MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous Programmes

BACHELOR of ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME and SYLLABUS

(2023-24 Admitted Batch)

V AND VI SEMESTERS (THIRD YEAR)

Academic Year 2025-26

Department of Mechanical Engineering

Vision of the institute

To be an institute of excellence in engineering education and research, Producing socially responsible professionals.

Mission of the institute

1. Create conducive environment for learning and research
2. Establish industry and academia collaborations
3. Ensure professional and ethical values in all institutional endeavors

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.

PROGRAM OUTCOMES (POs)

Mechanical Engineering students shall be able to,

1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

3. **Design/Development of solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

4. **Conduct investigations of complex problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

5. **Engineering tool usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

6. **The engineer and the world**: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

8. **Individual and collaborative team work**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary settings.

9. **Communication**: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

10. **Project management and finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

11. **Life-long learning**: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8

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.

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	**10**
CIE - 2		Descriptive Test	**10**
CIE - 3		Descriptive Test	**10**
Activity	Minimum of two activities to be conducted	Assignment / Case study/Practical/ Working model /Quiz	**20**
		Total	**50**

Examination		**Maximum marks**	**Minimum marks to be scored**	**Minimum Average marks to qualify**
CIE	**Tests**	**30**	**12 (> = 40%)**	**40 (> = 40%)**
	Activity	**20**	**08 (> = 40%)**	
SEE		**50**	**17.5 (> = 35%)**	

Scheme of Evaluation (Laboratory Courses)

Evaluation Type	**Evaluation modules**	**Marks**
Continuous internal Evaluation (CIE) in every lab session by the Course coordinator	Conduction of experiments	10
	Observation and tabulation of results	10
	Record writing	20
	Viva voce/Quiz	10
CIE		**50**
SEE		**50**

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

MALNAD COLLEGE OF ENGINEERING, HASSAN
B.E. in Mechanical Engineering
Scheme of Teaching and Examinations2024
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2024-25)

V Semester B.E. Mechanical Engineering

Sl NO	Course Category	Course Code	Course Title	Teaching Hours/Week				
				Theory Lecture	Tutorial	Practical /Drawing	Credits	Duration in hours
				L	T	P	C	
1	HSMS	23ME501	Industrial Management & Entrepreneurship	3	0	0	3	3
2	PCC	23ME502	Fluid Mechanics & Fluid Machines	4	1	0	4	5
3	PCC	23ME503	Machine Design	4	1	0	4	4
4	PCCL	23ME504	Fluid Mechanics and Fluid Machines Lab	0	0	2	1	3
5	PCCL	23ME505	CNC Programming and 3-D Printing lab	0	0	2	1	3
6	PEC	23ME55X	Professional Elective - I	3	0	0	3	3
7	PROJ	23ME506	Mini Project	0	0	4	2	3
8	AEC	23RIP	Research Methodology and IPR	3	0	0	3	3
9	MC	23EVS	Environmental Studies	0	0	2	1	2
Total				**17**	**2**	**10**	**22**	**26**

Professional Elective-I Course		
	23ME551	Mechatronics
	23ME552	Project Management
	23ME553	Quality Control and Management
	23ME554	Principles of CAD/CAM

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

23ME501 **LTPC: 3-0-0-3**

Exam Hours: 3 **Hours / Week: 04**

SEE: 50 Marks **Total hours: 40**

Course Objective: To develop proficiency for making rational decisions regarding problems likely to be encountered in professional practice, by applying management concepts and entrepreneurial skills.

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	POs	PSOs
1	Explainthebasicconcepts of management and entrepreneurship	1,11	-
2	apply the conceptual knowledge of management and entrepreneurship to make rational decisions in professional practice	1,11	-
3	utilize the initiatives by government and private institutions to boost entrepreneurial spirit	1,11	-

Course Contents:

Module –1	10 Hrs.
Management: Introduction, Management Functions, levels of management, Roles of a Manager, Managerial Skills, Managerial Effectiveness. **Planning:** Nature, importance and purpose of planning process, types of plans (meaning only), steps in planning & planning premises.	
Module –2	**10 Hrs.**
Organizing: Characteristics of an Organisation, types of organization, Process of Organizing, Span of Management, Departmentalization, Committees, Authority, Responsibility, Centralization and Decentralization. Staffing: Recruitment, Selection. **Directing:** Requirements of Effective Direction, Motivation: Maslow's Need-Hierarchy Theory, Herzberg's Two-Factor Theory, Leadership styles. Coordination: meaning, importance and techniques. **Controlling:** Meaning, steps in controlling, essentials of a sound control system.	
Module- 3	**10 Hrs.**
Entrepreneurship: Introduction, steps in entrepreneurship, role of entrepreneurs in economic development, entrepreneurship in India, corporate entrepreneurship, entrepreneurial competencies, capacity building for entrepreneurs, myths about entrepreneurship, environmental factors affecting entrepreneurial growth, creating a favorable environment for entrepreneurship.	
Module – 4	**10 Hrs.**
MSME: Role and importance, concepts and definitions, government policy initiatives for MSME, schemes for MSME, role of clusters in promoting MSME, problems in MSME sector, impact of liberalization, privatization and globalization on MSME sector, effect of WTO/GATT. Institutions supporting business enterprises: Central, state level and other institutions.	

Self-Study:

1. Prepare and present a report on business enterprises.
2. Case study on
    - Successful entrepreneurs.
    - User innovation and entrepreneurship from rural India.
    - Women entrepreneurship and the opportunity to promote India's development.
    - Information Technology and Entrepreneurship.

- Entrepreneurship and Economic Development in a Developing Country.
- Entrepreneurship and Innovation & Business creation and management.
- Social Enterprise.

3. Prepare and present a report on how to utilize the resources available effectively through ERP
4. Prepare and present a report on how to make use of IPRs and institutional support in entrepreneurship

TEXTBOOKS

1. Principles of Management, P C Tripathi, P N Reddy& Ashish Bajpai, Tata McGraw Hill, Seventh Edition, 2021. ISBN: 9789354600630
2. Entrepreneurship Development and Small Business Enterprises, Poornima M.Charantimath, Pearson, Third Edition, 2021

REFERENCE:

https://www.msme.gov.in/

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3										2			
CO2	3										2			
CO3	3										2			

FLUID MECHANICS AND FLUID MACHINES

23ME502 **LTPC: 4-1-0-4**

Exam Hours: 3 **Hours / Week: 05**

SEE: 50 Marks **Total hours: 52**

Course objectives:
To impart the students with fundamental knowledge of fluid properties, concept of fluid flow &basics principles of energy conversion in turbomachines

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

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

COs	Statement	POs	PSOs
1.	apply the fundamental laws of fluid statics and kinematics to various hydraulic systems	1,2, 3	-
2.	apply fluid flow governing equations to design free surface & pipe flows.	1,2,3	-
3.	analyseenergy transfer,stage parameters and performance characteristics of various turbomachines.	1,2,3	-
4.	analyse energy transfer and perform the preliminary design of steam turbines, hydraulic turbines and centrifugal pumps.	1,2,3	-

Module-I	**13 Hrs.**
Fluid statics: Definition of fluid, Fluid properties (No derivation & numerical problems), Classification of fluids, Pascal's Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of static fluid pressure: Hydrostatic forces on Plane –Inclined and Curved surfaces, Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy, Metacenter–Determination of Metacentric Height (Analytical method)-Numerical Problems. **Fluid kinematics:** Description of fluid motion – Lagrangian and Eulerian approach, Types of flows, Continuity equation, Continuity equation in three Dimension, velocity and acceleration, Streamlines, path lines and streak lines, Stream function and velocity potential function - Numerical Problems. **Self-Learning Component**: Manometers, Pressure at a point, Relation between pressures, Reynolds transport theorem.	
Module-II	**13 Hrs.**
Fluid dynamics: Euler and Bernoulli's equations, Practical application of Bernoulli's Equation– orifice meter, Venturi meter, Navier–Stokes Equations (No derivation) -Numerical Problems. **Flow through pipes:** Measurement in pipe flow- Major loss, Darcy–Weisbach equation, Minor losses (Numerical problem), Hagen Poiseuille equation-laminar flow through circular pipe and flow between two parallel stationary plates- (No Numerical Problems). **Self-Learning Component**: Introduction to flow through pipes and channels, Types of flows, Reynolds experiment.	
Module-III	**12 Hrs.**
Basics of Turbomachines: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance (No numerical questions on dimensional analysis), Unit and specific quantities, Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Numerical problems. **Steam Turbine**: Classification, Single stage impulse turbine, Condition for maximum blade	

efficiency, Stage efficiency, Nozzle efficiency, Need and methods of compounding, Numericalproblems.
Self-Learning Component: Derived quantities

Module-IV	**12 Hrs.**

Centrifugal pump: Centrifugal pumps, Work done, Head developed, Pump output and Efficiencies, Priming, Minimum starting speed, Performance of multistage pumps, Cavitation, Methods of prevention, Pump characteristics, Numerical Problems.
Hydraulic turbines: Classification of hydraulic turbines, Pelton wheel - Francis turbine - Kaplan and Propeller turbines, Velocity triangles, Specific speed, Theory of draft tube, Performance characteristics, Selection of turbines, (Numerical Problems only on Pelton wheel.)
Self-Learning Component: Introduction, Unit quantities

TEXTBOOKS:

1. Streeter V.L., Benjamin Wylie, "Fluid Mechanics", McGraw Hill Book Co., New Delhi, 1999, *ISBN*: 0070622426 9780070622425.
2. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008, *ISBN* 10: 8122431895 / *ISBN* 13: 9788122431896.

REFERENCES:

1. Robert W. Fox, Alan T. McDonald, Philip J. Pirtchard John W. Mitchell, Introduction to Fluid Mechanics, 9th Edition, Wiley Publications, 2015.
2. Dr. R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 5th Edition, Laxmi Publication, 2012, New Delhi, *ISBN*-10: 8131808157; *ISBN*-13: 978-8131808153.
3. Principals of Turbo machines, D. G. Shepherd, The Macmillan Company (1964), *ISBN* 10: 0024096601 / *ISBN* 13: 9780024096609.
4. Fluid Mechanics & Thermodynamics of Turbo machines, S. L. Dixon, Elsevier (2005), *ISBN* 9781856177931, 9780080962597

Tutorial Classes

1.	Numerical problems on Fluid statics
2.	Numerical problems on Fluid statics
3.	Numerical problems on Fluid Kinematics
4.	Numerical problems on Fluid Dynamics
5.	Numerical problems on Flow through pipes
6.	Numerical problems on Flow through pipes
7.	Numerical problems on Turbo machine
8.	Numerical problems on Turbo machine
9.	Numerical problems on Steam turbine
10.	Numerical problems on Steam turbine
11.	Numerical problems on Centrifugal pump
12.	Numerical problems on Centrifugal pump
13.	Numerical problems on Hydraulic turbines
14.	Numerical problems on Hydraulic turbines

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 the entire COs shall be covered.	Descriptive Test	**10**
CIE - 2		Descriptive Test	**10**
CIE - 3		Descriptive Test	**10**

Activity	Minimum of two activities to be conducted	Industrial visit / Case study/ Working model	**20**
SEE			**50**
Total			**100**

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1											
CO2	3	3	1											
CO3	3	3	3											
CO4	3	3	3											

MACHINE DESIGN

23ME503 **LTPC: 4-1-0-4**

Exam Hours:**3** Hours / Week :**05**

SEE: **50 Marks** **Total hours: 52**

Course objectives:

To design simple machine elements subjected to static and dynamic loads using the concepts of stress analysis and theories of failure.

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

COs	Statement	Pos	PSOs
1.	apply basic stress-strain analysis and failure theories to design machine elements subjected to Static and Dynamic loads	1,2,3,12	1
2.	design of mechanical elements such as curved beams and fasteners	2,3,5,9,12	2
3.	design of different types of gear drives for dynamic and wear considerations using standard practices	2,3,5,9,12	2

COURSE CONTENTS:

Module – 1	
Introduction: Mechanical Engineering Design, Phases of design Process, Design Considerations, Engineering Materials and their mechanical properties, Review of definitions - normal, shear, Biaxial and Triaxial Stresses, Principal Stresses. Design for Static Strength: Theories of failure – Maximum Normal stress Theory, Maximum Shear stress Theory, Distortion Energy Theory; Brittle and ductile failure. Stress concentration, Determination of Stress concentration factor. **Design for dynamic loads**: Impact strength: Introduction, Impact stress due to Axial, Bending and Torsional loads, Impact factor.	**13 Hrs.**
Module -2	
Fatigue loads: Introduction, Fatigue failure, Definition of Low Cycle Fatigue and High Cycle Fatigue, S-N diagram, Endurance Limit, Correction factors for Load, Size and surface finish, Fatigue Stress concentration factor, Notch sensitivity, Factors affecting Fatigue; Goodman and Soder-berg relationships. Problems on members subjected to fatigue due to Axial, Bending, Torsion, and combined loads. **Curved Beams**: Winkler - Bach equation, Stresses in curved beams of standard cross sections used in crane hook, Punching presses and clamps.	**13 Hrs.**
Module – 3	
Design of Gears- Spur and Helical Gears: Definitions, stresses in gear tooth, Lewis's equation and form factor, design for strength, dynamic and wear loads. Bevel Gears: Definitions, formative number of teeth, stresses in gear tooth, design for strength, dynamic and wear loads. **Design of Worm Gears:** Definitions, design based on strength, dynamic, wear loads and efficiency of worm gear drives.	**13 Hrs.**
Module – 4	
Threaded Fasteners: Stresses in Threaded Fasteners. Effect of Initial Tension, Design of Threaded Fasteners under Static, Dynamic and Impact loads. Eccentrically loaded bolted joints, **Riveted Joints**: Failures of Riveted joints, Design of Boiler joints as per IBR, eccentrically loaded riveted joints, **Welded Joints** – Types, Strength of Butt and Fillet welds, eccentrically loaded welded joints.	**13 Hrs.**

Self-study component

- Design of components subjected to eccentric loads
- Cumulative fatigue damage, Miner's rule. (https://www.sciencedirect.com/science/article/abs/pii/S0142112397000819)
- Design of splined shafts.
- Keys: Types of Keys, Selection of square keys
- Design of Knuckle Joint, cotter joint, Rigid and Flexible couplings: Flange Coupling, Bush and pin type Coupling
- Influence of Heat Affected Zone (HAZ) in welded joint
- Differential and Compound screws, Recirculating ball screw.

https://freevideolectures.com/course/2363/design-of-machine-elements-i

Tutorials:

1. Numerical on members subjected to static load
2. Numerical with respect to biaxial stresses acting on an object
3. Numerical on Theories of failure
4. Numerical on member subjected to axial impact load
5. Numerical on member subjected to bending impact load
6. Numerical on member subjected to repeated fatigue load
7. Numerical on member subjected to completely reversible fatigue load
8. Numerical on spur gears
9. Numerical on helical gears
10. Numerical on bevel gears
11. Numerical on worm gears
12. Numerical with respect to design of threaded fasteners
13. Numerical with respect to design of rivets
14. Numerical with respect to design of welded joints

TEXTBOOK:

1. Maleev&Hartman's, *Machine Design in SI units,* 6th Edition, C B S Publications, Delhi, 2015. ISBN:9788123926322

REFERENCE BOOKS:

1. M.F. Spotts, T.E. Shoup, L.E. Hornberger, S.R.Jayaram&C.V.Venkatesh, *Design of Machine Elements*, Pearson Education, 8th Edition, 2006. ISBN 9788177584219
2. Joseph Edward Shigley, *Mechanical Engineering Design,* Mc. Graw Hill, 8th Edition, 2008. ISBN:9780073529288.
3. V. B. Bhandari, *Design of Machine Elements,* TMH, 3rd Edition, 2007. ISBN:9780070681748

DESIGN DATA HANDBOOKS:

1. K. Mahadevan and Balaveera Reddy, Design *Data Handbook,* C B S Publications, Delhi. 4th edition, 2013. ISBN: 9788123923154.

COURSE ATRICULATION MATRIX

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	-
CO2	-	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**2**
CO3	-	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**2**

FLUID MECHANICS AND FLUID MACHINES LABORATORY

23ME504 **LTPC: 0-0-2-1**

Exam Hours: 3 **Hours / Week: 02**

SEE: 50 Marks **Total hours: 26**

Prerequisites: Fluid Mechanics and Fluid Machines

Course objective: 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 calibrate the fluid flow measuring devices and to evaluate performance of hydraulic machines.

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.	demonstrate& evaluate the losses through the pipes and the use of flow measuring devices.	1,2,9,10	-
2.	demonstrate the impulse-momentum principle to evaluate the hydrodynamic force exerted on a body by impact of jet.	1,2,9,10	-
3.	evaluate the performance parameters of hydraulic turbines and pumps.	1,2,3,9,10	-

Course Contents:

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Experiments on flow measuring devices
    a) Orifice plate
    b) Venturi-meter
4. Flow through notches
5. Impact of jets on vanes
6. Performance tests on Turbines
    a) Pelton Wheel
    b) Francis Turbine
    c) Kaplan turbine
7. Performance tests on pumps
    a) Centrifugal pump
    b) Reciprocating Pump.

SEE Scheme:

1.	One experiment from either 1 to 5	15 Marks
2.	Any one performance test either from6 or 7	25 Marks
3.	Viva Voce	10 Marks
	Total:	50 Marks

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3							2	2				
CO2	3	3							2	2				
CO3	3	3	2						2	2				

CNC PROGRAMMING AND 3-D PRINTING LAB

23ME505 **LTPC: 0-0-2-1**

Exam Hours: 3 **Hours / Week: 02**

SEE: 50 Marks **Total hours: 26**

Course objectives:

- ToexposethestudentstothetechniquesofCNCprogrammingandcuttingtoolpathgenerationthroughCNCsimulationsoftwareby using-Codes and M-codes.
- To educate the students on the usage of CAM packages.
- To impart skillsontheusageof3DPrintingTechnology

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 concepts of computer numerical control & 3D-printing technology.	1,5,9,10	-
2	simulate CNC machining operations using CAM packages	1,5,9,10	2
3	prepare components using 3D-printing technology	1,5	2

The following topics should be covered before starting the experiments:

Fundamentals of Machining, Fundamentals of Numerical Control, Elements of CNCSystem, Design Considerations of CNC Machine Tools, CNC Tooling, Automatic Tool Changers, Tool Magazines, Work Holding, Incremental andAbsolute Systems of Programming, G-codes& M-codes, Machine Control Panel, Work Offset.

Sl.No.	Experiments
1.	Simulation of work offset on CNC simulator.
2.	Simulation of part program to perform Facing operation using SinuTrain.
3.	Simulation of part program to perform Facing & Turning operation using SinuTrain.
4.	Simulation of part program to perform Step Turning operation using SinuTrain.
5.	Simulation of part program to perform Taper Turning & Fillet operation using SinuTrain.
6.	Simulation of part program to perform Thread Cutting&Grooving operation using SinuTrain.
7.	Simulation of part program to perform milling operation using CNC simulator.
8.	Generation and simulation of part programs to perform milling operation using CAM packages.
9.	Simple3DPrintingModel:CreatingSimple3DmodelinCADsoftwareandprintingthemodelusing3DPrinter.
10.	AssemblyModel-1: Creatinga3DCADmodelofNUTandBoltprintthemodelusing3DPrinterandChecktheassembly.

11.	AssemblyModel-2: Creating a 3DCADassemblymodelcontainingfourormorepart(examplescrewjack,Plumberblocket c.) andprintthemodelusing3DPrinterandCheckthеassembly.
	DemonstrationExperiments(ForCIE)
1.	Model-1: Preparing a model using CNC turning center (CNC Lathe) as per given dimensions by performing facing, turning, step turning and taper turning operations
2.	Model-2: Preparing a model using CNC machining center (CNC Milling Machine) as per given dimensions by performing pocket milling or face milling operations

Scheme of Evaluation

Evaluation Type	Evaluation modules	Marks
Continuous internal Evaluation (CIE) in every lab session by the Course coordinator	Conduction of experiments from 1 to 11	30
	DemonstrationExperiments	10
	Record writing	10
	CIE	**50**
Semester End Examination		
1. One experiment from 3 to 8		20
2. One experiment from 9 to 11		20
3. Viva-Voce		10
	SEE	**50**

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	2				3									3
CO3	2				3									3

MECHATRONICS

23ME551 **LTPC: 3-0-0-3**

Exam Hours: 3 **Hours / Week: 03**

SEE: 50 Marks **Total hours: 40**

Course Objectives: To impart knowledge of Microprocessors, Microcontrollers, PLCs and their roleinMechatronicssystems.Tointroducethestudents,thefundamentalsofinterdisciplinaryengineeringcomponents andtheir integrationinMechatronicssystems design approach.

CourseOutcomes (COs) {withmappingshownagainst the **Program Outcomes (POs)}**

Uponcompletionofthecourse,students shallbeableto:

#	Course Outcomes	Mappingto POs	Mappingto PSOs
1.	Interpretthebasic principlesofMicroprocessor,Microcontrollerand their applications	1, 2	-
2.	apply the concepts of automatic control system for Engineering applications using digital controls	1, 3	-
3.	design digitally controlled Mechatronics and PLC system for industrial process automation	3, 5	-

CourseContents:

Module-1	10 Hrs.
Introduction to Microprocessors: Evolution of Microprocessor, organization of Microprocessor based system. Memory - Flip-Flop as a storage element. 8085 Microprocessor Instruction set Instruction classification.Architecture of 8085 Microprocessor. Instruction fetches operation**.** Microprocessor communication and bus timings. **Microcontrollers**-Architecture of 8051 Microcontroller, selection factors. Comparison of Microprocessor and Microcontroller. Microchip Microcontrollers. Interfacing and Applications	
Module-2	**10 Hrs.**
Signal conditioning and Actuation systems – Analog andDigital signals – Analogue to Digital Conversion (ADC), Digital to Analogue(DAC), Data acquisition systems. Actuators: Encoders, D. C. Motors, A. C. Motors, Stepper motors. **Mechatronics:** Introduction, Role of Various Engineering disciplines in Mechatronics, The Design process, Systems, Measurement systems, Control systems, Microprocessor based controllers.	
Module-3	**10 Hrs.**
Introduction to PLC: Introduction, Basic PLC structure, Input/output processing, Introduction to Programming of PLCs, General PLC Programming procedures, for process control. PLC Timer and Counter functions, Simple Ladder Logic Programs using above PLC functional elements for automatic industrial process controls	
Module-4	**10 Hrs.**
Design of Mechatronics Systems: Mechatronics system Case studies: Design Solutions for **Autotronics;** Car engine Management systems, Windscreen Wiper Mechanism Engine, Temperature Measurement, Antilock or Antiskid Device, Air Bag Deployment System etc. **Avionics**; Aircraft Engine Control, Cockpit Instrumentation etc. Automatic Camera System, Pick and place robot, Engine management system etc., MEMS and Microsystems, overview of Micro manufacturing, Introduction to Artificial Intelligence.	

Self-learningcomponents:

- Sensor Networks in Mechatronics
- Mechatronics in Biomedical Engineering
- Autonomous Robots using Mechatronics
- Mechatronics in Agriculture: Opportunities and Challenges
- Networking PLCs: Levels of Industrial control, Types of Networking,
- Network communications, PLC and Internet, Cell control by PLC Networks.

Activity:

Activity:

1. **Introduction to programmable open-source microcontroller board** - Introduction to Arduino IDE- features, IDE overview. Programming concepts, Concept of GPIO in programmable open-source microcontroller board, digital input and output. Peripheral Interface
2. PLC in automation and its applications

TEXTBOOKS:

1. William Bolton, Mechatronics, Sixth Edition, Pearson, ISBN-9788131732533
2. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Fifth Edition, Pearson, 2015, ISBN-13 978-9332555129

REFERENCEBOOKS:

1. Aditya P. Mathur, "Introduction to Microprocessors", THM 3rd edition, 2000, ISBN_0-07-460222-5
2. Stamatios Manesis & George Nikolakopoulos, Introduction to Industrial Automation, CRC Press, 2018, ISBN: 978-1-4987-0540-0
3. Hugh Jack, Automating Manufacturing Systems with PLCs, Publisher: Lulu.com (September 12, 2010); eBook (Creative Commons Licensed)
4. M D Singh and J G Joshi, Mechatronics, Prentice-Hall-India, ISBN-81-203-2986

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	2		2											
CO3			3		1									

PROJECT MANAGEMENT

23ME552 **LTPC:3-0-0-3**

Exam Hours: **3** Hours/Week:**03**

SEE: **50Marks** Totalhours:**40**

Courseobjectives:Toimpart a comprehensiveunderstandingofhowtoplan,optimizeandefficiently manageprojects (ortasks) to implementproducts,servicesor developments.

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

(POs) Uponsuccessful completionofthiscourse,thestudentshallbeableto

CO's	Statement 's	PO's
1	describe project management, the project lifecycle, planning, estimating, and the project manager's roles.	1, 9, 11
2	demonstrate project organization structures, tendering and contracting processes, scheduling, and CPM and PERT.	1, 2, 9, 11
3	comprehend,how organizations enhance project management through directing, coordinating, and controlling.	1, 9, 10, 11
4	explain the importance of software efforts and techniques in project management and conduct project case studies.	1, 9, 10, 11

CourseContents:

Module–I	**10 Hrs.**
IntroductiontoProjectManagement: Conceptofprojectandprojectmanagement, characteristic features and classification of projects, phases of Project management,selectionofprojectmanagersandtheirduties. **ProjectPlanningandEstimation:**Projectplanningsteps,objectivesandgoalsoftheproject,Feasibilityreports, financing arrangements,preparationof cost estimation,evaluationmethodsforprojectprofitability.	
Module–II	**10 Hrs.**
OrganizingandStaffingtheProjectTeam:Authoritiesofprojectmanager, organizational organizational structure and types, accountability in project execution, contracts, 3'R'sofcontracting, tenderingprocessandselection of contractors, team building. **ProjectSchedulingToolsandTechniques:**Gantt chart,barchartforcombinedactivities, Critical path method (CPM) and Project evaluation and reviewtechnique(PERT), Numericalproblems	
Module–III	**10 Hrs.**
Project Direction, Coordination and Control: Project direction, communication in a project, PMIS,projectcoordinationcontrol,schedulecontrol& cost control. **Riskmanagement:**Introduction,RiskManagement Process, Monitoring andControlRisks. **PerformanceMeasuresinProjectManagement:**Performanceindicators, performance improvement,TheCM&DMcompaniesforbetterprojectmanagement,projectmanagement environment.	

Module–IV.	10Hrs
Software project management: Introduction, computerized project management,managing software projects, overview of capability maturity model (CMM), projectmanagementandtheCMM.**Casestudiesonprojectmanagement:** CasestudiesonProjectplanning,scheduling,toolsandtechniques,performancemeasurement.	

Self-StudyComponent:

- HistoryandEvolutionofProjectManagement
- Groupofstudentstotakeuponminiprojectandapplyvariousphasesofprojectmanagement .Preparareportonit.
- Makesurveyof various Softwareprojectmanagementtoolsanduseany one tool.

Textbook:

1. ProjectManagementaSystemapproachtoplanningScheduling&Controlling-HaroldKerzner, 10th edition 2009, John Wiley &sons.
2. ChaudhryS,ProjectExecutionPlan-PlanforprojectExecutioninteraction,2001

ReferenceBooks:

1. SoftwareProject Management inPractice-PankajJalote,Pearsoneducation
2. FundamentalsofProject Management: RoryBurke,2010,BurkePublishing.
3. Projectplanningscheduling&control,JamesP.Lawis,MeoPublishingCompany,5th editi on 2010.
4. AManagementGuidetoPERTandCPM,WEIST&LEVY-EasternEconomyofPHI2002.

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2								3		3			
CO2	2	2							3		3			
CO3	2								3	2	3			
CO4	2								3	2	3			

QUALITY CONTROL AND MANAGEMENT

23ME553 **LTPC:3-0-0-3**
Exam Hours: **3** Hours/Week:**03**
SEE: **50Marks** Totalhours:**40**

Course objective: To make students apply quality management concepts and statistical process control techniques to improve quality.

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 basic concepts of quality management	1,2	-
2	apply statistical process control techniques to control the quality standards	2	-
3	develop and interpret control charts	2	-

COURSE CONTENTS:

Module – 1	**10 Hrs.**
Quality Management: Introduction, basic approach, TQM framework, different dimensions of quality, historical review and Deming's philosophy. Continuous Quality Improvement Tools: PDSA cycle, Juran quality trilogy, Kaizen, benchmarking, steps involved in benchmarking process, 5S, 3M and poka-yoke.	
Module – 2	**10 Hrs.**
Statistical Process Control: Introduction, pareto diagram, process flow charts, cause and effect diagram. Statistical fundamentals: Six sigma, process capability, chance and assignable causes of quality variations, statistical basis for the control charts.	
Module – 3	**10 Hrs.**
Control charts for variables: Development and interpretation of $\bar{X}$&Rcharts: Process Capability Estimating, Process capability ratio, Fraction of nonconforming, Revision of Control Limits and Center Lines, Control Limits, Specification Limits and Natural Tolerance Limits.Development of$\bar{X}$&charts.	
Module – 4	**10 Hrs.**
Control Charts for Attributes: Introduction, control charts for fraction defectives, development of control charts for constant sample size & variable sample sizes, and control charts for defects. Guidelines for implementing control charts, construction, applications and interpretation of p – chart, np – chart and C –chart.**AcceptanceSampling:**Introduction, Types of Sampling Plan.	
SELF LEARNING COMPONENT: ➢ Quality management systems: Quality management principles, development of ISO 9000 series standards, ISO 9001:20015 requirements, implementation of ISO 9001:20015, comparison between ISO 9001:20015 and ISO 9001:2000, documentation, certification, benefits of ISO certification. ➢ Environmental management systems: Importance of ISO standards, ISO standards for different sectors, environmental management systems, ISO 14000 series standards, concepts of ISO 14001, requirements of ISO 14001:2015, implementation of ISO 14001:2015, benefits of environmental management system, documentation and certification.	

Textbooks:

1. Dale H. Bester field, Total Quality Management, Pearson Education India, 2018. ISBN: 9789353066314, Fifth Edition
2. Douglas C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, Inc. 6th edition.ISBN: 978-0-470-16992-6

Reference Books:

1. M. Zairi, Publisher, Total Quality Management for Engineers, Wood head Publishing, ISBN: 1855730243
2. Manohar Mahajan, Statistical Quality Control, Dhanpati Rai and Sons, New Delhi, 2018.
3. E.L. Grant, and R.S. Leavenworth, Statistical Quality Control, Seventh Edition, TMH, New Delhi, 2016. ISBN: 0-07-114248-7

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2		3												
CO3		3												

PRINCIPLESOFCAD/CAM

23ME554 **LTPC:3-0-0-3**

Exam Hours:3 **Hours/ Week:03**

SEE:50Marks **Totalhours: 40**

CourseObjective:

To make students apply the concepts of CAD to develop models of machine components andCAMto obtain machined components.

Course Outcomes (COs) {with mapping shown against the **Program Outcomes (POs)**}**Upon successful completion ofthis course, studentsshall beableto:**

COs	Statement	Pos	PSOs
1	acquire the basic concepts of CAD/CAM with their software requirementsanddifferentgeometricalmodelingtechniquestodevelopmodelsof machinecomponents	1,3,5	2
2	IllustratetheconceptsofCNCandCAMtowritepartprogramsforvarious Machining operationsandobtainmachinedcomponents	1,2,5	-
3	Discussttheadvancedmanufacturingapproachestoensureoptimum utilizationofavailable resources	1,2	-

COURSECONTENTS:

Module-I	**10Hrs**.
Computer Aided Design: Introduction of CAD and CAM tools, Product Life Cycle. Softwareconfiguration for graphic system, Functions of graphic package. **Principles of ComputerGraphics:**Graphic primitives, Database Co-ordinate systems, 2-D Transformations of geometry,Displayfunctions like Window, Viewport, viewingand clipping operations.	
Module-2	**10 Hrs.**
Modeling Techniques: Geometrical Modeling and its importance, modeling types: solid,wireframe & surface modeling, approaches. **Mathematical representations of Surfaces:**Surface entities, Parametric representations of Analytical and Synthetic surfaces (Bezier and B-spline).	
Module-3	**10 Hrs.**
Computer Aided Manufacturing: Basic components of NC, NC coordinate systems, NCmotioncontrol systems,CNC and DNC features. **CNC programming Techniques:** Part programming fundamentals, Preparatory andMiscellaneousfunctions, Typical examplesofDrillingandMillingoperationsthroughmanualpartprogramming methods.	
Module-4	**10 Hrs.**
Advanced Manufacturing Approaches: Rapid prototyping and its processes, SL, LTP,Flexible Manufacturing System, Reconfigurable Manufacturing Systems, Reverse Engineering,Leanmanufacturing,	

TextBooks:

1. Michel P Groover & Emory W Zimmeres, JR, CAD & CAM, TMH, 2nd Edition, 2004, ISBN-81-203-04020-0
2. Ibrahim Zeid "S.Subramanya V. Raju, CAD & CA Theory and practice, TMH, 2nd Edition,2010,ISBN-0-07-463991-9

Reference Books:

1. Dr. SadhuSingh,ComputerAidedDesignandManufacturing,Khannapublishers,2011,ISBN:81-7409-069-3
2. P.N Rao, "CAD&CAM Principles & Application", TMH, 2nd Edition, 2004, ISBN-13-978-81-2336-8.

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	1	-	1	-	-	-	-	-	-	-	-	1
CO2	2	1	-	-	1	-	-	-	-	-	-	-	-	1
CO3	2	1												

MINI PROJECT

23ME506 **LTPC:0-0-4-2**

Exam Hours:3 **Hours/ Week:04**

SEE:50Marks **Totalhours:**

Course Objectives: To take part in a 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 thrust areas in field of Mechanical or allied areas of Engineering	1, 2, 4, 6,7	-
2.	generate and implement innovative ideas for social benefit	1, 2, 4, 5,6	-
3.	Conducting preliminary Analysis /Modeling /Simulation /Experiment /Design/Feasibility	4, 5, 6, 8, 9, 10, 11, 12	-
4.	prepare a report on the Study conducted for presentation	10,12	-

The objective of Mini Project is to enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The mini project is designed to develop practical ability and knowledge about tools/techniques to solve the actual problems related to industry, academic institutions or similar area. The mini project should be undertaken preferably by a group of minimum two and maximum four students who will jointly work together and implement the project. Students can take up any application level/fabrication level/ experimental design / implementation tasks of relatively minor intensity and scope as compared to the major project, pertaining to a relevant domain of study. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. At the end of each phase, presentation and demonstration of the project should be conducted, which will be evaluated based on the rubrics set by the department under the committee of HOD, one professor, one Associate professor and one Assistant Professor. A detailed project report duly approved by the guide in the prescribed format should be submitted by the student for final evaluation.

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

Examination	Maximum marks	Minimum marks to qualify
CIE	**100**	**40**

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		3		2	2							
CO2	2	3			2	2								
CO3				3	3	2		3	3	2	2	2		
CO4										3		2		

Course Title	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS		
Course Code	23RIP	L-T-P	(3-0-0) 3
CIE	50	Hours/Week	3
SEE	50	Total Hours	40

Course Objective: To give an overview of technical research activities and patenting methodology.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Carry out Literature Review and write technical paper	2,3,4,8,12	-
2.	Describe the fundamentals of patent laws and the patent drafting procedure.	6,8,10,12	-
3.	Elucidate the copyright laws and subject matters of copyright	6,8,10,12	-

MODULE-1 — 10 Hrs.

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering

Research, Types of Engineering Research. **Ethics in Engineering Research**: Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of

Prior Art ,Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading.

MODULE-2 — 10 Hrs.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions.

Technical Writing and Publishing : Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?—The Choice, Writing, Journal Paper: Structure and Approach: Title, Abstract, and Introduction, Methods, Results, and Discussions, Table, Figures, Acknowledgments, and Closures

MODULE-3 — 10 Hrs.

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights

Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable

Matters. Patent Infringements.

Process of Patenting: Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Do I Need First to File a Patent in India. Patent Related Forms. Fee Structure. Types of Patent Applications.

MODULE-4 — 10 Hrs

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright.Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word

‘Publish’. Transfer of Copyrights to a Publisher. Copyrights and the Word ‘Adaptation’. Copyrights and the Word ‘Indian Work’. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration.

Self study: Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, IP Organizations In India.

Textbooks:

1. Dipankar Deb, Rajeeb Dey, Valentina E, Balas, “Engineering Research Methodology”, Springer, 2019.
2. Prof. Rupinder Tewari, Ms. Mamta Bhardwa, “Intellectual Property” , Professor Gurpal Singh Sandhu Honorary Director, Publication Bureau, Panjab University, 2021.

Reference Books:

1. David V. Thiel, “Research Methods for Engineers”, Cambridge University Press, 2014.
2. N.K.Acharya, “Intellectual Property Rights”, Asia Law House, 8th Edition, 2021.

MOOC:

https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Course Articulation Matrix

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

Course Title	Environmental Studies		
Course Code	23EVS	L-T-P	(0-0-2) 1
Exam	3 Hrs.	Hours/Week	2
CIE	100 Marks	Total Hours	20

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

#	Course Outcomes (CO)	Mapping to POs
1.	Acquire an awareness of sensitivity to the total environment and its allied problems.	7, 9,12
2.	Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it.	6,8
3.	Analyze and evaluate environmental measures in real world situations in terms of ecological, political, economic, societal and aesthetic factors.	6, 7,8, 9

MODULE-1 **5Hrs**

Environment: Definition, Ecosystem, Balanced ecosystem, Effects of human activities on environment Agriculture Housing Industry Mining and Transportation.

MODULE-2 **5 Hrs.**

Natural Resources: Water resources, Availability and Quality, Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources - Forest Resources - Material Cycles - Carbon, Nitrogen and Sulphur Cycles.

MODULE-3 **5Hrs**

Pollution: Effects of pollution - Water pollution - Air pollution Land pollution - Noise pollution.

MODULE-4 **5 Hrs.**

Current Environmental issues of importance: Acid Rain, Ozone layer depletion - Population Growth, Climate change and Global warming. Environmental Impact Assessment and Sustainable Development Environmental Protection - Legal aspects. Water Act and Air Act.

Text Books:

1. Environmental Studies - Dr. D.L Manjunath, Pearson Education -2006
2. Environmental Studies - Dr. S. M. Prakash - Elite Publishers – 2006

Reference Books:

1. Environmental Studies - Benny Joseph - Tata McGraw ill- 2005
2. Principles of Environmental Science and Engineering P. Venugopala Rao, Prentice Hall of India.
3. Environmental Science and Engineering - Meenakshi, Prentice Hall India.

Assessment Strategy

CIE	Schedule	Assessment Method	Marks	Duration (Min.)
CIE I	At the end of 8 weeks	Objective Questions	25	60
CIE II	At the end of 11 weeks	Objective Questions	25	60
Project	At the end of 14 weeks	Project/Presentation/Prototype development/Plantation	50	-

Course Articulation Matrix

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

VI Semester Academic Year 2025-26

Sl. No.	Course Category	Course Code	Course Title	Teaching Hours/Week				
				Theory Lecture	Tutorial	Practical/ Drawing	Credits	Duration in hours
				L	T	P	C	
1	IPCC	23ME601	Heat Transfer	3	0	2	4	5
2	PCC	23ME602	Mechanical Vibrations	3	0	0	3	3
3	PEC	23ME63X	Professional Elective - II	3	0	0	3	3
4	OEC	23OEME64X	Open Elective -I	3	0	0	3	3
5	PROJ	23ME605	Major Project Phase - I	0	0	4	2	3
6	PCCL	23ME606	Design lab	0	0	2	1	3
7	AEC	23ASK	Analytical Ability & Soft Skills	0	0	2	1	1
8	MC	23ME608	Sustainable Engineering	0	0	2	0	2
9	OEC	23SW01	Swayam (NPTL)	0	1	0	0	2
Total				**12**	**1**	**12**	**17**	**25**

Professional Elective-II Course

23ME631	Additive Manufacturing	23ME633	Geometric Dimensioning and Tolerancing
23ME632	Fundamentals of Industry 4.0and Industrial IoT	23ME634	Automotive Engineering

Open Elective-I Course

23OE ME 61	Principles of Manufacturing
23OE ME 62	Project Management
23OE ME 63	Accounting for Engineers
23OE ME 64	Operations Research
23OE ME 65	Industrial Engineering and Ergonomics
23OE ME 66	Occupational Health and Safety Engineering

HEAT TRANSFER

23ME601 **LTPC: 3-0-2-4**
Exam Hours:03 **Hours / Week: 05**
SEE: 50 Marks **Total hours:40+12**

Course objective:
To equip the students with fundamentals and mechanisms of heat transfer enabling them to develop methodologies for solving practical problems.
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 basic law of heat transfer to account for the conscience of modes of heat transfer in thermal analysis of engineering system	1, 2,3,9,10
2.	analyze unsteady heat transfer in lumped capacitance and semi-infinite solid thermal systems.	1, 2
3.	analyze the heat transfer mechanism through natural and forced convection inside ducts and exterior surfaces	1, 2,7,9,10
4.	carry out preliminary design of heat exchanger using LMTD methods and apply the concept of boiling and condensation and the principle of radiation heat transfer	1, 2,7,9,10

COURSE CONTENTS:

Module –I	
Introduction: Modes of heat transfer; Basic laws governing modes of heat transfer. Conduction-Basic Equations: Derivation of general form heat conduction equation in rectangular coordinates. Types of boundary conditions, Thermal resistance in series and in parallel. **One dimensional steady state conduction:** Steady state conduction in a slab, cylinder and sphere with and without heat generation, Composite wall, overall heat transfer coefficient, critical thickness of insulation, Heat transfer in extended surfaces of uniform cross-section without heat generation, long fin, short fin with insulated tip and without insulated tip. Fin efficiency and effectiveness. Numerical problems.	**10 Hrs**.
Module – II	
One-Dimensional Transient Conduction: Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder, and sphere; Numerical Problems. **Free or Natural Convection:** Application of dimensional analysis for free convection-physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal, and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems**.**	**10 Hrs**.
Module – III	
Forced Convection: Applications of dimensional analysis for forced convection. The physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems. **Heat Exchangers:** Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD method of analysis of heat exchangers. Numerical problems.	**10 Hrs**.

Module – IV	
Condensation And Boiling: Types of condensation (discussion only), use of correlations for condensation on vertical flat surfaces, horizontal tube, and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems. **Radiation Heat Transfer:** Radiation laws, Thermal radiation; Radiation heat exchange between two parallel infinite black surfaces and infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Numerical problems	**10 Hrs**.

TEXTBOOKS:

1. Principals of Heat Transfer,FrankKreith, Raj M. Manglik, Mark S. Bohn, Seventh Edition, Cengage learning, 2011.
2. YunusCengelandAfshinGhajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education (India) Private Limited;5th Edition,2015.

REFERENCE BOOKS:

1. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
2. P.K.Nag, Heat & Mass Transfer, TMH, 2008. ISBN:0-07-047337-4
3. S.P.Sukhatme, Heat transfers, 4th edition. ISBN:8173715440
4. R.K.Rajputh, Heat & Mass Transfer, S.Chand& Company Ltd, 3rd Edition, 2006. ISBN :81-219-1777-8

HEAT TRANSFER DATA HANDBOOK:

1. Heat and Mass Transfer Data Book (S.I. Unit) by V.M. Domkundwar, Anand V. Domkundwar ISBN: 670000000039, Publisher: DhanpatRai&Co.Year of publishing: 2014.

E-BOOKS/WEB REFERENCES:

1. A Textbook of Heat Transfer, John H Lienhard, 4th Edition,
2. NPTEL Heat Transfer course for Mechanical Engineering, http://nptel.ac.in/courses/112101097/
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com

MOOCs:

1. Fluid flow, Heat and Mass Transfer- http://ocw.tudelft.nl/courses/applied-earth-sciences/fluid-flow-heat-mass-transfer/course
2. Heat transfer course- https://legacy.saylor.org/me204/Intro/

Exp NO.	EXPERIMENT NAME	Marks	COs	Pos	Level
1	Determination of Thermal conductivity of a Metal rod.	**20**	**CO1**	1,2, 9,10	**3**
2	Determination of Thermal conductivity of a liquid	**20**	**CO1**	1,2, 9,10	**3**
3	Determination of overall heat transfer coefficient of a Composite Wall	**20**	**CO1**	1,2, 9,10	**3**
4	Determination of Heat Transfer co-efficient for free convection wall	**20**	**CO3**	1,2, 9,10	**3**
5	Determination of Heat Transfer co-efficient for forced convention	**20**	**CO3**	1,2, 7,9,10	**3**
6	Determination of Stefan Boltzmann constant	**20**	**CO4**	1,2, 9,10	**3**
7	Determination of emissivity of a surface.	**20**	**CO4**	1,2, 9,10	**3**
8	Determination of efficiency and Effectiveness of the fin by natural convection using pin fin apparatus	**20**	**CO1**	1,2,7, 9,10	**3**
9	Determination of efficiency and Effectiveness of the fin by forced convection using pin fin apparatus	**20**	**CO1**	1,2, 7,9,10	**3**
10	Determination of LMTD and effectiveness in a parallel flow and counter flow Heat exchanger	**20**	**CO4**	1,2, 7,9,10	**3**
	Average of 10 Experiments = 20 marks	**26 Hrs.**			

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2						3	3				
CO2	3	3	2						3	3				
CO3	3	3	2				2		3	3				
CO4	3	3	2				2		3	3				

MECHANICAL VIBRATIONS

23ME602 **LTPC:3-0-0-3**

Exam Hours:3 **Hours/ Week:03**

SEE:50Marks **Total hours: 40**

Course objectives:

Toprovidebasicknowledgeonprinciplesofvibrationstoanalyses,modelandbuild mechanical systems.

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.	Analyze undamped and amped free vibration for single degree freedom systems	2, 5	-
2.	Analyze forced vibration for single degree of freedom systems	2	-
3.	Design mechanical systems to achieve vibration isolation and measurement of vibration	2	-
4.	analyze free & forced vibration for two and multi degree off reedom systems	2, 3	-

Course Contents:

Module–1	**12Hrs.**
Introduction: Types of Vibrations, Simple Harmonic Motion (S.H.M),and principle of super position applied to Simple Harmonic Motion, Beats, Undamped Free Vibrations: Single degree off reedom systems, Undamped free vibrations natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum. **Damped Free Vibrations:** Single degree freedom systems, different types of damping, concept ofcriticaldamping and its importance, study of response of viscous damped systems for cases of underdamping,criticalandover damping, Logarithmic decrement	
Module–2	**08Hrs.**
Forced Vibrations: degree freedom systems, steady state solution with viscous damping due toharmonicforce.SolutionbyComplexalgebra,reciprocatingandrotatingunbalance,vibration isolation-transmissibility ratio,due to harmonic excitation and support motion.	
Module–3	**10 Hrs.**
Vibration Measuring Instruments &Whirling of Shafts: Vibrometer and accelerometer. Whirling of shafts with and without air damping, discussion of speeds above and below critical speeds. **Systems with Two Degrees of Freedom:** Introduction, principal modes and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions.	

Module–4	10 Hrs.
Numerical Methods for Multi Degree Freedom Systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, method of matrix iteration - Method of determination of all the natural frequencies using sweeping matrix andorthogonalityprinciple.Holzer'smethod, Stodolamethod.	

Self-StudyComponent

1. Harmonic Analysis - Fourier's Series. Vibration Analysis:https://youtu.be/Vj1xmze3GlE.Vibration Diagnostics for beginners:https://youtu.be/4fDqII7ut6Y
2. ApplicationsofTwoDegreesofFreedomSystemslike vehicle esuspension,dynamicvibrationabsorber,Dynamics ofreciprocatingEngines
3. MechanicalVibration-VirtualLabs,http://mdmv-nitk.vlabs.ac.in/#.

TEXTBOOKS:

1.S.S.Rao,*MechanicalVibrations***,** PearsonEducationInc,6th Edition,2017.ISBN-9780134361307.

REFERENCEBOOKS:

1. LeonanrdMeirovitch, Elements*ofVibrationsAnalysis*,MH,SpecialIndianedition,2007,ISBN-81-7700-047-0.
2. S.GrahamKelly,*MechanicalVibrations*,Schaum'soutlineseries,TMH,SpecialIndianEdition,2007,ISBN-14-09780070616790.

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3			1									
CO2		3	1											
CO3		3												
CO4		2	3											

ADDITIVE MANUFACTURING

23ME631 **LTPC: 3-0-0-3**

Exam Hours: 3 **Hours / Week: 04**

SEE: 50 Marks **Total hours: 40**

Course objectives: To understand the basic concepts of rapid prototyping, and identify their advantages, limitations and 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.	identify the development of different rapid prototyping techniques	1,7	---
2.	describe the working principles and process parameters of additive manufacturing processes	1, 3	---
3.	interpret suitable post processing operation based on product repair requirement	1, 7	---
4.	Explore applications of different prototyping systems and develop a model using additive manufacturing processes	1, 5, 9,12	---

Course Contents:

Module – 1	**10 Hrs.**
Introduction: Prototype Fundamentals, Historical Development, Fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping, Commonly Used Terms, Classifications of Rapid Prototyping System. **Rapid Prototyping Process Chain:** Fundamental Automated Processes, Process Chain. **Stereo Lithography Systems:** Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.	
Module – 2	**10 Hrs.**
Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Process parameter, Path generation, Applications. **Fusion deposition modeling:** Principle, Process parameter, Process details, Applications. **Solid Ground Curing:** Principle of operation, Machine details, Applications.	
Module –3	**10 Hrs.**
Laminated Object Manufacturing: Principle of operation, Process details, application, LOM materials. **Laser Engineered Net Shaping (LENS):** Principle of operation, Process details, applications. **Friction stirs additive manufacturing:** Process, parameters, advantages, limitations and applications.	

Module – 4	10 Hrs.

Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.

Case Studies on Rapid Prototyping Applications: Aerospace Industry, Automotive Industry, Biomedical Industry, Jewelry Industry, Coin Industry and Tableware Industry.

SELF LEARNING COMPONENT:

1. 3 D Printers, Historical Development.
2. List the materials used in development of engineering and commercial products using stereo lithography, selective sintering, fused deposition modeling and laminated object manufacturing processes.
3. Rapid Prototyping Applications: Application - Material Relationship, Finishing Processes, Applications in Design, Applications in Engineering, Analysis and Planning, Applications in Manufacturing and Tooling.

Realization of product by modeling simple machine parts or assembly using the 3D printing facilities in the Department.

TEXT BOOK:

1. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
3. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.

REFERENCE:

1. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.

Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & Francis Group, 2020.

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	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				2				1			1		

Course Title	**FUNDAMENTALS OF INDUSTRY 4.0 AND INDUSTRIAL IOT**		
Course Code	**23ME632**	**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**
Industry 4.0 Introduction, Various Industrial Revolutions, Fourth Revolution, Drivers, Enablers and Challenges for Industry 4.0. Lean Production System, Smart Factories, Smart and Connected Business Perspectives, Collaboration Platform and Product Life-Cycle Management.	
Module – 2	**10 Hrs**
Cyber-Physical Systems (CPS) and Next Generation Sensors, Industrial Sensing and Actuation, Smart Manufacturing, Smart Devices and Products, Smart Logistics. 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**
Industrial IoT Introduction, Internet of Things (IoT), Industrial IoT, Industrial Processes, Advanced technologies: Software Defined Networking and Security in IIoT. 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
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, 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**										

GEOMETRIC DIMENSIONING AND TOLERANCING

23ME633 **LTPC: 3-0-0-3**

Exam Hours: 3 **Hours / Week: 02**

SEE: 50 Marks **Total hours: 40**

Course Objective: To teach the students concepts and interpretation of Geometric Dimensioning and Tolerancing of a component that goes into assembly from the point of view of Design, manufacture and Assembly.

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

#	Course Outcomes	Mapping to POs
1.	Comprehend the mutual dependence of design and manufacture in the production of cost-effective quality products	3
2.	recognize various symbols used to specify tolerances on component drawings and understand the functional significance of a particular feature on a component	4
3.	Interpret and/or specify tolerance for a specific fit between mating components in an assembly	4
4.	Identify the most suitable inspection method/technique for cost effective quality control	11

Course contents:

Module – 1	
Introduction to Geometrical Tolerancing: Need for GD&T, Size general principles, Definitions of size, Groups of sizes and dimensions. Classification and symbols of Geometric Tolerancing. **Tolerances of form** - General concepts, Straightness, Roundness, Flatness, Cylindricity, Line and surface profile, Rules for form Tolerancing.	**10 Hrs.**
Module – 2	
Datums: Datums, datum features and simulated datum features, establishing datums, Datum targets, Datum systems - Three-Plane datum-system, Groups of features nominated as datums. **Tolerances of Orientation:** Parallelism Perpendicularity and Angularity tolerances with typical examples	**10 Hrs.**
Module – 3	
Tolerance of location: Position, Concentricity &Coaxiality and Symmetry tolerances of line or surface with or without datum - Profile any line, Profile any surface. **Tolerances of runout:** Circular run-out, Circular run-out in the radial direction, Circular run-out in the axial and in any direction, total runout. **Material Conditions:** Maximum and least material condition, Shift Tolerance, Principle of independency, Maximum material condition, Maximum material virtual limit, least material requirement, Reciprocity requirement.	**10 Hrs.**
Module – 4	
Taylor's Principle of design of gauges, Taylor's Envelop Principle, Go and No-Go gauges for size, Terms and Definitions for Individual Features of Size, Actual Size Definitions, Relationship of individual Features, Perfect Orientation between Features. Projected tolerance zone, Free state Tolerancing. Introduction to stack up analysis.	**10 Hrs.**

SELF STUDY COMPONENT

- To undergo survey on various applications of GD&T symbols in production drawings of real-world applications and prepare a report on it.

Group activity on preparation of GD&T models for different types of tolerances and prepare a report on it.

TEXT BOOK

Geometrical Product Specifications – Course for Technical Universities by Z. Humienny et al, Warsaw University Press 2001

REFERENCE BOOKS

1. Geometric Dimensioning and Tolerancing, for Mechanical design by Gene R. Cogorno, McGraw Hill, 2006

Geometric Dimensioning and Tolerancing – James D. Meadows, Marcel Dekker Inc., Special Indian Edition, 1995

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3										
CO4	-	-	-	-	-	-	-	-	-	-	3	-	-	-

AUTOMOTIVE ENGINEERING

23ME634 **LTPC:3-0-0-3**

ExamHours:0**3** Hours/Week:**03**

SEE:**50Marks** Total hours :**40**

Course objectives: To impart knowledge on components of automotive systems and their functions

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

Outcomes (POs)}Upon completion of the course, students shall be able to:

#	Course Outcomes	POs
1.	Describe the functional components and mechanisms of IC engines.	1
2.	Summarize the cooling, lubrication, ignition, and fuel supply systems of IC engines.	1, 7
3.	Explain the importance and functions of the transmission, suspension, and braking systems of automobiles.	1
4.	Choose the fuel, mixture requirements, and methods of emission control for IC engines.	1, 7

Course Contents:

Module– 1	10 Hrs.
Introduction: Components of an automobile, engine systems, types of engines, cylinder – arrangements, Engine Components-liners, piston, pistonrings, connecting rod, camshaft, crankshaft, valves, valve actuating mechanisms and choice of materials for different engine components. **Cooling & Lubrication Systems:** Cooling requirements, methods of cooling– air and water cooling, Objects and methods of lubrication systems.	
Module– 2	**10 Hrs.**
Ignition Systems: Requirements of an ignition system, Types - Battery and magneto ignition systems, transistorassist contacts electronicignition, automaticignitionadvancesystems. **Fuels &Fuel Supply Systems for SI & CI Engines:** Normal and abnormal combustion. Mixturestrength requirements of SI engines, simple carburetor, single point and multi point petrol injectionsystems,diesel injectionsystem–common railand individualpump injection methods. **SuperchargersandTurbochargers:**Supercharger–types,constructiondetailandworkingprinciple,Turbo charger& turbocharger lag.	
Module– 3	**10 Hrs.**
Clutches: Requirements and principle of operation. Types-single plate, multi-plate and centrifugal clutches. **Transmission system:** Necessary of transmission, types – constant mesh boxes, automatic transmissions, epicyclic gear trains. **Drive To Wheels:** Propeller shaft and universal joints, final drive, differential, rear axle, rear axle, rear axledrives-hotch kiss and torquetube drives. **Steeringsystem**: Introduction,steeringlinkageforrigidaxleand, steeringgears&power steering.	

Module– 4	10 Hrs.

Suspension system: Requirements, Torsion bar suspension systems, leaf spring, coil spring, shock absorbers and air suspension system.

Brakes: Requirements, method of actuation, drum brakes, disk brakes, antilock braking systems (ABS).

Emission Control Systems: Introduction, methods of emission controls - controlling crankcase ventilation,controlling evaporative emissions,redesigningtheengine, treatingtheexhaustgasforSIandCIengines,emissionstandards.

SELFLEARNINGCOMPONENTS:

1. AutomotiveelectricalSystem:Chargingsystem,startingsystem, storage batteries,lightingsystem, safety sensors etc.
2. Accessories: Air-conditioning,powerwindows, centrallocking,vehicletrackingsystem, cruisecontrol,keyless entryetc.
3. ClassificationandspecificationsofMotorcycles,four, Six,andmorethan Six-wheelvehicles

REFERENCEBOOKS:

1. Dr.KirpalSingh,AutomobileEngineering,Vol.1Standardpublisher'sdistributors,13th Edition2013.ISBN:978-81-8014-196-6.
2. Dr.KirpalSingh, AutomobileEngineering,Vol.2Standardpublisher'sdistributors,13th Edition2014.ISBN:978-81-8014-206-2.
3. R. B. Gupta, Automobile Engineering, SatyaPrakashan,4thEdition.1984.ISBN:9788176843799.
4. V.Ganesan,Internalcombustionengines,McGraw-Hilleducation, 4thEdition2013.ISBN:978-1-25-900619-7.
5. N.K. Giri,Automobile Mechanics,KhannaPublisher,8thEdition2008.ISBN:978-8174092168.

Course Articulation Matrix

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3						1							
CO3	3													
CO4	3						1							

PRINCIPLES OF MANUFACTURING

23OEME61 **LTPC:3-0-0-3**
Exam Hours: **3** Hours/Week:**03**
SEE: **50Marks** Totalhours:**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	-
2	comprehend the basic principles and recent developments of modern manufacturing processes	1, 5	-
3	realize the significance of various joining and assembly techniques	1	-
4	infer the basic concepts of special processing and assembly technologies	1, 5	-

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: Classification of material removal processes, 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, electro less plating, mechanical plating, porcelain enameling, clad materials.	
Module – 4	**09 Hrs.**
Rapid Prototyping: Fundamentals of rapid prototyping, classification of rapid prototyping technologies, applications of rapid prototyping. **Processing of integrated circuits:** Overview of IC Processing, Silicon Processing, Layer Processes Used in IC Fabrication, electronics assembly and packaging, micro fabrication technologies, and nanofabrication technologies.	

SELF-STUDY:

1. Simulation of manufacturing processes through online virtual labs.
   - https://3dp-dei.vlabs.ac.in/List%20of%20experiments.html
   - http://msvs-dei.vlabs.ac.in/upsetting_simulation.php
   - http://mm-coep.vlabs.ac.in/
   - http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/#
   - http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpMM/
2. Preparation of reports on the simulation and presentations to be made in a group.

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

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3				1									
CO3	3													
CO4	3				1									

PROJECT MANAGEMENT

23OEME62 **LTPC:3-0-0-3**

Exam Hours: **3** Hours/Week:**03**

SEE: **50Marks** Totalhours:**40**

Courseobjectives:Toimpart a comprehensiveunderstandingofhowtoplan,optimizeandefficiently manageprojects (ortasks) to implementproducts,servicesor developments.

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

(POs) Uponsuccessful completionofthiscourse,thestudentshallbeableto

CO's	Statement's	PO's
1	describe project management, the project lifecycle, planning, estimating, and the project manager's roles.	1, 9, 11
2	demonstrate project organization structures, tendering and contracting processes, scheduling, and CPM and PERT.	1, 2, 9, 11
3	comprehend,how organizations enhance project management through directing, coordinating, and controlling.	1, 9, 10, 11
4	explain the importance of software efforts and techniques in project management and conduct project case studies.	1, 9, 10, 11

CourseContents:

Module–I	**10 Hrs.**
IntroductiontoProjectManagement: Conceptofprojectandprojectmanagement, characteristic features and classification of projects, phases of Project management,selectionofprojectmanagersandtheirduties. **ProjectPlanningandEstimation:**Projectplanningsteps,objectivesandgoalsoftheproject,Feasibilityreports, financing arrangements,preparationof cost estimation,evaluationmethodsforprojectprofitability.	
Module–II	**10 Hrs.**
OrganizingandStaffingtheProjectTeam:Authoritiesofprojectmanager, organizational organizational structure and types, accountability in project execution, contracts, 3'R'sofcontracting, tenderingprocessandselection of contractors, team building. **ProjectSchedulingToolsandTechniques:**Gantt chart,barchartforcombinedactivities, Critical path method (CPM) and Project evaluation and reviewtechnique(PERT), Numericalproblems	
Module–III	**10 Hrs.**
Project Direction, Coordination and Control: Project direction, communication in a project, PMIS,projectcoordinationcontrol,schedulecontrol& cost control. **Riskmanagement:**Introduction,RiskManagement Process, Monitoring andControlRisks. **PerformanceMeasuresinProjectManagement:**Performanceindicators, performance improvement,TheCM&DMcompaniesforbetterprojectmanagement,projectmanagement environment.	

Module–IV.	**10Hrs**
Software project management: Introduction, computerized project management,managing software projects, overview of capability maturity model (CMM), projectmanagementandtheCMM.**Casestudiesonprojectmanagement:** CasestudiesonProjectplanning,scheduling,toolsandtechniques,performancemeasurement.	

Self-StudyComponent:

- HistoryandEvolutionofProjectManagement
- Groupofstudentstotakeuponminiprojectandapplyvariousphasesofprojectmanagement.Preparereporton it.
- Makesurveyof various Softwareprojectmanagementtoolsanduseany one tool.

Textbook:

3. ProjectManagementaSystemapproachtoplanningScheduling&Controlling-HaroldKerzner, 10th edition 2009, John Wiley &sons.
4. ChaudhryS,ProjectExecutionPlan-PlanforprojectExecutioninteraction,2001

ReferenceBooks:

5. SoftwareProject Management inPractice-PankajJalote,Pearsoneducation
6. FundamentalsofProject Management: RoryBurke,2010,BurkePublishing.
7. Projectplanningscheduling&control,JamesP.Lawis,MeoPublishingCompany,5th edition 2010.
8. AManagementGuidetoPERTandCPM,WEIST&LEVY-EasternEconomyofPHI2002.

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2								3		3			
CO2	2	2							3		3			
CO3	2								3	2	3			
CO4	2								3	2	3			

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

ACCOUNTING FOR ENGINEERS

23OEME63 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **03**
SEE: **50 Marks** Total hours: **40**

Course objective:

1. Understand the accounting concepts; prepare financial statement as per the standards.
2. Make decisions using accounting tools.
3. Analyze the financial status and identify the avenues in which companies will lead to profitable and undisclosed information.
4. Utilize budgetary techniques for future planning, identify the alternatives and formulate the best decisions.

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.	comprehend the Indian accounting standard and international accounting standard.	2, 11,12
2.	apply basic accounting and finance ideas, which you can then utilize when working in a managerial role in an organization.	2, 11,12
3.	analyze a company's financial position to uncover hidden profit opportunities.	2, 11,12
4.	use budgetary approaches for both long-term and short-term decision making in the organization.	2, 11,12

COURSE CONTENT:

Module -I	**10 Hrs.**
Introduction to Financial Accounting: Definition, Importance, Principles - Concepts & Conventions, Double entry bookkeeping system, Bases of accounting - Cash basis and Accrual basis, Journal, Ledger, and Trial Balance (Simple numerical problems)	
Module -II	**10 Hrs.**
Preparation and Interpretation of Financial Statements: Objective, Importance and Limitations, Trading Account, Profit and Loss Account, Balance Sheet- Grouping of assets and liabilities, Preparation of final accounts without adjustments. Interpretation of financial statements (Simple numerical problems).	
Module -III	**10 Hrs.**
Financial Ratio Analysis: Introduction, Objectives, Classification, Advantages, Limitations and Computation of Liquidity ratios, Profitability ratios, Leverage ratios, Activity ratios (Simple numerical problems).	
Module -IV	**10 Hrs.**
Budgetary Control: Budgetary Control: Meaning of a Budget, Budgetary control, Objectives of budgetary control, Essential features of Budgetary Control& merits, Steps in budgetary Control, Types of Budgets, Flexible Budget, Limitation of Budget Control (Simple numerical problems).	

TEXTBOOKS:

1. Kakani Ramachandran, (2011), Financial Accounting for Management, 3rd edition,McGrawHill, India
2. Godwin, Alderman, Sanyal (2016), Financial ACCT - Financial Accounting (2016), Cengage Learning.

REFERENCE BOOKS

1. Anthony A.Atkinson, Robert S.Kaplan, S.Mark Young, Ella Mae Matsumura, G.Arunkumar (2014), Management Accounting: Information for Decision Making and Strategy Execution, 6thedition, Pearson Education, India.
2. R.L.Gupta, V.K.Gupta: Fundamentals of Accounting: Sultan Chand & Sons: Year of Publication 1993
3. Khatri, (2011), Financial Accounting, 1stedition, McGraw Hill, India.
4. Khan M.Y, Jain P.K, (2009), Management Accounting, 5thedition, McGraw Hill, India

Course Articulation Matrix

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3									3	2		
CO2		3									3	2		
CO3		3									3	2		
CO4		3									3	2		

MALNAD COLLEGE OF ENGINEERING, HASSAN
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OPERATIONS RESEARCH

23OEME64 **LTPC:3-0-0-3**
Exam Hours: **3** Hours/Week:**03**
SEE: **50Marks** Totalhours:**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.	2,5,6,11	-
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.	2,5,6,11	-

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.
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 models.

Module – 4	**09 Hrs.**

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.
Sequencing: Johnson's 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.

TEXTBOOKS:

1. Taha H. A, Operations Research and Introduction**,** Pearson Education edition, 8th edition, 2007, ISBN: 9780131889231.
2. Operations Research, S. D. Sharma –KedarnathRamnath& 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

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2											
CO2		3		2		2								
CO3		3			2	2					2			
CO4		3			2	2					2			

MALNAD COLLEGE OF ENGINEERING, HASSAN
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INDUSTRIAL ENGINEERING AND ERGONOMICS

23OEME65 **LTPC:3-0-0-3**
Exam Hours: **3** Hours/Week:**03**
SEE: **50Marks** Totalhours:**40**

Course objectives: To provide 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, 6,11	-
2.	compare and prepare the charts for the existing method andnew / proposed method to identify the unnecessary movements.	2, 6,11	-
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 and work study: Definition of productivity, Production and productivity, expectations from productivity, benefits from productivity, productivity measures, advantages and limitations of productivity measures, 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, preparing to measure process work, techniques of work measurement, types of elements, time study equipments, performance rating, allowances, computation of standard time, comparison of various techniques, work sampling, synthetic data, predetermined motion time analysis (PMTS)	

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. Industrial Engineering and Production Management, Martand T Telsang, 3rd edition, 2018. ISBN 978-93-525-3379-4 2. Work Study & Ergonomics, Suresh Dalela& Saurabh, standard publishers & distributors. 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 Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					2					2			
CO2		2				2					2			
CO3		2				2								
CO4			2			2								

MALNAD COLLEGE OF ENGINEERING, HASSAN
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OCCUPATIONAL HEALTH AND SAFETY ENGINEERING

23OEME66 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **03**
SEE: **50 Marks** Total hours: **40**

Course objectives:

To apply the basic concept of occupational health and safety standards in workplace scenario.

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.	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 and electrical safety hazards, Product Safetyandriskin the workplace.	6, 7, 11

COURSE CONTENTS:

Module – I	
Introduction: Occupational Safety and Health Act, Occupational Safety and Health Administration, right to know Laws. Indian Acts – Labour Act, Factories Act, OSHA.	**10 Hrs.**
Module – II	
Occupational Hazard and Control: Hazard Analysis, Human Error and Fault Tree Analysis, Emergency Response. Hazards and their control in different manufacturing and processing industries.	**10 Hrs.**
Module – III	
Fire Prevention and Protection: Types of Fire, Fire Development and its Severity, Effect, Extinguishing Fire, Electrical Safety, Product Safety and Environmental Management Plan.	**10 Hrs.**
Module – IV	
Occupational Health: Personal Protective Equipments. Health and Safety Considerations in Construction Industries, Textile Industries, Food Processing Industries, Pharmaceutical Industries and Chemical& petroleum Industries. Occupational Health and Safety considerations in Wastewater Treatment Plants.	**10 Hrs.**

SELF STUDY:

Workplace ergonomics, fire safety, workplace violence prevention, employee health resources, and environmental safety.

TEXTBOOK:

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

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3					2			
CO2						3	2				1			
CO3						3	2				1			

MALNAD COLLEGE OF ENGINEERING, HASSAN
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DESIGN LABORATORY

23ME606 **LTPC: 0-0-2-1**
Exam Hours: **3** 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.	**1,2,9,10**	**-**
2	conduct experiments on governors, gyroscope, balancing of rotating masses and pressure distribution around journal bearing.	**1,2,9,10**	**-**
3	determine the stresses & strains in a member subjected to combined Loading using rosettes and photo elasticity.	**1,2,9,10**	**-**

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 ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3							2	2				
CO2	3	3							2	2				
CO3	3	3							2	2				
CO4	3	3							2	2				

MALNAD COLLEGE OF ENGINEERING, HASSAN
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PROJECTWORK PHASE-1

23ME605 **LTPC: 0-0-4-2**
Exam Hours: **3** Hours / Week: **04**
SEE: **50 Marks** Total hours: **26**

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

CourseOutcomes(COs){withmappingshownagainstthe**ProgramOutcomes (POs)**} Upon successful completion of this course, the student shall be able to:

#	Course Outcomes	Mappingto POs	Mappingto PSOs
1.	identifyaproblemfromtheavailableliteratureandsocietal needs	1,2,3,4,5,6,7,8, 9,10,11,12	-

SCHEMEOF EVALUATION

PHASE -I		MAXMARKS:
Sl. No.	**Particulars**	**Distributionof Marks**
1.	LiteratureSurvey/Problem Declaration(Team)	20
2.	Presentationskill(Individual)	20
3.	Vivavoce(Individual)	10

SEEisconductedfor50marksbyinternalandexternalexaminersappointedbytheDean(Exams)on recommendations of the HOD

Examination	Maximummarks	Minimummarks to qualify
CIE	**50**	**20**
SEE	**50**	**20**

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	2	2		

MALNAD COLLEGE OF ENGINEERING, HASSAN
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RUBRICSFOR PROJECT WORK (PHASE -I)

PHASE – I (100 Marks)

Criteria/ Grading	LiteratureSurvey/ Problem Identification (40)	Presentationskill (40)	Vivavoce (20)
Excellent(37-40)	Outstandinginvestigationinallaspects.Theproject'spurposeandneedareexplainedin great detail.	A well-planned and executed presentation anddemo that clearly demonstrated the product'svalue.Presentationsarewell-preparedanddelivered.Maintainingeyecontactwiththe audienceandspeakingclearly.	Outstanding Contributiondemonstratingtheindividual'sdependenceon the project.
Good(32-36)	Awell-researchedprojectwith depth and thoroughness,goodresearchplanning,andample referencing. Collects alotofdataandstudiestheexistingsystems.	Verygooddemonstration.Detaileddescriptionoftheprojectanditsissues.Presentations are well-prepared and delivered.Goodspokenlanguagebutlesseyecontactwithaudience.	Strongcontribution,asevidencedbythe overall qualityof thework.
Average(16-30)	Thestudyisorganized.Coverageissuitableandreferenced. Moderate analysisofexistingsystems;gathers basicdata.	Timedpresentation,demowithstudentexplainingwhattheylearned.Presentationshave good content but poor delivery. Few eyecontactsandamuddled voice.	Somecontributionasreflectedinoverallwork.
Poor(0-15)	Minimalresearch,minimalreferencing, moderateexplanationoftheproject's purposeandneed.	Thestudentcan'tarticulatetheprojectdevelopment. Presentations are inappropriateandpoorlydelivered.Pooreyecontactand voiceclarity.	NoContribution.

MALNAD COLLEGE OF ENGINEERING, HASSAN
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CourseTitle	**Analytical Ability and Soft Skills**	
CourseCode	**23ASK**	**L-T-P-C (0-1-0)1**
ExamHrs.	**1**	**Hours/Week: 2**
SEE	**50Marks**	**TotalHours: 30**

CourseObjective: To Enhance problem solving skills and communication skills
CourseOutcomes(COs):Uponcompletionofthecourse,studentsshallbeableto:

#	CourseOutcomes	MappingtoPOs
1.	Apply methods to solve numerical and reasoning problems	2,3
2.	Lead a team in corporate offices	8,9
3.	Communicate effectively in professional ambience	10

CourseContents:

MODULE–1

Hard Skills: Speed/Distance, Probability, Permutations/Combinations, Profit/Loss, Simple Interest/Compound Interest, Number theories, Number/Letter series, Coding/Decoding, Blood relations, Directions, Clock, Calendar. Logical reasoning (**12Hrs.)**

MODULE–2

Soft Skills: Basic grammar, Spotting errors, Sentence formation, Email writing, Public speaking, Client communication, Leadership, Managerial skills, Stress management, Presentation Skills (**06Hrs)**

MODULE–3

Technical Skills: Review of C programming, Simple coding, Syntax rules, MCQs in C language. **(06 Hrs.)**

MODULE–4

Activities: GD, JAM, Mock Interview, Pick and speak, Presentation**(06 Hrs.)**

COURSE ATRICULATION MATRIX

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3											
CO2								1	3					
CO3										3				

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

SUSTAINABLE ENGINEERING

23ME608 **LTPC:0-0-2-0**
Exam Hours:1 **Hours/ Week:02**
SEE:50Marks **Total hours: 26**

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 relevance and the concept of sustainability and the global initiatives in this direction	6, 7,12	-
2.	explain the different types of environmental pollution problems and their sustainable solutions.	6, 7, 12	-
3.	Outline the concepts related to conventional and non-conventional energy	6,7,12	-
4.	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles.	6,7, 12	-

COURSE CONTENTS:

Module-1	**06 Hrs.**
Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, zero waste concept.	
Module -2	**06 Hrs.**
Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change.	
Module -3	**07 Hrs.**
Resources and its utilization: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans and Geothermal energy.	
Module-4	**07 Hrs.**
Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport	
Textbooks: 1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall. 2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning. 3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006	

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Purohit, S. S., Green Technology - An approach for sustainable environment, AgrobiosPublicationErach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2005

COURSE ATRICULATION MATRIX

Course Out comes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	2					1		
CO2						3	2					1		
CO3						3	2					1		
CO4						3	2							