GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

Teaching and Evaluation Scheme

BE (Full-Time) in Mechanical Engineering

SEMESTER-VII

S. No.	Course Code	Subject	PO	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ME441	Internal Combustion Engines and GasTurbines	1,2,5,7	3	1	-	4	20	20	60	-	-	100
2	ME442	Refrigeration and Air Conditioning	1,3,4,5	3	1	-	4	20	20	60	-	-	100
3	ME443	Mechatronics	1,2,3,4	3	-	-	3	20	20	60	-	-	100
4	ME444	CAD/CAM	1,2,3,5	4	-	-	4	20	20	60	-	-	100
5		Department Elective – II (ME458 - ME464)	1,2,3,4,5	3	-	-	3	20	20	60	-	-	100
	LABORATORY COURSES												
1	ME445	Lab Internal Combustion Engines and Gas Turbines	1,2,6,7	-	-	2	1	-	-	-	25	25	50
2	ME446	Lab Refrigeration and Air Conditioning	1,2,6,8,9,10	-	-	2	1	-	-	-	25	25	50
3	ME447	Lab Mechatronics	1,2,3,4,6,7,10	-	-	2	1	-	-	-	25	25	50
4	ME448	Lab CAD/CAM	1,2,3,5,6	-	-	2	1	-	-	-	25	25	50
5	ME449	Seminar	1 TO 10	-	-	2	1	-	-	-	25	25	50
6	ME450	Project-I	4,5,6,8	-	-	2	1	-	-	-	25	25	50
				16	2	12	24	100	100	300	150	150	800

SEMESTER-VIII

S. No.	Course Code	Subject	PO	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ME451	Automatic Control System	1,2,3,4	3	1	-	4	20	20	60	-	-	100
2	ME452	Automobile Engineering	1,2	4	-	-	4	20	20	60	-	-	100
3	ME453	Tool Design	1,2,3,4,5,6	3	1	-	4	20	20	60	-	-	100

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4		Department Elective –III (ME465 – ME471)	1 to 10	3	-	-	3	20	20	60	-	-	100
	LABORATORY COURSES												
1	ME454	Lab Automatic Control System	1,2,3, 4,6,8, 9	-	-	2	1	-	-	-	25	25	50
2	ME455	Lab Automobile Engineering	1,2	-	-	2	1	-	-	-	25	25	50
3	ME456	Lab Tool Design	1,2,3, 58	-	-	2	1	-	-	-	25	25	50
4	ME457	Project-II	1,2,3, 4,5,6, 8,10	-	-	8	6	-	-	-	100	150	250
				14	2	14	24	80	80	240	175	225	800

L-Lectures, T-Tutorials, P-Practical, TA-Teacher Assessment, ESE-End-Semester Examination

Department Elective – II

1) ME 458: Energy Audit and Management
2) ME 459: Principles of Design Optimization
3) ME 460: Advanced Manufacturing Techniques
4) ME 461: Micro Processor and Micro Controller
5) ME 462: Flexible Manufacturing Systems
6) ME 463: Advanced Material
7) ME 464: Bio-Mechanical Engineering

Department Elective – III

1) ME 465: Robotics and Automation
2) ME 466: Tribology
3) ME 467: Production Management
4) ME 468: Cryogenics
5) ME 469: Advanced Joining Technology
6) ME 470: Reliability Engineering
7) ME 471: Operation Research and Techniques

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

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Department of Mechanical Engineering

Teaching and Evaluation Scheme

BE (Part-Time) in Mechanical Engineering

SEMESTER-VII

S. No.	Course Code	Subject		Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ME441	Internal Combustion Engines and Gas Turbines		3	1	-	4	20	20	60	-	-	100
2	ME442	Refrigeration and Air Conditioning		3	1	-	4	20	20	60	-	-	100
3	ME443	Mechatronics		3	-	-	3	20	20	60	-	-	100
4		Department Elective – II (ME458 - ME464)		3	-	-	3	20	20	60	-	-	100
	LABORATORY COURSES												
1	ME445	Lab Internal Combustion Engines and Gas Turbines		-	-	2	1	-	-	-	25	25	50
2	ME446	Lab Refrigeration and Air Conditioning		-	-	2	1	-	-	-	25	25	50
3	ME447	Lab Mechatronics		-	-	2	1	-	-	-	25	25	50
4	ME449	Seminar		-	-	2	1	-	-	-	25	25	50
				12	2	8	18	80	80	240	100	100	600

SEMESTER-VIII

S. No.	Course Code	Subject		Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ME444	CAD/CAM		4	-	-	4	20	20	60	-	-	100
2	ME451	Automatic Control System		3	1	-	4	20	20	60	-	-	100
3	ME452	Automobile Engineering		4	-	-	4	20	20	60	-	-	100
	LABORATORY COURSES												
1	ME448	Lab CAD/CAM		-	-	2	1	-	-	-	25	25	50
2	ME450	Project-I		-	-	2	1	-	-	-	25	25	50
3	ME454	Lab Automatic Control System		-	-	2	1	-	-	-	25	25	50
4	ME455	Lab Automobile Engineering		-	-	2	1	-	-	-	25	25	50
				11	1	8	16	60	60	180	100	100	500

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SEMESTER-IX

S. No.	Course Code	Subject		Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ME453	Tool Design		3	1	-	4	20	20	60	-	-	100
2		Department Elective –III (ME465 – ME471)		3	-	-	3	20	20	60	-	-	100
	LABORATORY COURSES												
1	ME456	Lab Tool Design		-	-	2	1	-	-	-	25	25	50
2	ME457	Project-II		-	-	8	6	-	-	-	100	150	250
				6	1	10	14	40	40	120	125	175	500

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Department Elective – II

1) ME 458: Energy Audit and Management
2) ME 459: Principles of Design Optimization
3) ME 460: Advanced Manufacturing Techniques
4) ME 461: Micro Processor and Micro Controller
5) ME 462: Flexible Manufacturing Systems
6) ME 463: Advanced Material
7) ME 464: Bio-Mechanical Engineering

Department Elective – III

1) ME 465: Robotics and Automation
2) ME 466: Tribology
3) ME 467: Production Management
4) ME 468: Cryogenics
5) ME 469: Advanced Joining Technology
6) ME 470: Reliability Engineering
7) ME 471: Operation Research and Techniques

ME 441: Internal Combustion Engines and Gas Turbines	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test-20Marks Teachers Assessment-20Marks End Semester Exam – 60 marks

Prerequisite: - ME243, ME253 Applied and Engineering thermodynamics, ME144 basics of mechanical engineering, ME 345 fluid mechanics

Course description: After completing this course, students will have a broad and fundamental understanding of Internal Combustion Engines. Topics range from an overview of IC Engines and its different types of combustion process in SI Engine, CI Engine normal combustion and abnormal combustion and performance evaluation of IC Engine heat balance sheet and learn the working of gas turbines and performance evaluation of gas turbine and method to improve efficiency of gas turbine In addition, students will learn common evaluation terminology, of IC Engine and gas turbine used and career options available within this field

Course Objectives:

1 To give an overview of Internal Combustion Engines, their classification, applications, operation and processes.
2. To give complete knowledge of type of fuels used in IC engines and the fuel supply systems
3. To describe combustion phenomena in IC engines
4 To explain the different performance analysis of IC engines
5. To explain the effects of exhaust emission on human health and various pollution norms
6. To explain the Gas Turbine with various operating cycles.

Course Outcomes:

After completing the course, students will be able to:

1. Understand various types of I.C. Engines and Cycles of operation.
2. Analyze the effect of various operating variables on engine performance
3Identify fuel metering and fuel supply systems for different types of engines
4. Understand normal and abnormal combustion phenomena in SI and CI engines
5. Evaluate performance Analysis of IC Engine and Justify the suitability of IC Engine for different application
6. Understand the conventional and non-conventional fuels for IC engines and effects of emission formation of IC engines, its effects and the legislation standards.
7. Analyze & Solve the performance of Gas Turbine

Detailed Syllabus

Unit-1

I.C. Engines - Classification based on multi cylinder engine, firing order, selection criteria of IC engines based on application, materials and manufacturing processes of ICE components.

Fuel Supply systems of SI and CI engines – Types of carburetor (makes), Fuel supply systems for C.I. engines: Requirement of ideal injection system, types of injection systems, fuel pumps and injectors, types of nozzles,

Unit-2

Combustion in SI engines – stages of combustion, ignition lag, engine variable affecting flame propagation, detonation, effects of detonation & its control, octane rating, combustion chamber design principle and types.

Combustion in CI engines – stages, delay period and it's, variable, diesel knock and its control, cetane rating of fuels, different types of combustion chambers.

Comparison of SI & CI engines – For different thermodynamics and operating characteristics.

Unit-3

Testing and performance – Review of IC engine testing, and trial calculation on testing at different load characteristics, Performance characteristics such as brake thermal efficiency volumetric efficiency BSFC, Economical running, Williams line, interrelationship of various engines variables, performance graphs.

Unit-4

Exhaust Emission – Introduction, constituents of exhaust gas, effects on human health and causes of formation and their measurement pollution control device and EURO standards.

Alternative fuels for IC engines like LPG, CNG, Alcohols, Hydrogen etc., their need, properties, engine modification and performance.

Unit-5

Gas Turbine – theory & fundamentals of gas turbine, principle, classification, Atkinson & Joule cycle, assumption for simple gas turbine, cycle analysis, work ratio concept of maximum and optimum pressure ratio, effect of operating variables on thermal Efficiency, Regenerative, Inter cooling and reheating their effect on performance.

Text and Reference Books

Heywood J.B., "Internal combustion Engine Fundamentals", McGraw Hill, 1988
Obert E.F., "Internal combustion Engine and Air Pollution", Intext Educational Pub,1974
Ganesan V., "Internal combustion Engines", 6 th Ed.Tata Mc Graw Hill Publishing Co.
Domkundwar V.M. "Internal Combustion Engines"-
Mathur M.C.,Sharma R.D.,"Internal combustion engines",8th Ed.; Dhanpat Rai publication.,2003
PulkrabekW, "Engineering Fundamentals Of Internal Combustion Engine", Prentice Hall, 1997

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Student's Presentation on related topics
2) Question & answer / Numerical solution
3) Study of automobile Industry visit and its presentation

Mapping of Course out come with programme outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3						3			
CO2		2								
CO3	2									
CO4	2									
CO5					2		3			
CO6	2									
CO7					2					

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Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K 5
COs	C01	C02/C06	C03	CO4/C07	CO5
Class Test (20 Marks)	03	05	03	03	06
Teachers Assessment (20 Marks)	04	03	03	05	05
ESE Assessment (60 Marks)	12	05	10	15	18

ME 442 : Refrigeration and Air Conditioning		
Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs/Week	Class Test	: 20 Marks
Tutorial: 1 Hr/Week	Teachers Assessment	: 20 Marks
Credits: 4	End Semester Exam	: 60 Marks

Prerequisites: ME 243 Engineering Thermodynamics, ME 253 Applied Thermodynamics

Course description: After completion of the course, students will have understanding of fundamentals of refrigeration and air conditioning. They will have knowledge of various refrigeration systems along with applications. They will be able to design, evaluate performance of air conditioning and refrigeration system. Their creativity will be addressed in mini project as a part of Teachers' assessment. They will know impact of refrigerants on environment as ODP, GWP and alternate refrigerant. Students will acquire skill to be entrepreneur in the field of refrigeration and air conditioning.

Course Objectives:

To provide a fundamentals of refrigeration and air conditioning, Psychrometry
To accustom with various methods of production of cold
To impart knowledge about applications of refrigeration and air conditioning
To familiarize with industrial protocols, regulations in the field

Course Outcome

After completing the course, students will be able to:

CO1	Understand the principles and remember the applications of refrigeration systems
CO2	Analyze performance of vapor compression refrigeration system
CO3	Analyze the air conditioning processes using principles of Psychrometry
CO4	Study the working principles of vapor absorption, thermoelectric, steam jet refrigeration system.
CO5	Evaluate cooling and heating loads in an air conditioning system
CO6	Create capacity to compute heating / cooling load

Detailed Syllabus:

Unit 1	Methods of Refrigeration, Vapour compression cycle, Thermodynamic analysis, effect of operating parameters, liquid-gas heat exchanger, actual vapour compression system (study with T-S & P-h planes) Flash gas removal and flash gas inter cooling, Introduction to multi-pressure system (multi-evaporator, multi compressor), multiple / individual expansion valve
Unit 2	Introduction to vapour absorption refrigeration systems, Ammonia-water, Lithium-Bromide, properties of absorbent - refrigerant pair, Steam jet refrigeration system, thermoelectric refrigeration system
Unit 3	Gas cycle refrigeration, Bell Coleman cycle, regenerative Bell Coleman cycle, Air craft air conditioning systems, introduction to expansion devices , control devices of VCRS Introduction to cryogenics, Liquefaction of gases.
Unit 4	ASHARE nomenclature pertaining to air conditioning, psychometric processes on psychometric chart, coil by pass factor, estimation of cooling / heating load, plotting air conditioning processes for summer using ESHF concept, concept of comfort air conditioning, effective temperature concept.
Unit 5	Refrigerants: desirable properties, designation, azeotrops, secondary refrigerants,

	Ozone depletion, global warming, alternate refrigerant Applications of refrigeration systems: Industrial, comfort, food preservation and medical

Text and Reference Books

1.J. L. Threlkeld, "Thermal Environmental Engineering", Prentice-Hall, vol 4, 2008

2.Ananthanarayanan, " Basic Refrigeration And Air Conditioning", Wiley-VCH Verlag GmbH, vol 3, 2005

3.Richard Charles Jordan, Gayle B. Priester, " Refrigeration and Air Conditioning", Prentice-Hall, vol2, 2007

4.Rex Miller, Mark Richard Miller, Edwin P. Anderson, "Audel Refrigeration: Home and Commercial", Wiley publication, vol 5, 2014

5.Rex Miller, Mark Richard Miller, Edwin P. Anderson, "Audel Air Conditioning: Home and Commercial", Wiley publication, vol 5, 2014

6.ASHARE Handbook: Fundamental, ASHARE publication, 2013

7.ASHARE Handbook: Standards, ASHARE publication, 2013

8.ASHARE Handbook: System and Equipment, ASHARE publication, 2008

9.Carrier Air Conditioning Handbook, Carrier publication, 2013

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2			2		3					
CO3			2		3					
CO4	1									
CO5					1					
CO6				1						

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Mini project on load calculation
3) Industrial case studies
4) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	05	12
K3	Apply	05	05	06
K4	Analyze	05	05	12
K5	Evaluate	00	00	18
K6	Create	00	05	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1/ K2	K3/K4	K4	K2	K5	K6
	C01	C02	C03	CO4	CO5	CO6
Class Test (20 Marks)	05	05	05	05	00	00
Teachers Assessment (20 Marks)	02	07	03	03	00	05
ESE Assessment (60 Marks)	12	12	06	12	18	00

Special Instructions if any: Nil

ME 443: Mechatronics	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: EE 143: Basic Electrical Engineering, ME 355: Mechanical Measurement

Course description: After completing this course, students will have a broad and fundamental understanding of Mechatronics. Topics range from an overview of sensors, Actuators, microcontroller, data acquisition system and an introduction of basic PLC. In addition, students will learn application of mechatronics in industrial automation and career options available within this field

Course Objectives:
To provide a clear view on key elements of mechatronics system, representation into block diagram
To accustom with various sensors, data acquisition system
To impart knowledge about microprocessor, microcontrollers used in mechatronics
To familiarize with PLC programming

Course Outcome
After completing the course, students will be able to:

CO1	Identification of key elements of mechatronics system, representation into block diagram
CO2	Apply knowledge of the concept of signal processing and signal conditioning for its industrial applications
CO3	Analyze the requirements for a given industrial process and select the most appropriate Actuators, sensors, design circuit according to applications
CO4	Understand the different logic gates, architecture of microprocessor and microcontroller for industrial applications.
CO5	Develop Mechatronics system according to an Industrial Applications
CO6	Development of PLC Ladder programming for Industrial Applications

Detailed Syllabus:

Unit 1	Introduction of Mechatronics. Sensors - working characteristics and mathematical model of Thermal sensors, Pressure sensors, Strain sensors, load cell, Motion sensor, Accelerometer, Optical sensors, Photo diode, Photo Emissive, Force sensors, Torque sensor
Unit 2	Hydraulic, Pneumatic & Electrical systems - Elements, Construction, Operation, Standard Symbols and Industrial Applications. Hydraulic and Pneumatic Circuits.
Unit 3	Introduction and significance of data acquisition system, types of DAS, Signal conditioning system, Industrial Applications
Unit 4	Digital Logic, Logic Gates, Boolean algebra. Principles of basic electronics Microprocessors / microcontroller, Industrial Applications, Hardware in mechatronics systems, Interfacing, DA and AD converters, software and hardware principles and tools to build mechatronics systems.
Unit 5	Programming Logic Controllers (PLC): basic structure, selection of PLCs, Ladder Programming in Industrial Applications Advanced applications in mechatronics: mechatronics control in automated manufacturing, CIM, Robot, Artificial Intelligence in mechatronics, fuzzy logic

	applications in mechatronics, micro sensor.

Text and Reference Books

1. Ernest O. Doeblin, "Measurement Systems Application and Design", McGraw Hill International Publication
2. Bolton, "Mechatronics" ,Pearson, Singapore
3. Mahalik , "Principles, concepts and applications Mechatronics" ,TMH
4. Ramesh Gaonkar, "Introduction to 8085-PENRAM",International Publishing.
5. Muzumdar, "Pneumatics" –Tata McGraw-Hill Education.
6. Pipenger, "Hydraulic valves and controls" ,M. Dekker.
7. K. Ayala, "8051 microcontroller Architecture, programming & Application" - Penram International Publishing
8. Steward, "Hydraulics and Pneumatics for production",Audal Series.
9. "Fundamentals of Pneumatics" , Festo series.
10. Vickers's manual on "hydraulics".
11. Curtis D. Johnson,"Process Control instrumentation Technology" –PHI Publication
12. HMT, "Mechatronics" –TMH.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2	1			2						
CO3		1	2	3						
CO4	1			2						
CO5		1		2						
CO6		2		1						

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industrial processes

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	10
K2	Understand	10	05	15
K3	Apply	05	05	20
K4	Analyze	00	05	15
K5	Evaluate	00	00	00

K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K3	K4
	C01	C02	C03	CO4	CO5	CO6
Class Test (20 Marks)	05	10	00	02	03	00
Teachers Assessment (20 Marks)	05	05	02	02	03	03
ESE Assessment (60 Marks)	10	15	10	15	05	05

Special Instructions if any: Nil

ME 444: CAD/CAM	
Teaching Scheme Lectures: 4 Hrs/Week Credits: 4	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 154: Engineering Graphics, ME 244: Machine Drawing, ME 342: Design of Machine Elements- I, ME 351: Design of Machine Elements- II

Course description: After completion of the course, students will have understanding of fundamentals of computer graphics, techniques for geometric modelling. They will have knowledge of fundamental knowledge of CAD/CAM with applications. They will be able to design, evaluate performance of the object and understand rapid prototyping and tooling concept in any real life application. Their creativity will be addressed in mini project as a part of Teachers' assessment.

Course Objectives:
To introduce new field of CAD/CAM
To understand mathematical representation of curve and surfaces.
To model the object using Wireframe, surface and solid modeling techniques
To design a basic automation system and its applications
To understand techniques of Rapid prototyping and their applications.

Course Outcome
After completing the course, students will be able to:

CO1	Identify proper computer graphics techniques for geometric modelling.
CO2	Transform, manipulate the object and understand rapid prototyping and tooling concept in any real life application.
CO3	Acquire fundamental knowledge of CAD/CAM.
CO4	Solve numerical on transformation.
CO5	Understand modelling of curves, surfaces and solids.
CO6	Generate tool path for part and to create CNC manual part program and APT part program.

Detailed Syllabus:

Unit 1	**Fundamentals of CAD/CAM:** Product cycle on CAD/CAM product features of CAD/CAM software. Geometric transformation. 2Dand3D Transformation, Translation, Rotation, Scaling, Reflection, Homogenous transformation, geometric concatenation, orthographic projection, mapping, perspective transformation. Orthographic transformation, Oblique Projections.
Unit 2	**Mathematics Representation of Curves and Surfaces:** Design of curves, parametric space of curves Blending function. Analytic curves, line circle parabola ellipse, hyperbola Synthetic curves, Hermite cubic spline, Bezier curves, B-spline curves introduction to NURBS. **Mathematics Representation of Surfaces:** Design of surfaces, Analytical surfaces, synthetic surfaces, parametric space of a surface, cylindrical surface ruled surface, surface of revolution. Introduction to Bezier surface spine surface, B-Spline surface.
Unit 3	**Solid Modelling:** Solid Modeling fundamentals, topology and geometry, Requirements of Geometric Modeling generalize concept of boundary set theory, Euler's operator. Geometric Modeling Method, Constructive Solid Geometry (CSG), Boundary

	Representation (Brep), Introduction to Wireframe, surface and solid modeling techniques. Introduction CAD data exchange format IGES, STEP
Unit 4	**NC and CNC Technology:** Introduction to automation. Need and future of NC, CNC and CAM. Basic component of NC, application and classification. Merit and demerit of NC and CNC. Dimensioning, axes designation, NC motion control. Introduction to Part programming, Introduction to group technology.
Unit 5	**Rapid Prototyping and Manufacturing:** Introduction to Rapid Prototyping (RP). Principle and advantages of Rapid Prototyping. Different techniques of Rapid prototyping and their applications. Advantages, accuracy economics consideration of Rapid prototyping.

Text and Reference Books

1. Faux,Prat,c"omputational geometry for design and manufacture"-Ellis Horwood.
2. Rogers and adams, "Mathematical elements for computer graphics" Mcgraw Hill publications, New York
3. Rogers and adams, "Procedural elements for computer graphics" Mcgraw Hill publications, New york
4. Mortenson M.E., "Geometric Modeling", John wiley and sons, New york, 1985
5. Hearn, Paulin, "Computer Graphics".-Pearson.
6. Martti mantylla, "An introduction to solid modeling", computer science press.
8. Ibrahim, CADCAM -Tata McGraw hill.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2	1	2								
CO3	1									
CO4			1		3					
CO5	1									
CO6	2	1	3							

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Mini project on load calculation
3) Industrial case studies
4) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20

K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03/CO5	CO4/CO6
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

ME 458: Energy Audit & Management	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 243 Engineering Thermodynamics, ME 254 Applied Thermodynamics

Course description: After completion of the course, students will have understanding of importance of energy conservation and management. Students will get familiar with the energy audit procedure , the data collection for the audit, opportunities for energy conservation, waste recycling and energy planning.

Course Objectives:
Students will learn
The benefits and drivers of an energy audit
Have knowledge of the energy audit of electrical utilities
Understand to plan and carry out an energy audit
Be confident with the process of reviewing energy data and analysis in the energy audit process
Have knowledge of the equipment and key considerations required when carrying out an energy audit
Assess the energy consumption of an organization
Analyse the energy systems data of the organization to identify key trends or issues
Identify the areas of significant energy use for that organization
To select energy efficient solutions.

Course Outcome
After completing the course, students will be able to:

CO1	Identify the quality and cost of various energy inputs and potential areas of thermal and electrical energy economy.
CO2	Analyze energy systems from a supply and demand perspective, applying fundamental knowledge of engineering
CO3	Develop innovative energy efficiency solutions and demand management strategies by analyzing economy, social, environmental and technological constraints and Implementation of majors for energy conservation and realization of savings.
CO4	Assess present pattern of energy consumption in different cost centers of operation and relate energy inputs and production output.

Detailed Syllabus:

Unit 1	**Energy Scenario**: Introduction, energy problems, energy use trends in developing countries, prospects of changes in energy supply, strategies for sustainable development, finite fossil reserve, Energy and environment, Need for renewable and energy efficiency, Energy conservation principles.
Unit 2	**Energy management** Definitions and significance, Two sides of energy management, Sectors of supply side energy management, Objectives of energy management, Hierarchical levels of supply side energy management, Trade-off between energy and environment, Energy and economy, energy management and control system (EMC's or EMS) for demand side, Energy management in end user plant, Seven principles of energy management, Energy policy of supply organization and demand side organization for energy management,

	Organization of energy management, Training and human resource development, motivation.
Unit 3	**Energy Planning** Energy strategy, Energy policy and energy planning, Essential imperatives and steps in supply side energy planning, energy planning flow for supply side, Essential data for supply side energy planning, infrastructure planning, Transportation of energy, Per capita energy consumption, Essential imperatives and steps in user side energy planning, Energy policy of demand side organization (energy consumer).
Unit 4	**Energy Audit** Introduction, Types of energy audits, energy audit, Intermediate energy audit, Comprehensive energy audit, End use energy consumption profile, Procedure of energy auditing, Composition of comprehensive auditing, Data for comprehensive audit, Site testing and management.
Unit 5	**Energy Conservation and Recycling** Introduction, Listing of energy conservation opportunities, Electrical ECOs, Thermodynamic ECOs, ECOs in chemical processing industries, ECOs in medium and small industries, ECOs in residential buildings, shopping complexes and in university campus, Human and animal bio-muscle energy, Waste management, Recycling of discarded materials and energy recycling, Waste recycling management.

Text Book and Reference Books:

1) "Energy Technology", by S. Rao, Dr. B.B. Parulekar, Khanna publications, Delhi
2) A.B. Gill, "Power Plant Performance", Butterworths, 1982
3) "The Efficient use of Energy", Ed: I.G.C. Dryden, Butterworths, London, 1982
4) Wood, A.J., Wollenberg, B.F., Power generation, Operations and control, John Wiley, York, 1984

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2			1	1	2					
CO3		1	2	1						
CO4					1					

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Industrial case studies
3) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20

K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03/CO5	CO4/CO6
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

ME 459: Principles of Design Optimization	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: GE 141: Engineering Mathematics-I, GE 151: Engineering Mathematics-II, ME 341: Applied Mathematics

Course description: There is need for a rigorous, quantitative design methodology that works with the non-quantitative and creative side of the design process in engineering systems. The goal of systems design optimization is to create, advance and complex engineering systems that must be competitive not only in terms of performance, but also in terms of life-cycle value. Focus of the course is to present tools and methodologies for performing system optimization. Review of linear constrained and unconstrained optimization formulations.

Course Objectives:
To present tools and methodologies for performing system optimization.
To accustom about solving linear programming problems.
To impart knowledge for determining the optimum solution to constrained and unconstrained problems.
To familiarize with dynamic programming and genetic algorithms.

Course Outcome
After completing the course, students will be able to:

CO1	Understand, formulate optimization problems
CO2	Identify and determine the integer solutions to linear programming problems
CO3	Identify and determine the optimum solution to constrained and unconstrained problems
CO4	Understand and simulate the dynamic programming and genetic algorithms

Detailed Syllabus:

Unit 1	Overview, Mathematical Fundamentals, Engineering Applications, Optimal Problem Formulation, Classification of Optimization Problems, Optimization Algorithms
Unit 2	Introduction, Linear Programming Problem, Simplex Method, Big M Method, Dual Simplex Method, Sensitivity Analysis, Transportation Problem
Unit 3	(a) One-Dimensional Minimization Methods: Optimality Criteria, Bracketing Methods, Golden Section Search Method, Quadratic Interpolation Method, Cubic Search Method (b) Unconstrained Optimization Methods: Optimality Criteria, Powell's Conjugate Direction Method, Cauchy's Method, Newton's Method, Variable Metric Method (c) Constrained Optimization Methods: Kuhn-Tucker Conditions, Penalty Function Method Sensitivity Analysis, Random Search Methods, Generalized Reduced Gradient Method, Sequential Quadratic Programming
Unit 4	Penalty Function Method, Branch and Bound Method, Geometric Programming, Introduction of Dynamic Programming
Unit 5	Genetic Algorithms, Simulated Annealing, Neural Network

Text and Reference Books

1. S. S. Rao, "Engineering Optimization", New Age International Publishers, New Delhi
2. Kalyanmoy Deb, "Optimization for Engineering Design, Prentice Hall of India", New Delhi
3. G. V. Reklitis, A. Ravindran and K. M. Ragsdell, "Engineering Optimization – Methods and Applications", Wiley publications
4. P.Y. Papalambras and D. J. Wilde, "Principles of Optimal Design", Cambridge University Press

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2	3						
CO2	1	2	3	3						
CO3		1	2	3						
CO4	1	2	2	3						

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study and develop solutions for Industry processes
4) Quiz

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

ME460: Advanced Manufacturing Techniques	
Teaching Scheme Lectures: 3 hrs/week Credits: 3	**Examination Scheme** Class Test – 20 Marks Teachers Assessment – 20 Marks End Semester Exam - 60 Marks

Prerequisite:- ME 245: Manufacturing Processes, ME 255: Machine Tools

Course description: After completing this course, students will have a broad and fundamental understanding of Advanced Manufacturing Techniques. Topics range from an Advanced casting, Advanced micro machining, Laser beam machining, powder metallurgy and Advanced measuring techniques like CMM etc. Students will learn Advanced manufacturing technique knowledge and tools used in it, and career options available within this field.

Course objectives:
To acquire knowledge of various advanced casting processes, casting simulation and analysis
Understand various micro-machining methods and devices
Understand the measurement system for micro-machining and understand it's inspection methods
Understand different aspects of powder metallurgy and surface coating
Understand rapid prototyping and generative manufacturing processes

Course outcomes:
Students After completing the course, students will be able to:

CO1	Understand and posses the knowledge of different advanced manufacturing technique
CO2	Identify different micro-machining processes and devices used for AMT
CO3	Evaluate different aspects of micro-machining
CO4	Understand about powder metallurgy and surface coating
CO5	Identify rapid prototyping and types of generative manufacturing processes

Mapping of Course outcome with programme outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**2**									
CO2		**2**								
CO3		**2**		**2**						
CO4	**2**									
CO5				**3**						

Detailed Syllabus

Unit 1	Advances in Casting Process: Sheet molding, casting, V-process, flask less molding, evaporative casting, plaster mould casting, design for plaster mould casting quality-accuracy, uniformity and other considerations in casting and molding. Recent developments in pattern and casting designing, Use of CAD/CAM in foundries, Casting simulation and analysis.
Unit 2	Micro Machining: Machining for Micro devices, Various methods of micromachining like Micro EDM, Micro ECM, Ultrasonic, Lithography, Beam machining processes: LBM, IBM, EBM. Micro Electro Manufacturing System (MEMS).

Unit 3	Measurement systems for Micromachining: uncertainty of measurement, calibration; Sensors; Non-contact inspection methods: ultrasonic, computer vision, laser-based, interferometry; Tactile inspection: Coordinate Measuring Machines (CMM), mechanical arms; Intelligent systems, components, benefits and applications. Devices, instruments used for micro machined components.
Unit 4	Powder metallurgy and surface coating: Powder Metallurgy: process, different methods of producing powders, different techniques to form the shape viz. pressing, extruding, sintering, and hot pressing, advantages, disadvantages, Surface Coating: principles, elements, process, advantages and surface preparation, physical vapour deposition, chemical vapour deposition, electroless coating.
Unit 5	Rapid Prototyping: Product development cycle and importance of prototyping, types prototypes, principles and advantages, different types of generative manufacturing process, viz. streolithography, FDM, and SLS

Text and Reference Books

1. Benjamin W. Niebel, Allen B Draper, Richard A. Wysk, "Modern Manufacturing process engineering" by McGraw Hill International Editions.
2. Garry F. Benedict- Marcel Dekker Inc "Non Traditional Manufacturing Processes" by CRC Press New York.
3. H.M.T , "Production Technology Hand Book",TMH
4. Hayane and Rosanthal "Metal Casting"
5. Derban Michigan, "Non traditional manufacturing process" by E.J. Weller Society of Manufacturing Engineers.
6. B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman "Manufacturing process", By John Wiley & Sons, Eighth edition.
7. ASM "Metals Hand Book", ASM Publications.
8. P.K. Mishra "Non conventional machining process" by, Narosa Publication.
9. M P Groover and Zimmer "Manufacturing processes"- PHI Pvt. Ltd. Publications
10.Amitabh Ghosh, "Genetic Manufacturing", Prentice Hall

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study of Industry processes

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	15
K2	Understand	10	05	20
K3	Apply	05	05	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1, K2	K1, K2	K3	K3, K4
	C01	C02	C03	CO4
Class Test (20 Marks)	10	05	02	02
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	15	20	05	15

Special Instructions if any: Nil

ME 461: Microprocessor and Microcontroller	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: EE 143: Basic Electrical Engineering

Course description: This course introduces microprocessor architecture and microcontroller systems, including memory and input/output interfacing. Topics include assembly language programming, bus architecture, bus cycle types, I/O systems, memory systems, interrupts, and other related topics. After completion, students should be able to interpret, analyze, verify, and troubleshoot fundamental microprocessor and microcontroller circuits and programs using appropriate techniques and test equipment.

Course Objective: The objective of this course is to become familiar with the architecture and the instruction set of an Intel microprocessor 8085 and microcontroller 8051. Assembly language programming will be studied as well as the design of various types of digital and analog interfaces.

Course Outcome

After completing the course, students will be able to:

CO1	Understanding of the Intel 8085 architecture
CO2	Student learns how to design, develop and interface complete microprocessor or microcontroller based systems to peripheral devices.
CO3	Knowledge of the Microprocessor 8085 instruction set and ability to utilize it in programming.
CO4	Knowledge of the Microcontroller 8051 instruction set and ability to utilize it in programming.
CO5	Ability to interface various devices to the microprocessor and microcontroller.

Detailed Syllabus:

Unit 1	Detail architecture of Intel 8085.
Unit 2	Instruction Set for Intel 8085, examples of Assembly Language programming
Unit 3	Interfacing and Data Transfer Schemes Memory Mapped I/O and I/O mapped I/O schemes, Memory interfacing, I/O interfacing. Data transfer scheme. Interrupts of 8085: Interrupt process, Interrupt, SIM & RIM instructions, Brief concept of DMA.
Unit 4	Introduction to Microcontrollers Comparison with microprocessors - Study of Microcontroller (MCS 51 family) -8051 microcontroller: Architecture instruction set – programming, addressing modes
Unit 5	Microcontroller Interfacing and Applications Interrupts- ports, timers, serial data transmission - Interfacing with Stepper motor, ADC and DAC- Typical embedded applications

Text and Reference Books

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5/E Prentice Hall, 2002.

2. B. Ram, "Fundamentals of Microprocessors and Microcontrollers" ,Dhanpat Rai Publications.
3. Borole and Vibhute, "Microprocessor", 2nd edition, Technova Publications
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson education, 2000
5 Kenneth J Ayala, The 8051 Microcontroller, "Architecture, Programming and Applications", International Thompson Publishing.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2		1	2			3						
CO3		1		2								
CO4		1		2								
CO5	1	3	2									

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of use of microprocessor and microcontroller in Industrial processes

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	05	15
K4	Analyze	00	05	10
K5	Evaluate	00	05	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K2
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	05	05	00	00
Teachers Assessment (20 Marks)	05	00	05	05	05
ESE Assessment (60 Marks)	15	15	10	10	10

Special Instructions if any: Nil

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ME 462: Flexible Manufacturing Systems	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites – ME 245: Manufacturing processes, ME 354: Industrial engineering,

Course description: After completion of the course, students will have understanding of importance of flexible manufacturing techniques in the fast growing industrialization. Student will also able to apply group technology, CAPP, MRP in the manufacturing.

Course Objectives:-

To introduce flexible manufacturing concepts.

To give exposure to the student to different types of advanced manufacturing processes, automated flow lines, the common CAD/CAM data base organized to serve both design and manufacturing.

To study about group technology, computer aided process planning, material requirement planning (MRP), Computer aided quality control and Flexible manufacturing systems.

To study the use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.

Course Outcome

After completing the course, students will be able to:

CO1	Identify how automation can be used in production systems
CO2	Recall basic elements of automation, and automation strategies
CO3	Apply group technology, cellular manufacturing, computer aided process planning, material requirement planning (MRP), and Computer aided quality control for the analysis and design of flexible manufacturing systems
CO4	Identify the use of computer technology in manufacturing to improve productivity

Detailed Syllabus:

Unit 1	FMS Concept: Introduction, Types of FMS, Difference between FMC and FMS, Types of flexibility, Flexibility criteria, volume variety relationship, Components of FMS: workstations, Material Handling and Storage System, Computer Control, Human Resource, FMS applications and benefits, Principle Objectives of FMS, Advantages and Disadvantages of implementing FMS.
Unit 2	Types of FMS layout, Factors influencing FMS Layout, Planning for the FMS: planning and Design issues, FMS operational issues, Production concepts and mathematical models, Quantitative analysis of FMS.
Unit 3	Automation Principles and Strategies, Fundamentals of automated production lines, Work-part transport mechanisms, storage buffers, control functions, Automation for machining operations, Automated assembly systems, Types, Part delivery at work stations, Design for automated assembly system, Concept of partial automation.
Unit 4	Fundamentals of Inspections, Types of inspection, Inspection procedure, Inspection Vs Testing, Automated inspection, offline and online inspection, Product inspection Vs process monitoring, Distributed Inspection Vs Final Inspection, Inspection methods: Sensor Technologies, CMM, Machine vision, Contact and non-contact inspection

	methods, Optical inspection methods.
Unit 5	Computer process control, Control requirements, Capabilities of Computer control, Levels of Industrial Process Control, Forms of computer process control, computer process monitoring. Group Technology: Part Families, Part Classification and Coding, Production Flow Analysis, Applications of GT.

Text Books and Reference Books

1. Groover M. P., "Automation, Production Systems and CIM", PHI Pvt. Ltd. Publications
2. H K Shivanandan, M M Benal, V. Koti, "Flexible Manufacturing Systems", New age International Publishers.
3. Kundra, Tiwari, "Computer Aided Manufacturing", Tata McGraw Hill Publications
4. Kusiak A., "Modeling and Design of FMS", Elsevier Science Publishers
5. Raouf A., Ahmed S.I., "Flexible Manufacturing", Elsevier Science Publishers
6. Ranky P.G., "Flexible Manufacturing Cells & Systems in CIM", Guildford Survey, UK
7. Ranky Paul G., "Design and operation of FMS", Guildford Survey, UK
8. Vishwanathan N., Narhari Y., "Performance Modelling of Automated Manufacturing System" PHI Publications

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	2							
CO2			2	1						
CO3	1	2	2		3					
CO4	1				1					

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Class test
3) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Understand	05	10	24
K2	Identify	10	05	12
K3	Analyze	05	05	12
K4	Solve	00	00	12
K5	Develop	00	00	00
Total Marks 100		20	20	60

Assessment table

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Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4/CO5
Class Test (20 Marks)	05	10	05	00
Teachers Assessment (20 Marks)	10	05	05	00
ESE Assessment (60 Marks)	24	12	12	12

Special Instructions if any: Nil

ME 463: Advanced Materials	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 344: Engineering Materials and Metallurgy

Course description: After completion of the course, students will have understanding of various modern engineering materials. They will have knowledge of various types of composites.
They will be able to analyze the performance of composite material. Students will be able to predict the possible mechanical properties of materials. Students will acquire skill in selection of materials for any specific application.

Course Objectives:
To understand the concept of composite material
To know the processes involved in the manufacturing of composite materials
To understand the various types of the composite materials and its compositions
To know the process of transformation of ferrous and non ferrous materials
To know the concept of polymers and its types.

Course Outcome
After completing the course, students will be able to:

CO1	Understand composite materials and its advantages and limitations
CO2	Analyze the production process of composite material
CO3	Evaluate the various types of composite materials
CO4	Analyze the various phases of transformation of ferrous and nonferrous materials
CO5	Understand the properties of various polymer materials

Detailed Syllabus:

Unit 1	Classifications of composites, general properties, application of composites in engineering, Advantages and Limitations, mechanical properties of composites.
Unit 2	Rule of mixtures equation of composites, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations in laminates
Unit 3	Polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulate reinforced composites, dental composites
Unit 4	Iron carbon diagram, mechanical properties of ferrous and nonferrous materials, heat treatments and applications for ferrous materials; stainless steel and its grades and heat resisting steels and its grades.
Unit 5	Classification, properties, application of polymers, plastics and elastomers. Ceramics: Classification, properties, structures of refractories, abrasive materials, electronic ceramics, cement and concrete.

Text and Reference Books
1. S Mileiko, "Metal and Ceramic Based Composites", Pub. Elsevier, 1st Edition,
2. V Raghavan, "Physical Metallurgy: Principles and Practice", Pub. PHI Learning, 2nd Edition

3. Chawla, Krishan K., "Composite Materials", Pub. Springers
4. Roman Pampuch, "An Introduction to Ceramics", Pub. Springers

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2			1	3						
CO3		2		1	1					
CO4	3		1	2						
CO5	1									

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Mini project on design of composites
3) Question & answer

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	12
K2	Understand	05	05	12
K3	Apply	00	00	06
K4	Analyze	10	05	12
K5	Evaluate	00	05	18
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	05	05	00	10	00
Teachers Assessment (20 Marks)	05	00	05	05	05
ESE Assessment (60 Marks)	12	12	06	12	18

Special Instructions if any: Nil

ME 464: Bio-Mechanical Engineering	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME344 Engineering Materials and Metallurgy

Course description: After completion of the course, students will have understanding of fundamentals of Bio-medical Engineering. They will have knowledge of various tissues, their anatomy and physiology. They will be able to understand bio material used for artificial organs. Their creativity will be addressed in mini project as a part of Teachers' assessment. They will know artificial replacement for natural organs. They will know CT, MRI, CATE, Bio-CAD. Students will acquire skill to be entrepreneur in the field of Bio medical Engineering.

Course Objectives:
To provide a fundamentals of bio-medical Engineering, tissue engineering
To accustom with various bio materials
To impart knowledge about applications of bio medical engineering
To familiarize with practical protocols regulations in the field

Course Outcome
After completing the course, students will be able to:

CO1	Understand the principles and remember the applications of bio medical engineering
CO2	Analyze different kinds of mechanics
CO3	Analyze bio compatibility and toxicological screening of materials
CO4	Study the definition, structure and organization of tissues, comparison of imaging modes.
CO5	Understanding testing and measurement of specimen
CO6	Create capacity to practically understand use of artificial organs

Detailed Syllabus:

Unit 1	Introduction, The modern health care system, Biomedical engineering introduction, roles played by biomedical engineers, morality & ethical issues introduction to anatomy and physiology, cellular organization, tissues, major organ systems, homeostasis.
Unit 2	Introduction to basic mechanics, heart tissues, soft tissues, testing and measurement of specimen, bio mechanics of joints, locomotion, cardiovascular mechanics, fluid mechanics
Unit 3	Definition of bio materials, requirement and properties of bio materials, metallic implant materials, polymeric implant materials, ceramic implant materials, composite implant materials, bio compatibility and toxicological screening of biomaterials.
Unit 4	Introduction to tissue engineering, definition, structure & organization of tissues, cell culture, molecular biology aspects, scaffold & transplant medical imaging, diagnostic ultra sound emaging, CT & MRI, comparison of imaging modes, computer aided tissue engineering (CATE) scope of CATE, Bio CAD & human body modeling
Unit 5	Introduction to artificial organs, prosthesis & orthotics, bio material used for artificial organs, artificial kidney, artificial heart lung machine, audiometry, rehabilitation engineering, impairment, disabilities & handicaps measurement & assessment, characterizing engineering concepts in sensory and motor rehabilitation, engineering

	concepts in communication disorders, rehabilitation for locomotive visual , speech & hearing, artificial limb and hands, prosthetic heart valves, externally powered & controlled orthotics & prosthetics, gait study, spinal rehabilitation.

Text and Reference Books

1. J. B. park, "Biomaterials- science & engineering plenum", press 1984
2. Sujata V. Bhatt, "Biomaterials", Narosa publishing house 2002
3. Alexander R Mc Neill, "Biomechanics", chapman and Hall, 1975
4. D. N. Ghista, "Biomechanics of Medical devices", macek Dekker 1982

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		2								
CO2	2		1							
CO3		3	2							
CO4			1							
CO5	1			2						
CO6		3	1							

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Mini project on computer aided tissue engineering (CATE)
3) Human body modelling
4) Question & answer

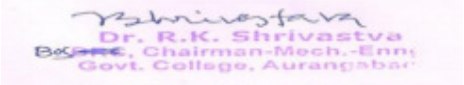
Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	08	07	20
K2	Understand	08	08	20
K3	Apply	00	00	00
K4	Analyze	04	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1/ K2	K4	K4	K2
	C01	C02	C03/CO5	CO4/CO6
Class Test (20 Marks)	08	00	04	08
Teachers Assessment (20 Marks)	07	00	05	08
ESE Assessment (60 Marks)	20	10	10	20

Special Instructions if any: N



ME 445: LAB Internal Combustion Engines and Gas Turbines	
Teaching Scheme Practical: 2 hrs/week Credits: 1	**Examination Scheme** Term work– 25 marks Practical Exam. – 25 marks

Course Objectives:

1. To describe the performance and operating characteristics of Internal Combustion Engines,
2. To explain the parts and complete knowledge of type of fuels used in IC engines and the fuel supply systems
3. To describe combustion process phenomena in IC engines
4 To explain the different methods of performance analysis of IC engines
5. To explain the effects of exhaust emission on human health and different pollution norms

Course Outcomes:

1. Identify the various types of I.C. Engines and Cycles of operation.
2. Express the effect of various operating variables on engine performance
3. Demonstration of fuel metering and fuel supply systems for different types of engines
4Analyze & Justify the suitability of conventional and non-conventional fuels for IC engines
5 Understand the effects of emission formation of IC engines, its effects and the legislation standards.

Term work
Term work shall consists of record of the following experiments
1. Trial on diesel engines for performance evaluation.
2. Trial on petrol engines for performance evaluation.
3. Morse test trial
4. Assembling and disassembling of modern fuel supplying system.
5. Actual valve timing diagram of high/low speed engine.
6. Exhaust gas analysis of S.I. /C.I. engines.
7. Study of alternative fuel.
8. Experiment and trail on VCR IC Engine

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course and viva-voce based on the syllabus.

Mapping of Course outcome with programme outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**3**									
CO2		**2**								
CO3	**2**									
CO4	**2**									
CO5						**2**	**3**			

Assessment table

Assessment Tool	S1	S2	S3	S2	S2
	C01	C02	C03	CO4	CO5
Term work 25 Marks	10	05	02	02	01
Practical Examinations & Viva Voce	07	03	02	06	02

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

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ME 446: Lab Refrigeration and Air conditioning	
Teaching Scheme Practical: 2 Hrs/Week Credits: 1	**Examination Scheme** Term Work : 25 Marks Practical Examination & Viva Voce: : 25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Study of refrigerant compressors, expansion devices used in vapour compression refrigeration system, thermostat with range and differential setting, charging of refrigeration system
CO2	Trial on pilot ice plant to evaluate cycle performance and actual coefficient of performance
CO3	Participate in a group atmosphere for the understanding of an industrial refrigeration system.
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation.

List of Experiments

Sr. No.	Details
1	Study of refrigerant compressors
2	Study and trial on pilot ice plant to evaluate cycle performance and actual coefficient of performance
3	Industrial visit to understand working of water chiller plant, pasteurization heat exchangers, cold storage of a milk plant.
4	Study of expansion devices used in vapour compression refrigeration system
5	Study of thermostat with range and differential setting.
6	Plotting of psychometric processes of air conditioning using air conditioning rig
7	Study of charging of refrigeration system
8	Industrial visit to study central air conditioning plant.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2		2				3				
CO3	1					3				
CO4								1	2	3

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3
	C01	C02	C03	CO4
Term Work (25 Marks)	08	08	04	05
Practical Examination & Viva Voce (25 Marks)	08	07	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	08	08
S2	Manipulation	08	07
S3	Precision	09	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	08	08
Conduct of Experiment (S2)	04	04
Observation and Analysis of Results (S3)	05	05
Record (S2)	04	03
Presentation/ Viva-Voce (S3)	04	05
Total	**25**	**25**

ME 447: Lab Mechatronics	
Teaching Scheme Practical: 2 Hrs/Week Credits: 1	**Examination Scheme** Term Work : 25 Marks Practical Examination & Viva Voce: : 25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Study of sensors, Hydraulic and Pneumatic actuators and experiment ion of its characterization for industrial applications.
CO2	Study of data acquisition system and its industrial applications
CO3	Understand the architecture of microprocessor and microcontroller
CO4	Develop pneumatic circuit /hydraulic circuit for industrial applications and measure its performance
CO5	Develop an understanding of plc ladder diagram related to industrial automation systems and measure its performance.

List of Experiments (Any Five)

Sr. No.	Details
1	Study of different sensors and perform characteristics experimentation(Any two)
2	Study of Data acquisition system.
3	Study of microprocessor/microcontroller
4	Pneumatic circuit design for certain industrial applications.
5	Hydraulic circuit design for certain industrial applications.
6	Development of ladder diagram/programming PLC for level control, position control or any other mechanical engineering application
7	An industrial visit to study the mechatronics system. Industrial Visit report to be submitted

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2	3						
CO2	1		2	3						
CO3	1	2		3						
CO4	1	1	2			2	3			3
CO5	1	1	2			2	3			3

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S2	S1	S1	S3	S3
	C01	C02	C03	CO4	CO5
Term Work (25 Marks)	04	04	05	06	06
Practical Examination & Viva Voce (25 Marks)	04	04	05	06	06

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	09	09
S2	Manipulation	04	04
S3	Precision	12	12
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	05
Conduct of Experiment (S2)	04	07
Observation and Analysis of Results (S3)	08	05
Record (S2)	03	03
Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

ME 448: Lab CAD/CAM	
Teaching Scheme Practical: 2 Hrs/Week Credits: 1	**Examination Scheme** Term Work : 25 Marks Practical Examination & Viva Voce: : 25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Study of program in C or MATLAB for 2 D Transformations.
CO2	Developing program in C or MATLAB for graphical output of any one type of curve/surface.
CO3	Creating 3 D Model on any CAD software like Pro/E, UG, CATIA, etc. and get its hard copy
CO4	Developing any four part programs lathe and milling operations

List of Experiments

Sr. No.	Details
1	Developing program in C or MATLAB for 2 D Transformations.
2	Developing program in C or MATLAB for 2 D Transformations.
3	Developing program in C or MATLAB for graphical output of any one type of curve/surface.
4	Creating 3 D Model on any CAD software like Pro/E, UG, CATIA, etc. and get its hard copy.
5	Study and classification of part family using OPTIZ coding system.
6	Developing any four part programs out of the following lathe and milling operations. (i) Plain turning and facing. (ii) Taper and profile turning (iii) Thread cutting (iv) Plain milling (v) Key way milling (vi) Pocket milling
7	Developing program in C or MATLAB for forward kinematic of a robot
8	Industrial visit to study the following CNC systems w.r.t. to automation, or ATC, CNC machines, or flexible tooling system. A visit report to be included..

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2							
CO2	1				3					
CO3	1	1				2				
CO4	1		2							

1 – High 2 – Medium 3 - Low

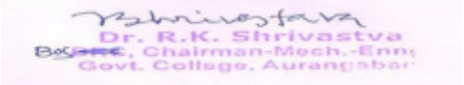
Assessment Table

Assessment Tool	S1	S2	S3	S3
	C01	C02	C03	CO4
Term Work (25 Marks)	06	04	10	05
Practical Examination & Viva Voce (25 Marks)	06	04	10	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	06	09
S2	Manipulation	04	06
S3	Precision	05	05
S4	Articulation	10	05
55	Naturalization	00	05
Total		25	25

Preparation (S1)	06	09
Conduct of Experiment (S2)	04	06
Observation and Analysis of Results (S3)	05	05
Record (S2)	10	05
Presentation/ Viva-Voce (S3)	00	05
Total	**25**	**25**



ME 449: Seminar	
Teaching Scheme Practical: 2 Hrs/Week Credit: 01	**Examination Scheme** Term Work : 25 Marks Practical/Viva-Voce : 25 Marks

Course description: After completing this course, students will develop the life-long learning habit of archiving, assessing, and sharing their learning by creating a portfolio to honor, understand, and connect their learning from self to global society for the betterment of both. The seminar will cover topics of current interest or provide in-depth coverage of selected topics.

Course Objectives:

To survey selected topics addressing issues of science in society today
To familiarize with scientific literature
To collect information on each topic
To assimilate, synthesize and integrate information
To organize the information on each topic into an analysis structured in this manner
To discuss the information and present work in prescribed formats

Course Outcome

After completing the course, students will be able to:

CO1	Identify and compare technical and practical issues related to the area of program specialization.
CO2	Outline annotated bibliography of research demonstrating scholarly skills.
CO3	Prepare a well organized report employing elements of technical writing and critical thinking.
CO4	Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Detailed description:

Seminar should be based on literature survey on any current topic, with audiovisual aids, graphs, charts and models as assigned to them on individual basis. It will be submitted as a report in hard bound. The candidate will have to deliver a seminar presentation in front of the examiners, one of them will be guide and other will be the examiner appointed by BoS. The performance of the student will be evaluated by both examiners jointly based on the content of the seminar, delivery of seminar and answers to the queries of the examiners.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2		3			2	1	1
CO2			3				2	2		
CO3	1			2		2				
CO4			1	1				1		

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	07	07
S2	Manipulation	08	08
S3	Precision	10	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	07	07
Conduct of Experiment (S2)	04	04
Observation and Analysis of Results (S3)	05	05
Record (S2)	04	04
Mini-Project / Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Assessment Table

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	07	08	05	05
Practical Examination & Viva Voce (25 Marks)	07	08	05	05

Special Instructions if any: Nil

ME 450: Project-I	
Teaching Scheme	**Examination Scheme**
Practical: 2 Hrs/Week	Term Work : 25 Marks
Credit: 1	Practical/Viva-Voce : 25 Marks

Course description: After completing this course, students will be able to familiarize with scientific literature, to assimilate, synthesize and integrate information for solving the problem in a group

Course Objectives:

To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
To familiarize the process of solving the problem in a group
To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
To inculcate the process of research

Course Outcome

After completing the course, students will be able to:

CO1	Identify a topic in advanced areas of Mechanical Engineering.
CO2	Review literature to identify gaps and define objectives & scope of the work.
CO3	Generate and implement innovative ideas for social benefit.

Detailed description:

Students should conduct literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide. Students should use multiple literatures and understand the problem.

Project I should be assessed based on following points
Quality of problem selected
Clarity of Problem definition and Feasibility of problem solution
Relevance to the specialization
Clarity of objective and scope
Breadth and depth of literature survey
Project I should be assessed through a presentation by the student project group to a panel of examiners appointed by the BOS

Mapping of Course outcome with Program Outcomes

Laboratory Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1						2				
CO2				2	2					
CO3				2				2		

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	07	07
S2	Manipulation	08	08
S3	Precision	10	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	07	07
Conduct of Experiment (S2)	04	04
Observation and Analysis of Results (S3)	05	05
Record (S2)	04	04
Mini-Project / Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Assessment Table

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
Term Work (25 Marks)	07	08	10
Practical Examination & Viva Voce (25 Marks)	07	08	10

Special Instructions if any: Nil

ME 451: Automatic Control System	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	Class Test : 20 Marks
Tutorial: 1 Hr/Week	Teachers Assessment : 20 Marks
Credits: 4	End Semester Exam : 60 Marks

Prerequisites: ME 355: Mechanical Measurements

Course description: After completing this course, students will have a broad and fundamental understanding of the concepts of industrial control system. Students will have knowledge of pneumatic and hydraulic controls and control action. Students will be able to evaluate characteristics of first order and second order control system. Students will be able to evaluate stability of control system.

Course Objectives:
To provide a clear view of operational characteristics of sensors for its use in control system
To accustom with different industrial control system
To impart knowledge of pneumatic and hydraulic control actions
To acquire and apply knowledge of stability of control system

Course Outcome
After completing the course, students will be able to:

CO1	Understand and apply the knowledge of different type of sensors in control system
CO2	Develop analogy for spring-mass damping system with electrical systems, thermal system, flow system
CO3	Understand and apply the knowledge of different types of pneumatic and hydraulic control actions
CO4	Understand and apply the knowledge of stability of control system

Detailed Syllabus:

Unit 1	Introduction, Manual v/s Automatic Control, Closed loop control and open loop control. Comparison, Practical Examples of Generalized control systems (Speed control system of I.c. Engine, Temperature control system, Level control system), Building blocks and transfer functions. Impulse response and transfer function, properties of transfer function, Laplace transformations. Review of various types of measuring instruments and transducers.
Unit 2	Representation of Control system components, Industrial control system, Mechanical system – spring–Mass–damper system, Force voltage and force current analogy, Hydraulic servo mechanism, pneumatic system, flow control system, A.C. Servomotors, D.C. Servomotors, Armature control DC motor, Field control DC, DC and AC Position control - Mathematical modeling and transfer function of all above system, Mathematical representation of physical systems, Block diagrams representation and reduction, Signal flow graph
Unit 3	Time Domain analysis, need of standard test signal, step, ramp, parabolic, impulse input, steady state error – derivation, Analysis of first order system, second order system, Transient response and stability, Transient response analysis of Zeroth, first and second order system.
Unit 4	Basic Control Actions: ON/OFF, Proportional, Integral, Derivative, PI, PD, PID, response of control actions for unit ramp and unit step input, Output vs. time characteristics, block diagram, Effect of these control action on system performance, Pneumatic controllers (flapper nozzle amplifier), pneumatic relay, (bleed and non bleed type), pneumatic actuating valves, pneumatic P, P+I, P+D, PID Controller (Operation, Block diagram, derivation), Effect on

	system performance, Hydraulic P, P+I, P+D, PID Controller (Operation, Block diagram, derivation, Effect on system performance)
Unit 5	Stability, Stability criterions, Routh's stability criterions, Frequency response methods, polar plot, Bode plots, steps in solving Bode plots, Nyquist stability criteria, relative stability. Final Controlling Elements – Actuators, Applications of AC Tachometer, Incremental Encoder, Synchros, Stepper Motor

Text and Reference Books

1. Raven F.H. "Automatic Control Engineering", Fifth edition, McGraw Hill International Editions, 1995.
2. Nagrath I.J., Gopal M., "Control Systems Engineering", New Age International Publishers, Fifth edition, 2007.
3. Ogata, "Modern Control Engineering", PHI, Eastern Economy Edition,
4. Joseph J. Distefano, III. Allen R. Stubberd Iva J. Willaims, Adapted by K.A. Gopala Rao, "Feedback and Control Systems", second edition, Schaum's Outlines, TMH, New Delhi, 2007.
5. Rao V. Dukkipati, "Analysis and Design of Control Systems using MATLAB", First edition, New Age International (P), Ltd., Publishers, New Delhi, 2006.
6. Barapate R.A., "Feedback Control Systems (Principles of Control Systems), Tenth Revised Edition, Tech-Max Publications, Pune 2006.
7. CURTIS D. JOHNSON, "Process Control Instrumentation Technology" Seventh Edition, Prentice-Hall India.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		3							
CO2		1	2	3						
CO3	1	2	3							
CO4		1	2							

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question & answer / Numerical solution
2) Presentation of case studies of control system
3) Study of Industry processes and control system and its presentation
4) Quiz

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

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ME 452: Automobile Engineering	
Teaching Scheme Lectures: 4 hrs/week Credits: 4	**Examination Scheme** Class Test – 20 marks Teachers Assessment – 20 marks End Semester Exam – 60 marks

Prerequisite: - ME243, ME253 Applied and Engineering thermodynamics, ME144 basics of mechanical engineering, ME 345 fluid mechanics.

Course description: After completing this course, students will have a broad and fundamental understanding of Automobile Engineering. Topics range from a classification of automobile to details sub systems of vehicle such as engine, clutch, gear box, transmission line , differential gear box, types of axles ,steering system, breaking system and electrical system overdrive suspension system etc. and career options available within this field

Course Objectives:

To study basics of principles of actual automobile systems.
To study importance and features of different systems like axle, differential, brakes, Steering, suspension, and balancing etc
To study working of various Automobile Systems.
To know some modern trends in Automotive Vehicles.

Course Outcomes:

Course objectives are to be fulfilled. Students learn and become familiar with

CO1	Understand the Construction, working and other details about Internal Combustion Engines used in automobiles
CO2	Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.
CO3	Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
CO4	Identify Modern technology and safety measures used in Automotive Vehicles

Detailed Syllabus

UNIT I :- Classification of automobiles, chassis, layout types,Sub-systems of automobile Power Unit:-Functions and locations power for propulsion,Engine parts-types, construction and functions, multiple cylinder engines. General considerations of engine balance vibration, firing order road performance curves.
UNIT II :- Fuel feed systems :- fuel feed systems for petrol engines. Fuel pumps, Basic principles of MPFI and CRDI. Multipoint Fuel Injection Systems (MPFI), Common Rail Diesel Injection Systems (CRDI) ,Cooling system : purpose, types of cooling system, troubles and remedies of cooling system. lubrication :- Types of lubricants, ,multiviscosity oils, chassis lubrication. Engine lubrication:- types of lubricating systems, crankcase ventilation, Engine lubrication troubles and remedies.
UNIT III :- starter motor drive-Bendix drive, over running clutch drive,Solenoid switch; solenoids switch. Ignition system:- Battery coil and magneto ignition system,Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system.
UNIT IV :- Transmission system:- Construction, transmission, requirements of single plate friction clutch and multiplate clutch, clutch adjustments, clutch troubles and remedies. Gear

Boxes:- Sliding mesh, constant mesh and synchromesh gear box, function of over drives, trouble shooting and remedies. Propeller shaft, hotchkiss drive torque tube drive, differential ,Final drive Types of rear axles.
UNIT V :- Braking system:- Mechanical, hydraulic brakes, power brakes, air brakes and vacuum brakes Fault finding and maintenance of brakes, Steering system:- Function, types of linkages, steering gears, steering gear ratio. Wheel alignment, steering geometry, & their effects, Introduction of power steering. Suspensions: - Types of Rigid, axle and independent suspension system, shock absorbers.

Reference: Books
1. Singh K. "Automobile Engineering"-Vol.I vol II. 9th Ed; Standard pub&Distributors,
2. Ramalingum K.K." Automobile Engineering; Scitech publications", Chennai
3. Srinivasan S." Automotive Engines", Tata Mc Graw Hill,
4. Crouse W.H."Automotive Mechanics", Tata Mc Graw Hill
5.Joseph Heitner," Automotive Mechanics", East-West press pvt .Ltd
6. T. R. Banga&Nathu Singh, "The Automobile Engineering", Khanna Publishers
7. R. K. Rajput," Automobile Engineering", Laxmi Publication
8., Kirpal Singh Automobile Engineering Vol I & II, Standard publishers Distributors ,Delhi
9., K. K. Jain & R.B. Asthana." Automobile Engineering", Tata Mcgraw Hill
10., S. Srinivasan, "Automotive Mechanics", Tata Mcgraw Hill
11., Vol I & II, R.K. Mohanty, "Automobile Engineering", Standard Book House

Mapping of Course out come with programme outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**3**									
CO2		**2**								
CO3	**2**									
CO4	**2**									

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study of Industry processes and its presentation
4) Mini projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	15
K2	Understand	10	05	20
K3	Apply	05	05	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00

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Total Marks 100	20	20	60

Assessment table

Assessment Tool	K1, K2	K1K2	K3	K3, K4
	C01	C02	C03	CO4
Class Test (20 Marks)	10	05	02	02
Teachers Assessment (20 Marks)	07	03	02	06
ESE Assessment (60 Marks)	15	20	05	15

Special Instructions if any: Nil

ME 453: Tool Design	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	Class Test : 20 Marks
Tutorial: 1 Hr/Week	Teachers Assessment : 20 Marks
Credits: 4	End Semester Exam : 60 Marks

Prerequisites: ME 244: Machine Drawing, ME 245: Manufacturing Process, ME 255: Machine Tools, ME 342: Design of Machine Elements-I, ME 351: Design of Machine Elements-II

Course description: After completing this course, students will have a broad and fundamental understanding of metal cutting theory, tool life, multi point cutting tools, die design and procedures involved in the design, construction, and use of common jigs and fixtures used in the metal working industry.

Course Objectives:
To provide a clear view on theory of metal cutting and tool geometry
To accustom with tool life calculation
To acquire and apply fundamental principles of locating and clamping devices
To impart knowledge about jig and fixture design
To familiarize with concept of die design for piercing, blanking, bending and forming

Course Outcome
After completing the course, students will be able to:

CO1	Interpret and understand the theory of metal cutting, tool life and geometry of single point and multipoint cutting tools
CO2	Understand principles of locating and clamping devices
CO3	Design jigs for drilling and fixtures for turning and milling
CO4	Select and design dies for piercing, blanking, bending and forming operations

Detailed Syllabus:

Unit 1	Theory of Metal Cutting: Definition of tool. Classification and tool angles, cutting tool materials & their properties. Orthogonal and oblique cutting, mechanism of chip formation, types of chips, tool geometry and tool signature, Machinability, Marchant's theory of mechanics of metal cutting, Velocity Permissible speed, feed, and depth of cut, Design of single point turning tool, Optimum value of tool angles.
Unit 2	Tool life and factors affecting on it, Tool life calculation, Economic tool life, Influence of tool geometry on tool life, Tool wear, Tool wear types (Crater and flank), various inserts used in industries, Cutting fluids types and characteristics
Unit 3	Jigs & fixtures: Principle of location, locating devices, Principle of clamping & clamping devices, force calculation, Types of bushes & their applications, Definition of drill jig, types of drill jig, chip formation in drill jig, general consideration in design of drill jigs, method of construction, indexing drill jig, drill jig and modern manufacturing method. Definition of fixture, fixture and economics, types of fixtures, milling fixture, turning fixtures, indexing fixture.
Unit 4	Multi-Point Cutting Tool: Drills- classification, nomenclature, geometry, Force and power consumption, Tooth form and cutting angle. Reamers - classification, nomenclature, geometry, Force and power consumption, Tooth form and cutting angle. Milling cutter - classification, nomenclature, geometry, Force and power consumption, Tooth form and

	cutting angle. Taps & hobs- classification, nomenclature, geometry, Force and power consumption, Tooth form and cutting angle.
Unit 5	The fundamentals of die cutting operation, power press types, general press operation, cutting action in punch and die operations, Die clearance, types of die construction, blanking and piercing die construction, pilots, strippers and pressure pads, press work materials, strip layout, Bending dies, forming dies, drawing operation, variables that affect metal flow during drawing, determining blank size, Drawing Force, Single and double action draw dies.

Text and Reference Books

1. Amitabh Bhattacharyya,"Metal Cutting Theory and Practice",Central Book Publication, Calcutta
2. Donaldson, "Tool Design",Tata McGraw-Hill Publishing Co.Ltd, New Delhi
3. Kempster,"Introduction to Jig and Tool Design", M.H.A.English Launguage Book Society
4. P.H.Joshi, "Jigs and Fixtures", Tata McGraw-Hill Publishing Co.Ltd, New Delhi
5. "Production Engineering", H.M.T.Hand-Book, Tata McGraw-Hill Publishing Co.Ltd, New Delhi
6. Wilson(Edited), "Fundamentals of Tool Design", A.S.T.M.E.
7. P.C.Sharma, S.Chand, "Production Engineering", and Company Ltd New Delhi
8. V.A.Kortesoja ,"Properties and Selection of Tool Material",ASM publication,Ojio
9. S K Basu and S N Mukharjee,"Fundamentals of tool engineering design",Oxford and IBH public ation Co.Pvt.Ltd Bombay

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	2	3		3				
CO2	1		2	3						
CO3		1	1	2	3	3				
CO4		1	1	2	3	3				

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study of Industry processes and its presentation
4) Mini projects
5) Application/Development

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	15
K3	Apply	05	05	15
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	15	15	20

Special Instructions if any: Nil

ME 465: Robotics and Automation	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME355Mechanical Measurement, ME343Theory of machine

Course description: After completing this course, students will have a broad and fundamental understanding of Robotics and Automation. This course provides an overview of robot mechanisms, dynamics, and intelligent controls.

Course Objectives:

To understand basic terminologies and concepts associated with Robotics and Automation
To study various Robotic sub-systems and Automation systems
To study kinematics and dynamics to understand exact working pattern of robots
To study the associated recent updates in Robotics and Automation

Course Outcome

After completing the course, students will be able to:

CO1	Understand robotics and automation terminology
CO2	Evaluate and plan robotic path.
CO3	Know various end effectors along with selection criterion
CO4	Analyze robot matching with workplace
CO5	Understand industrial environment for robotics system

Detailed Syllabus:

Unit 1	Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components, Types of Robot drives – pneumatic, hydraulic and electrical drive systems
Unit 2	Transformations and Kinematics: Coordinate transformation -Vector operations – Basic transformations matrices - Properties of transformation matrices-Homogeneous transformations– Forward solution, DH algorithm - Inverse kinematic solution, Brief Robot dynamics
Unit 3	Controls and End Effectors: Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic - Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design.
Unit 4	Robot Applications: Work cell control and interlocks, Robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection, etc. Introduction to Robotics Technology of the future, Future applications.
Unit 5	Automation; Introduction , Types of Automation, Types of Automation Systems, Programmable Logic Controllers, Parts of a typical PLC system, Programming of PLC, Example applications of PLC in a CNC machine.

Text and Reference Books

1. Groover M.P. Weiss Mithell Nagel R.N., Odery N.G., "Industrial Robotics, Technology, Programming and Applications", McGraw Hill International Editions, 1986.
2. Klafter,"Robotics Engineering", PHI Pvt. Ltd., New Delhi.
3. Ks. Fu, Rc. Gonzalez, CSG Lee, "Robotics", McGraw Hill International Editions.
4. Grover M.P., "Automation Production Systems, and Computer Integrated Manufacturing", Second Edition, Pearson Education, India, 2006.
5. Groover M.P., Zimmers E.W., "CAD/CAM Computer Aided Design and Manufacturing", PHI, Pvt. Ltd., New Delhi, 2002.
6. 6.Radhakrishnan P. Subramanian S., Raju V.,"CAD/CAM/CIM", New Age International Publishers Pvt. Ltd., New Delhi, India, 2008.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2		2			1							
CO3	1	1										
CO4			1				2					
CO5	1		2				1					

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Quiz
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industrial processes and its presentation

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	00	05	12
K3	Apply	05	05	12
K4	Analyze	10	05	12
K5	Evaluate	05	05	18
K6	Create	00	0	06
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	00	05	05	10	00
Teachers Assessment (20 Marks)	05	05	00	05	05
ESE Assessment (60 Marks)	12	18	12	12	06

Special Instructions if any: Nil

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ME 466: Tribology	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME342: Design of Machine Elements-I, ME351: Design of Machine Elements-II

Course description: Design of surfaces in contact is a critical problem for mechanical engineering. This course addresses the design of tribological systems: the interfaces between two or more bodies in relative motion. Fundamental topics include: friction, wear, wear mechanism, wear model, hydrodynamic, hydrostatic and gas lubrication.

Course Objectives:
To impart knowledge about lubricants and its properties
To provide a clear view on types of wears, sources of frictions and lubrication systems
To accustom with hydrodynamic lubrication
To acquire and apply fundamental principles of hydrostatic lubrication
To impart knowledge about gas lubrication

Course Outcome
After completing the course, students will be able to:

CO1	Interpret and understand various lubricants and its properties
CO2	Understand and apply principles of mechanism of wear, sources of friction and lubrication systems.
CO3	Understand, apply and analyze the knowledge of hydrodynamic and hydrostatic lubrication
CO4	Understand and apply the knowledge of gas lubrication

Detailed Syllabus:

Unit 1	Introduction to Tribology, tribology in design, tribology in industry, Lubricants - Properties-physical and chemical, Types of additives, extreme pressure lubricants, Lubrication-introduction, basic modes of lubrication, Tribology of sliding contact bearings and Rolling contact bearings.
Unit 2	Wear, Friction and Lubrication: Wear: Mechanism, Wear classification – adhesive, abrasive, fatigue wear, oxidative wear (mechanism, wear behavior, effect of load, sliding speed, temperature, hardness, attack angle), Wear Transitions (Transition in plastics, polyamide against steel), Fretting wear of unlubricated metal. Friction: Sources of friction, Influence of roughness of friction, coefficient of friction for unlubricated and lubricated surfaces, static and kinematics coefficient of friction, effect of different additives on coefficient of friction. Lubrication: Types of lubricants, lubricant coating, lubrication mechanism, squeeze film, hydrodynamic, elastohydrodynamic lubrication
Unit 3	Hydrodynamic Lubrication: Mechanism of pressure development in oil film in hydrodynamic lubrication, Solution of Generalized Reynold's equation, Infinitely long journal bearing, Infinitely short journal bearing, thrust bearing, Sommerfeld number, Raimondi and Boyd method, Temperature rise, Parameters of bearing design-Length to diameter ratio, Unit bearing pressure, Optimal Radial clearance and minimum oil film thickness.
Unit 4	Hydrostatic Lubrication: Basic concept, advantages and limitations, Viscous flow through rectangular slot, Load carrying capacity and flow requirement of hydrostatic step bearing,

	energy losses (Numerical Treatment). Hydrostatic squeeze film: Introduction, circular and rectangular plates approaching a plane.
Unit 5	Gas Lubrication: Introduction, Reynolds equation for gas lubrication, self acting gas bearing, Merits and demerits of gas lubrication, Applications, Lubrication in metal working: Rolling, Forging, Drawing and extrusion. Bearing Materials and bearing constructions. Oil seals and shields, Gaskets.

Text and Reference Books

1. Fuller D. D., "Theory and Practice of Lubrication for Engineers", John Wiley and Sons.
2. Halling J., "Principles of Tribology", McMillan Press Ltd.
3. Cameron A., "Basic Lubrication Theory", Wiley Eastern Ltd.
4. Neale M. J., "Tribology Hand Book", Butterworths.
5. C. Majumdar, "Introduction to Tribology and Bearings", H. Wheeler and Company Pvt. Ltd.
6. O. P. Orlov, "Fundamentals of Machine Design", Vol. IV, MIR.
7. Bhandari V. B., "Design of Machine Elements", Tata-McGraw Hill Publication Co. Ltd.
8. Bharat Bhushan,"Handbook of Tribology" by
9. Raymond G. Bayer, "Mechanical Wear Prediction and Prevention", Marcel Dekker Inc, New York.
10. Andras Z. Szerl, "Fluid Film Lubrication Theory and Design", Cambridge University Press.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2	1	2								
CO3	1		1	2	3					
CO4	1	2								

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study of Industrial processes of wear and its presentation
4) Quiz

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00

Total Marks 100	20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

ME 467: Production Management	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 362 Industrial Organization and Management

Course description: After completion of the course, students will have understanding of the various functions of Production Management. They will have knowledge of all the Production related activities. The student will have a holistic view of management as a whole which will help him at looking at the problems from an interdepartmental perspective. Students will acquire skills necessary for a works manager.

Course Objectives:
To understand the dynamics nature of private and public administration related to production activity.
To understand the concept of human resource and its development in production related activities.
To study the financial implications of production.
To evaluate the different types of industrial ownerships.
To understand the different administrative controls operating on the employees.

Course Outcome
After completing the course, students will be able to:

CO1	Understand the principles and remember the applications of principles of management related to public and private administration in relation to production activities.
CO2	Apply human relation skills for motivating the employees.
CO3	Develop Logical and Analytical ability to apply analyze problems related to production activity.
CO4	Understand the working of public sector undertakings and their production problems.
CO5	Understand the authority and responsibility of a production manager.

Detailed Syllabus:

Unit 1	Meaning, scope and significance of Public and Private production Administration; Difference and similarity between public and Private production administration, Challenges of liberalization, Privatisation , Globalisation.
Unit 2	Importance of human resource development in production activity, Production related functions: Recruitment, training, career advancement, position classification, discipline, performance appraisal, promotion, pay and service conditions; employer-employee relations, grievance redressal mechanism; Code of conduct; Administrative ethics.
Unit 3	Organisation and methods, Work study and work management; Management aid tools like network analysis, MIS, PERT, CPM.
Unit 4	Weber's bureaucratic model – its critique and post-Weberian Developments ,Public sector in modern India; Forms of Public Sector Undertakings; Problems of autonomy, accountability and control; Impact of liberalization and privatization
Unit 5	Concepts of accountability and control, Workers, Citizen and Administration ,Theories of Leadership: Traditional and Modern, Process and techniques of decision-making, Simon's decision-making theory.

Text and Reference Books

1) Terry and Frankline, "Principles of management", Pub. A I T B S
2) Stephen P Robbins, "Organisation Behaviour", Prentice Hall International, Inc.
3) Keith Davis, "Human Behaviour at work", Pub. McGraw-Hill series
4) Paul Hersey & Ken Blanchard¸ "Management of organizational behavior", Pub.Prentice Hall.
5) Nicholas Henry, "Public Administration and Public Affairs", Pub.PHI Learning

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2									
CO2			1		2	1				
CO3			1		3	2				
CO4	2									
CO5					1	2				

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Management games
2) Industrial case studies
3) Case study presentations

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	12
K2	Understand	05	05	18
K3	Apply	00	05	18
K4	Analyze	10	05	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1/ K2	K3	K4	K2
	C01	C02	C03	CO4/CO5
Class Test (20 Marks)	05	00	10	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	12	18	12	18

Special Instructions if any: Nil

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ME 468: Cryogenics	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 243 Engineering Thermodynamics

Course description: After completion of the course, students will have understanding of fundamentals of cryogenics. They will have knowledge of various cryogenics systems along with applications. They will understand properties of materials at cryogenic temperature. Information about liquefaction of gases, separation and purification of gases will be imparted. They will have knowledge about storage and transfer of cryogenic fluids, insulation, and superconductivity.

Course Objectives:
To provide the fundamentals of cryogenics
To accustom with various methods of production of cryogenic fluids
To impart knowledge about applications of cryogenics

Course Outcome
After completing the course, students will be able to:

CO1	Understand the principles cryogenics systems
CO2	Remember the applications of cryogenic systems
CO3	Analyze performance of cryogenics gas liquefaction system
CO4	Evaluate material properties at cryogenic temperature

Detailed Syllabus:

Unit 1	Introduction to cryogenic, history and development, cryogenic temperature scale, Material properties, Low temperature properties of engineering materials, mechanical properties Thermal properties, electric and magnetic properties, Debye model of thermal conductivity.
Unit 2	Gas liquefaction and cooling systems, introduction, production of low temperature, liquefaction systems for Freon, hydrogen, helium and other gases, cry coolers, sterling, G-M and pulse tube cry coolers.
Unit 3	Gas separation and purification systems, the thermodynamically ideal separation systems, properties of mixtures, principles of gas separation-Linde single column and double column system of air separation.
Unit 4	Different machines used for liquefaction of gases, production of yield such as modified Linde, Kapza hydland Phillips machine.
Unit 5	Cryogenic fluid storage and transfer systems, cryogenic fluid storage vessels Insulation cryogenic fluid transfer systems, Application of cryogenic systems, super conductive devices, cryogenic space technology-cryogenics in biology and medicine. Applications of refrigeration-Industrial, comfort, food preservation, medical

Text and Reference Books
1. Cryogenics systems – Randall Barron- Mc Graw hill book co
2. Cryogenic Engineering – R.B.Scott- Van Nosfrand co

3. Cryogenic Engineering – J.H. Bell – prentice hall
4. Cryogenic Engineering- R.W.Vance- John Welley.
5. Cry coolers – Walkers- Prentice hill publication

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1									
CO2	2									
CO3			2		3	1				
CO4					2	3				

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Mini project on load calculation
3) Industrial case studies
4) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	12
K2	Understand	10	05	18
K3	Analyze	05	05	12
K4	Evaluate	00	05	18
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	10	05	00
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	12	18	12	18

Special Instructions if any: Nil

ME 469: Advance Joining Techniques	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: ME 245: Manufacturing Process, ME 150: Lab-Workshop-I, ME 160: Lab-Workshop-II, ME 249: Workshop Practice –III, ME 260: Workshop Practice –IV, ME 344: Engineering Materials and Metallurgy

Course description: The advance joining technology will describe the modern welding methods and their applications in various fields. It will elaborate the different welding mechanism, design for the weld, Metallurgy of welding, failure of welds, and Inspection code for weldments. It also describes the other joining process like adhesive bonding, soldering and brazing.

Course Objectives:
To impart detail knowledge about the various welding process
To make familiars with the different welding parameters and other joining process.
To impart knowledge for design of welds and different welding codes.
To be able to solve the welding design problem.

Course Outcome
After completing the course, students will be able to:

CO1	Understand, formulate optimization problems
CO2	Identify and determine the integer solutions to linear programming problems
CO3	Identify and determine the optimum solution to constrained and unconstrained problems
CO4	Understand and simulate the dynamic programming and genetic algorithms

Detailed Syllabus:

Unit 1	History of the joining processes, welding basics welding processes and grouping, Methods of applying welding, metal joining processes, heat sources for joining of metals.
Unit 2	Modern welding processes like Electron beam welding, Laser beam welding, Ultrasonic welding, Mechanized, Automated and robotic arc welding, diffusion bonding etc.
Unit 3	Pulsed current welding processes, welding of ceramics, plastics, composites, joint design and design of weld joint and welds, Influence of specification on design, design conversion to weldments, welding symbols
Unit 4	Metallurgy of welding, heat treatment, residual stresses and stress relief methods, metals and their weldability, welding steels, welding nonferrous metals
Unit 5	Failure of welds, nondestructive testing of welds, inspection codes for weldments

Text and Reference Books

1. C. Howard," Modern Welding Technology", Prentice Hall, 1979.
2. P. T.Houldcroft , "Welding Process Technology", Cambrige University Press, 1985.
3. M. M.Schwartz , "Metal Joining Manual", McGraw Hill, NewYork, 1979.
4. L. P.Connur , "Welding Handbook, Vol. 1 & 2", American Welding Society, 1989, 1990.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2	3						
CO2	1	2	3	3						
CO3		1	2	3						
CO4	1	2	2	3						

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study and develop solutions for Industry processes and its presentation
4) Quiz

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	C01	C02	C03	CO4
Class Test (20 Marks)	05	05	05	05
Teachers Assessment (20 Marks)	05	05	05	05
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

ME 470: Reliability Engineering	
Teaching Scheme Lectures: 3 Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: None

Course description: After completing this course, students will have a broad and fundamental understanding of the concepts of reliability, availability and maintainability. Students can build, assess and implement reliability models for different configurations.

Course Objectives:
To provide a clear view on the concepts of reliability, availability and maintainability
To accustom with hazard-rate models
To impart knowledge about reliability models for different configurations
To familiarize with procedures for assessing reliability of components and systems
To acquire and apply strategies for improving reliability of different systems

Course Outcome
After completing the course, students will be able to:

CO1	Understand the concepts of reliability, availability and maintainability
CO2	Develop hazard-rate models to know the behaviour of components
CO3	Build system reliability models for different configurations
CO4	Asses reliability of components and systems using field and test data
CO5	Implement strategies for improving reliability of repairable and non-repairable systems

Detailed Syllabus:

Unit 1	Introduction: Probabilistic reliability, failures and failure modes, repairable and non-repairable items, pattern of failures with time, reliability economics.
Unit 2	Component Reliability Models: Basics of probability & statistics, hazard rate & failure rate, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, timedependent & stress-dependent hazard models, bath-tub curve.
Unit 3	System Reliability Models: Systems with components in series, systems with parallel components, combined series-parallel systems, k-out-of-m systems, standby models, loadsharing models, stress-strength models, reliability block diagram.
Unit 4	Life Testing & Reliability Assessment: Censored and uncensored field data, burn-in testing, acceptance testing, accelerated testing, identifying failure distributions & estimation of parameters, reliability assessment of components and systems.
Unit 5	Reliability Analysis & Allocation: Reliability specification and allocation, failure modes and effects and criticality analysis (FMECA), fault tree analysis, cut sets & tie sets approaches; Maintainability Analysis: Repair time distribution, MTBF, MTTR, availability, maintainability, preventive maintenance.

Text and Reference Books
1. Ebeling CE, "An Introduction to Reliability and Maintainability Engineering", TMH, New Delhi, 2004.
2. O'Connor P and Kleymer A, "Practical Reliability Engineering", Wiley, 2012.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2			2	3	2	3			
CO2		2	2	2	3					
CO3		3	3		3					
CO4					2	2	2			
CO5							2	3	3	3

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Presentation of case studies
2) Question & answer / Numerical solution
3) Study of Industry processes and its presentation
4) Mini projects

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	10
K2	Understand	05	05	10
K3	Apply	05	05	20
K4	Analyze	05	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K3
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	05	05	02	05	03
Teachers Assessment (20 Marks)	05	05	02	05	03
ESE Assessment (60 Marks)	10	10	10	20	10

Special Instructions if any: Nil

ME 471: Operations Research Techniques	
Teaching Scheme Lectures: 3Hrs/Week Credits: 3	**Examination Scheme** Class Test : 20 Marks Teachers Assessment : 20 Marks End Semester Exam : 60 Marks

Prerequisites: GE 141, GE 151 Engineering Mathematics

Course description: After completion of the course, students will have understanding of importance of operation research techniques in the decision making process. Understand the characteristics of different types of decision-making environments. Students will be able to design new simple models, like: CPM to improve decision–making and develop critical thinking and objective analysis of decision problems and develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Course Objectives:

1. The study the need of using OR for effective decision making
2. Application of complex mathematical models in management science
3. Study simplex method for linear programming and perform iterations of it by hand.
4. Recognize, formulate and solve transportation problem involving large no of routes.
5. Study use of PERT and CPM techniques for project management.
6. Study replacement and maintenance analysis techniques.

Course Outcome

After completing the course, students will be able to:

CO1	Understand the characteristics of different types of decision-making environments
CO2	Identify and develop operational research models from the verbal description of the real system.
CO3	Solve specialized linear programming problems
CO4	Recognize the basic type of queuing model, derive and calculate steady state system performance characteristics and analyze projects with a view to managing resources, minimizing costs, and coping with uncertainty
CO5	Design new simple models, like: CPM to improve decision –making and develop critical thinking and objective analysis of decision problems

Detailed Syllabus:

Unit 1	**Introduction:** Operations Research history, definitions, objectives, scope, characteristics, limitations, phases and applications. Models: classification, advantages, methods for solving. **Linear Programming:** General structure, Assumptions**,** limitations**,** Formulation of L.P. Problem, Basic solution, Graphical method, Simplex method, Two phase simplex, Big-M method, special cases in L.P., including infeasible solution, unbounded solution, alternate solution, Degeneracy in L.P., Duality in L.P., Dual simplex method.
Unit 2	**Transportation Models:** Assumptions, Definition, methods for finding initial solution, test of optimality-MODI method, Maximization transportation problem, Degeneracy. **Inventory Control System:** Introduction, classification of inventory models, EOQ,

	Deterministic inventory models with replenishment rate infinite and finite without shortages. Inventory models with price breaks.
Unit 3	**Assignment Models:** Definition, Mathematical representation of the assignment model, comparison with the transportation model, The Hungarian method for solution of assignment problem, Variations of the assignment problem. **Sequencing Models:** elements, assumptions, processing of n jobs through 1, 2, 3 and m machines, processing of two jobs through m machines using graphical method, processing of n jobs through m machines, routing problems in network, minimal path problem (shortest acyclic route model).
Unit 4	**Queuing Models:** Applications, and Structure of queuing system, operating characteristics of a queuing system. Kendall's notation for representing queuing models, classification of queuing models. Single channel Poisson arrival with exponential service, infinite population model. **Theory of Games:** Characteristics of games, Game models, Definitions, Rules for game theory, Two person zero sum game with saddle point, dominance, Pure strategies (Minimax and maximin principle), method of sub game, for 2 x n or m x 2 games. Graphical method for 2 x n or m x 2 games, method of matrices for 3 x 3 games.
Unit 5	**Network Models:** Introduction to CPM/PERT and its importance in project management, Phases of project management, Rules for drawing network diagram, Looping, Dangling, Dummy activity, Fulkerson's rules for numbering, Forward pass computations, Backward pass computations, Determination of critical path, Types of floats, Determination of floats and slack times, PERT time estimates, Probability of completion of project on or before specified time. **Replacement Model:** Types of failures, Replacement of items that deteriorate whose maintenance cost increase with time and value of money remains constant during the period, Replacement of items that deteriorate whose maintenance cost increase with time and value of money changes with time, Replacement of items that fail suddenly: Individual replacement policy and Group replacement policy.

Text Books & References Books:

1. P.K.Gupta, D.S.Hira, 'Operations Research', S. Chand Publications, New Delhi.
2. J K Sharma, "Operations Research Theory and Applications", 3rd edition, Macmillan India Ltd.
3. Manohar Mahajan, "Operations Research", Dhanpat Rai & Company Pvt. Limited.
4. S. D. Sharama, "Operations Research"Kedar Nath Ram Nath & Co. Meerut.
5. Taha, Hamdy A., "Operations Research, An Introduction", 7th edition (with CD Rom), Prentice Hall Inc.2003.
6. N. D. Vohra, "Quantitative techniques in Management", Tata McGraw Hill Publishing Company Limited, New Delhi.
7. Ragsdale, Cliff T., "Spreadsheet Modeling and Decision Analysis, A Practical Introduction to Management Science", South Western, Cengage Learning.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1						3	3	3	2
CO2	2	3	1	3				1		
CO3					1	2				

CO4			1			2				
CO5		1		1	2	2		2	3	3

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Technical quizzes
2) Spreadsheet Modeling and Decision Analysis
3) Case studies
4) Question & answer / Numerical solutions

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Understand	03	05	12
K2	Identify	02	05	12
K3	Analyze	05	05	36
K4	Solve	10	05	00
K5	Develop	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	03	02	05	10	00
Teachers Assessment (20 Marks)	05	05	05	05	00
ESE Assessment (60 Marks)	12	12	12	24	00

Special Instructions if any: Nil

ME 454: Lab Automatic Control System	
Teaching Scheme Practical: 2 Hrs/Week Credit: 1	**Examination Scheme** Term Work : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand characteristics of sensors, Hydraulic and Pneumatic actuators and experimentation of its characterization for industrial applications.
CO2	Understand and develop Characterization of performance of PID Controller and stability of controller
CO3	Participate to develop Mechanical system block diagram
CO4	Communicate effectively by preparing laboratory report

List of Experiments (Any Five)

Sr. No.	Details
1	Study of Control system components and industrial control systems
2	Determination of characteristics of ON/OFF Temperature Controller.
3	Determination of characteristics of DC/AC motor speed control.
4	Determination of characteristics of various modes of control P, PD, PI, PID
5	Development and selection of Automatic Control system component with (a) Plant Layout (b) Block Diagram (c) Steady State Analysis (d) Controller for various control systems like temperature, etc.
6	Study of NC/CNC machine controller.
7	An Industrial Visit to study the process control systems.

Mapping of Course outcome with Program Outcomes

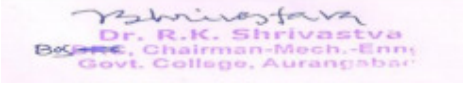
Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2	3						
CO2	1	2		3		3				
CO3	1							2	3	
CO4	1							1		

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	Skill Level	Term Work	Practical Examination & viva voce
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	05	05
Conduct of Experiment (S2)	05	05



Observation and Analysis of Results (S3)	05	05
Record (S2)	05	05
Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Assessment Table

Assessment Tool	S1	S2	S3	S3
	C01	C02	C03	CO4
Term Work (25 Marks)	05	10	05	05
Practical Examination & Viva Voce (25 Marks)	05	10	05	05

ME 455: Lab Automobile Engineering	
Teaching Scheme Practical: 2 hrs/week Credits: 1	**Examination Scheme** Term work– 25 marks Practical Exam. – 25 marks

Course Objectives:

To study basics of principles of actual automobile systems.
To study importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
To study working of various Automobile Systems.
To know some modern trends in Automotive Vehicles.

Course Outcomes:

Course objectives are to be fulfilled. Students learn and become familiar with

CO1	Understand the Construction, working and other details about Internal Combustion Engines used in automobiles
CO2	Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.
CO3	Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
CO4	Identify Modern technology and safety measures used in Automotive Vehicles

LIST OF PRACTICALS At least seven practical's from the list below.
1. Study of lubricating system.
2. Study of fuel supply systems of automobile
3. Study of various electrical and starting systems in automobile
4. Fault finding of ignition system.
5 Study of various suspension systems of automobile
6. Disassembly & assembly of two types of gear boxes in the automobile
7. Study of braking systems of automobile
8. Study of steering system & its adjustment.
9. Disassembly & assembly of two stroke engine.

Practical Examination:
Shall be based on viva-voce both on term work and practical's conducted by student as per sally bus, Internal and external examiner.

Mapping of Course out come with programme outcome

Course Out come	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**3**									
CO2		**2**								
CO3	**2**									
CO4	**2**									

1 – High 2 – Medium 3 – Low

Assessment table

Assessment Tool	S1	S2	S3	S2	S2
	C01	C02	C03	CO4	CO5
Term work 25 Marks	10	05	02	02	01
Practical Examinations & Viva Voce	07	03	02	06	02

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

ME 456: Lab Tool Design	
Teaching Scheme Practical: 2 Hrs/Week Credit: 1	**Examination Scheme** Term Work : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand the geometry of single point and multipoint cutting tools and analyze tool life calculation
CO2	Participate to develop locating and clamping devices and analyze minimum force required for clamping
CO3	Design jigs for drilling and fixtures for turning and milling for particular industrial product
CO4	Select, design and draw standard dies for Piercing and Blanking operations

List of Experiments (Any Six)

Sr. No.	Details
1	Sheet No.1: Locating Devices: Drawing and Designing of various Locating systems/devices for Jigs/Fixtures
2	Sheet No.2: Clamping Devices and Drill Bushes Drawing and Designing of various Clamping system/devices (mechanical/hydraulic/pneumatic) for Jigs/Fixtures and Drill bushes
3	Sheet No.3: Design of Drilling Jig: Design and Drawing of Drilling Jig for the given component
4	Sheet No.4: Design of Milling/Turning Fixture: Design and Drawing of Milling/Turning fixture for the job given.
5	Sheet No.5: Design of Press Tool: Design and Drawing of Blanking/Piercing press tool for the given components
6	Sheet No.6: Multipoint Cutting Tool: Drawing of various Multipoint cutting tools e.g. drill, milling cutters, reamers, broaches, taps, hobs
7	Journal Assignment on a) Tooling Materials: Tool materials and its characteristics and classification b) Single point Cutting Tool: Geometry, Tool signature, Significance of various angles, Merchant theory, factors affecting Tool life, Tool wear c) Press Working: Working, operations, classification, types of dies etc.
8	Models: Preparing a model of Single Point Cutting Tool from soft/wood material Preparing one of the Multipoint cutting tool from soft/wood material

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1		2		3					
CO2	1	2						3		
CO3	1	2	3		3					
CO4	1	2	3		3					

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	05	05
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	05	05
Record (S2)	05	05
Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Assessment Table

Assessment Tool	S1	S2	S3	S3
	C01	C02	C03	CO4
Term Work (25 Marks)	05	10	05	05
Practical Examination & Viva Voce (25 Marks)	05	10	05	05

ME 457: Project-II	
Teaching Scheme Practical: 8 Hrs/Week Credit: 6	**Examination Scheme** Term Work : 100 Marks Practical/Viva-Voce : 150 Marks

Prerequisites: ME 450: Project-I

Course description: After completing this course, students will be able to implement the principles of engineering learnt by them in practical applications with innovative ideas and thus enable them to have a practical exposure.

Course Objectives:
To provide an opportunity to work in group on a topic / problem / experimentation
To encourage creative thinking process
To provide an opportunity to analyze and discuss the results to draw conclusions
To acquire and apply fundamental principles of planning and carrying out the work plan of the project through observations, discussions and decision making process.

Course Outcome
After completing the course, students will be able to:

CO1	Identify methods and materials to carry out experiments/develop code.
CO2	Reorganize the procedures with a concern for society, environment and ethics.
CO3	Analyze and discuss the results to draw valid conclusions.
CO4	Prepare a report as per recommended format and defend the work.
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

Detailed description:

Students should conduct literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by experimental/simulation methods. The solution to be validated with proper justification and report to be compiled in standard format.

Project work shall be based on any of the following:
1. Design / Fabrication of product / testing setup of an experimentation unit / apparatus / small equipment, in a group with engineering analysis / performance analysis / modeling
2. Experimental verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

Mapping of Laboratory outcome with Program Outcomes

Laboratory Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	2	2	3			3		3
CO2	2		2							
CO3			1			1		3		
CO4						1		2		
CO5				2		1		2		

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	20	25
S2	Manipulation	30	50
S3	Precision	50	75
S4	Articulation	00	00
55	Naturalization	00	00
Total		100	150

Preparation (S1)	20	25
Conduct of Experiment (S2)	15	40
Observation and Analysis of Results (S3)	35	50
Record (S2)	15	10
Mini-Project / Presentation/ Viva-Voce (S3)	15	25
Total	**100**	**150**

Assessment Table

Assessment Tool	S1	S2	S3	S3	S3
	CO1	CO2	CO3	CO4	CO5
Term Work (100 Marks)	20	30	25	20	05
Practical Examination & Viva Voce (150 Marks)	25	50	25	25	25

Special Instructions if any: Nil