, autoclave molding, cutting of laminates, physical tests – density and void fraction, mechanical tests - tensile test, flexural test, interlaminar shear strength test, impact test, water absorption studies, tribological test.	

Module – 3	**10 Hrs**
Metal matrix composites: Reinforcement materials, types, Characteristics & Selection, base metals - selection, applications. Powder metallurgy technique, liquid metallurgy technique. **Non-Destructive Testing:** Purpose, Types of defects, NDT method - Ultrasonic inspection, Radiography, Acoustic emission and Acoustic ultrasonic method.	
Module – 4	**10Hrs**
Application developments: Aircraft and military applications, automotive applications, marine applications, sporting goods, infrastructure, building and civil engineering, chemical industries, electrical and electronics applications, machine elements and mechanical engineering applications, medical field – human implants.	

SELF STUDY:

- Extraction techniques employed for different natural fibers and methods used for their characterization (FTIR, XRD, TGA, DSC, SEM etc.,)
- Fabrication of a composite laminate using hand lay-up technique using a natural/synthetic fiber/fabric.
- Carrying out physical (density & void fraction) or mechanical property (tensile, flexural or impact) or water absorption tests on prepared composite laminate using standard formulae and equipments as per standard ASTM methods.

TEXT BOOK:

1. K. K. Chawla, Composite Science and Engineering, Springer Verlag 1998. ISBN: 0387984097.
2. Autar K. Kaw, Mechanics of Composite Materials, CRC Press New York, 2nd edition, 1997. ISBN: 0849396565, 9780849396564.

REFERENCE:

1. Hull and Clyne, Introduction to composite materials, Cambridge University Press, 2nd edition, 1990. ISBN:1-85166-468-8.
2. Ronald F. Gibson, Principles of composite Material Mechanics, McGraw Hill International, 1994. ISBN-13: 9780070234512.
3. Mein Schwartz, Composite Materials Handbook, McGraw Hill Book Company - 1984. ISBN-10: 0070557438, 13: 978-0070557437.
4. Robert M. Jones, Mechanics of Composite Materials, McGraw Hill Kogakusha Ltd. – 2008. ISBN:9780070853478.
5. Fonning Metal hand book, 9th edition, ASM handbook, V15. 1988, P327- 338.
6. V. Srinivasan, Smart Structures analysis and Design, Cambridge University Press, Cambridge Newyork -2001. ISBN: 052165027.

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Course Title	**INDUSTRIAL ENGINEERING AND MANAGEMENT**		
Course Code	**20ME843**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course Objectives: To analyse different planning activities needed during the operations stage of a manufacturing or a service industry and apply productivity techniques for achieving continuous improvement.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	analyse the way price of a product that affects the demand for a product for consequent actions and predict demand for a product by making use of different demand forecasting techniques.	2, 11	-
2.	manage and implement different concepts involved in method study and understanding of work content in different situations.	2, 9, 11	-
3.	describe different aspects of work system design and facilities design pertinent to manufacturing industries.	2, 9, 11	-
4.	apply cellular manufacturing concepts in industry and compute material requirement needed to satisfy the Master Production Schedule of a factory by having thorough understanding of MRP logic.	2, 11	-

Course Contents:

Module - 1	**10 Hrs.**
Introduction to macro and micro-economics: Macro-economic measures – microeconomics – Demand and supply – Determinants of demand and supply – Elasticity of demand – Demand forecasting techniques (short term & long term) – Problems. **Elements of cost:** Determination of Material cost - Labour cost – Expenses - Types of cost – Cost of production – Over-head expenses–break even analysis - Problems.	
Module - 2	**10 Hrs.**
Introduction to work study: Method study, Time study, micro-motion study and principles of motion economy, Work measurement: time study, work sampling, standard data, PMTS; performance rating allowances. **Work system design:** Introduction to ergonomics and its scope in relation to work. Outline for discipline of anatomy, physiology and psychology, with respect to ergonomics building blocks such as anthropometry and biomechanics Job evaluation, merit rating, incentive schemes, wage administration and business process reengineering.	

Module - 3	**10 Hrs.**
Facility Design: Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques– CRAFT, ALDEP, CORELAP; assembly line balancing; materials handling systems. Concepts of Group Technology and cellular manufacturing.	

Module - 4	**10 Hrs.**
Cellular Manufacturing: Group Technology – Cellular layout – Machine-Part Cell Formation (MPCF) – Heuristic approaches – Hierarchical clustering for MPCF. **Material requirement Planning (MRP)**: Objectives – functions – MRP system – MRP logic – Management information from MRP – lot sizing consideration – Manufacturing resource planning – capacity requirement planning (CRP) – Bill of material.	
SELF STUDY: A brief history of ergonomics, Attempts to 'humanise' work, Anatomy, posture and body mechanics, Postural stability and postural adaptation, Low back pain, Risk factors for musculoskeletal disorders in the workplace, Behavioural aspects of posture.	
TEXTBOOK: 1. R Dan Reid, and Nada R. Sanders, Operations Management, John Wiley & Sons, 5th Edition, 2012.	
REFERENCE BOOKS: **1.** Introduction to Work study, ILO, Geneva, and Oxford & IBH Pub Co. Pvt. Ltd. **2.** Ergonomics at Work, Murrell **3.** Plant Layout and Material Handling, James M. Apple, John Wiley & Sons **4.** Facility Layout and Location – An Analytical Approach, Richard L. Francis& John A. White,Prentice Hall	

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Course Title	**ENGINEERING SYSTEM DESIGN**		
Course Code	**20ME844**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objective: To make students apply the concepts such as designing at system level, reliability, man-machine interaction, and engineering economics while evaluating various design concepts.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	apply knowledge of system design to generate innovative ideas for solving engineering problems	2,3	-
2.	develop design morphology, identify and analyze the need, and evaluate alternatives.	2,3	-
3.	apply reliability concepts in system design	2,6	-
4.	apply appropriate combinations of advanced concepts of engineering economics and man machine interaction	2, 3,6	-

COURSE CONTENTS:

Module- 1	**10 Hrs.**
Introduction: What is designing, Man as a designer, Design by evolution, inadequacies of traditional design method, System approach of engineering problems, Need models: design history of large-scale existing system. **Morphology of Design:** The three phases of design projects, the structure of design process, decision making and iteration. **Identification and Analysis of Need:** Preliminary need statement, analysis of need, specifications, standards of performance and constraints.	
Module - 2	**10 Hrs.**
Origination of Design Concept: Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brain storming. **Preliminary Design:** Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis.	
Module– 3	**10 Hrs.**
Evaluation of Alternatives and Design Decisions: Physical realizability, Design Tree: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical). **Reliability Considerations in Design:** Bathtub curve, exponential reliability function, system reliability concept (Numerical).	

Module- 4	**10 Hrs.**
Economics and Optimization in Engineering Design: Economics in Engineering Design, Fixed and variable costs, break-even analysis (Numerical) **Man-Machine Interaction:** Man-machine cycle, Design of displays and controls. Factors influencing displays and controls.	
SELF STUDY: Sustainability, Planning and Design for Sustainability, Environmental Considerations, Environmental Assessment Programs and Techniques, Social Impact, Social Assessment Tools and Methods	
TEXT BOOKS: 1. V. Gupta and P. Murthy, An Introduction to engineering design method, Tata McGraw Hill, 2000. ISBN-0070964416. 2. Graeme Dandy, Trevor Daniell, Bernadette Foley and Robert Warner, Planning & Design of Engineering Systems, Third Edition, CRC Press, 2018. ISBN: 978-1-1380-3189-0	
REFERENCE BOOKS: 1. D.D. Meredith, K.W. Wong, R.W. Woodhead and K.K. Worthman, Design &Planning of engineering systems. 2000 2. M.A. Asimov, Introduction to Design, Prentice Hall. 1996 3. J. C. Jones, Design Methods, John Wiley & Sons Inc., 1992. ISBN: 0-471-28496-3. 4. T. Woodson, Introduction of Engineering Design, McGraw Hil1, 2001.	

MALNAD COLLEGE OF ENGINEERING, HASSAN
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Course Title	**OCCUPATIONAL HEALTH AND SAFETY ENGINEERING**		
Course Code	**20ME845**	**LTPC**	**3-0-0-3**
Exam	**03Hours**	**Hours / Week**	**03**
SEE	**50 Marks**	**Total hours**	**40**

Course objectives: To apply the basic concept of occupational health and safety standards in work place scenario.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces.	6, 11	-
2.	apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.	6, 7, 11	-
3.	identify fire safety hazard and risk in the work place & report deficiencies.	6, 11	-
4.	Apply OSHA exposure limits and work place standard to health hazard.	6, 11	-

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws. Indian Acts – Labour Act, Factories Act, OSHA.	
Module – 2	**10 Hrs.**
Occupational Hazard and Control: Hazard Analysis, Human Error and Fault Tree Analysis, Emergency Response. Hazards and their control in different manufacturing and processing industries	
Module – 3	**10 Hrs.**
Fire Prevention and Protection: Types of Fire, Fire Development and its Severity, Effect, Extinguishing Fire, Electrical Safety, Product Safety	
Module – 4	**10 Hrs.**
Occupational Health: Health Safety Considerations, Personal Protective Equipment. Health problems in different types of industries – construction, textile, steel and food processing, pharmaceutical, occupational Health and Safety considerations in Wastewater Treatment Plants.	

SELF STUDY: Prepare a report on: workplace ergonomics, fire safety, workplace violence prevention, employee health resources, environmental safety
TEXT BOOK: Goetsch D.L., "Occupational Safety and Health for Technologists", Engineers and Managers", Prentice Hall.
REFERENCE: 1. Heinrich H.W., "Industrial Accident Prevention", McGraw Hill Publication, Network. 2. Colling D.A., "Industrial Safety Management and Technology", Prentice Hall, New Jersey. 3. Della D.E., and Giustina, "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc. 4. CPHEEO, Manual on Sewerage and Sewage Treatment, M/s.Jain Book Agency, c-9, Connaught place, New Delhi. 5. National Safety Council and Associate (Data) Publishers Pvt. Ltd., "Industrial Safety and Pollution Control Handbook"

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						**3**					**1**			
CO2						**3**	**1**				**1**			
CO3						**3**					**1**			
CO4						**3**					**1**			