GOVT. COLLEGE OF ENGINEERING

AURANGABAD

CURRICULUM

Final Year B. Tech. (Mechanical Engineering)

Department of Mechanical Engineering

2018-2019

Structure For Final Year B. Tech (Mechanical Engineering) (Full Time)

Choice Based Credit System

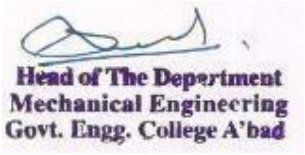
SEMESTER- VII													
Sr. No.	**Code**	**Subject**	**Contact Period (Hrs.)**			**Credits**	**Continuous Evaluation in terms of Marks**						
							Theory				**TW**	**Practical /Viva Voce**	**Total**
			L	**T**	**P**		**C.T.I**	**C.T.II**	**TA**	**ESE**			
1.	ME 4001	IC Engine & Gas Turbine	2	1	0	3	15	15	10	60	-	-	100
2.	ME 4002	Mechatronics	2	1	0	3	15	15	10	60	-	-	100
3.	ME 4003	CAD/CAM	3	0	0	3	15	15	10	60	-	-	100
4.	#	**Professional Electives V**	4	0	0	4	15	15	10	60	-	-	100
5.	*	**Open Elective III**	3	0	0	3	15	15	10	60	-	-	100
6.	ME 4010	Lab- IC Engine & Gas Turbine	0	0	2	1	-	-	-	-	25	25	50
7.	ME 4011	Lab- Mechatronics	0	0	2	1	-	-	-	-	25	25	50
8.	ME 4012	Lab – CAD/CAM	0	0	2	1	-	-	-	-	25	25	50
9.	ME 4013	Seminar	0	0	2	1	-	-	-	-	-	25	25
10.	ME 4014	Project I	0	0	2	1	-	-	-	-	25	25	50
11.	ME 4004	Industrial Training	0	0	2	1	0	0	0	0	25	0	25
12.	$	**Audit Course V**	0	0	2	0	0	0	0	0	0	0	0
		Total	**14**	**2**	**14**	**22**	**75**	**75**	**50**	**300**	**125**	**125**	**750**

SEMESTER- VIII													
Sr. No	**Code**	**Subject**	**Contact Period (Hrs.)**			**Credits**	**Continuous Evaluation in terms of Marks**						
							Theory				**TW**	**Practical /Viva Voce**	**Total**
			L	**T**	**P**		**C.T.I**	**C.T.II**	**TA**	**ESE**			
1.	ME 4017	Automatic Control System	3	0	0	3	15	15	10	60	-	-	100
2.	ME 4018	Tool Design	2	1	0	3	15	15	10	60	-	-	100
3.	ME 4019	Refrigeration &Air Conditioning	2	1	0	3	15	15	10	60	-	-	100
4.	#	**Professional Electives VI**	4	0	0	4	15	15	10	60	-	-	100
5.	*	**Open Elective IV**	3	0	0	3	15	15	10	60	-	-	100
6.	ME 4026	Lab- Refrigeration &Air Conditioning	0	0	2	1	-	-	-	-	25	25	50
7.	ME 4027	Lab- Automatic Control System	0	0	2	1	-	-	-	-	25	25	50
8.	ME 4028	Lab - Tool Design	0	0	2	1	-	-	-	-	25	25	50
9.	ME 4029	Project II	0	0	6	3	-	-	-	-	50	100	150
Total			**14**	**2**	**12**	**22**	**75**	**75**	**50**	**300**	**125**	**175**	**800**
Grand Total			**28**	**4**	**26**	**44**	**150**	**150**	**100**	**600**	**250**	**300**	**1550**

L=Lecture, **T** = Tutorial, **P** = Practical, **TA** = Teacher Assessment, **ESE** = End Semester Examination

# **Professional Elective V**	**#Professional Elective VI**	***Open Elective III**
ME 4024 Tribology	ME 4020 Automobile Engineering	ME 4015 Industrial management
ME 4025 Advanced Joining Techniques	ME 4021 Energy Audit &Management	ME 4016 Costing and Cost Estimation
ME 4032 Advanced Materials	ME 4022 Reliability Engineering	
	ME 4023 Robotics and Automation	

$ Audit Course V	***Open Elective IV**
AC 4001 Talent hour	ME4130 Engineering Economics and costing
AC 4002 Drama	ME 4031 Renewable Energy Engineering
AC 4003 Music Instrument	



ME4001: Internal Combustion Engines and Gas Turbines	
Teaching Scheme Lectures: 2 hrs/Week Tutorials: 1 hr/Week Credits: 3	**Examination Scheme** Class Test I -15 Marks Class Test II -15 Marks Teachers Assessment-10Marks End Semester Exam – 60 marks

Prerequisite: - ME2001Engineering thermodynamics, ME2011 Applied thermodynamics, ME1001-Basics of mechanical engineering, ME3004 Fluid mechanics and Hydraulics Machines.

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:

CO 1	Understand various types of I.C. Engines, Cycles of operation and Identify fuel metering, fuel supply systems for different types of engines .
CO 2	Understand combustion phenomena in SI and CI engines and Analyze the effect of various operating variables on engine performance.
CO 3	Evaluate performance Analysis of IC Engine and Justify the suitability for different applications.
CO 4	Understand the conventional and non-conventional fuels and effects of emission formation of IC engines, its effects and the legislation standards.
CO 5	Analyze 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 systemsfor 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 flamepropagation, 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 andcauses 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 & Joulecycle, 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,1974Ganesan V., "Internal combustion Engines", 6 thEd.Tata McGraw Hill Publishing Co. Domkundwar V.M. "Internal Combustion Engines"-

MathurM.C.,SharmaR.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 10 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 program outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**						**3**							
CO2		**2**							**1**	**1**				
CO3	**2**												**2**	
CO4	**2**										**1**			
CO5					**2**		**3**					**1**		

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test I	Class Test II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	03	03	03	10
K2	Understand	02	02	02	10
K3	Apply	02	02	02	20
K4	Analyze	05	05	03	10
K5	Evaluate	03	03	00	10
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K 5
Cos	C01	C02/C06	C03	CO4/C07	CO5
Class Test (15 Marks)	03	02	05	05	03
Class Test (15 Marks)	03	02	05	05	03
Teachers Assessment (20 Marks)	03	02	02	03	00
ESE Assessment (60 Marks)	10	10	20	15	05

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad

ME 4002 : Mechatronics	
Teaching Scheme **Lectures: 2Hrs/Week** **Tutorial: 1 Hr/Week** **Total Credits : 03**	**Examination Scheme** **Class Test-I : 15 Marks** **Class Test-II : 15 Marks** **Teachers Assessment : 10Marks** **End Semester Exam : 60 Marks**

Prerequisites: EE1003: Basic Electrical Engineering, ME3017: 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:

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

Course Outcomes:

After completing the course, students will be able to:

CO1	Identify the 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 PLC Ladder programming for Industrial Applications.

Detailed syllabus

Unit-I	**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-II	**Hydraulic, Pneumatic & Electrical systems** Elements, Construction, Operation, Standard Symbols and Industrial Applications. Hydraulic and Pneumatic Circuits.
Unit-III	**Data Acquisition System** Introduction and significance of data acquisition system, types of DAS, Signal conditioning system, Industrial Applications
Unit-IV	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 V	**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 InternationalPublication.
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
8. Publishing
9. Steward, "Hydraulics and Pneumatics for production",Audal Series.
10. "Fundamentals of Pneumatics", Festo series.
11. Vickers's manual on "hydraulics". Curtis D. Johnson,"Process Control instrumentation Technology" –PHI Publication HMT, "Mechatronics" –TMH.

Mapping of Course outcome with Program Outcomes (Mechanical Engineering)

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2	1			2										
CO3		1	2	3									**1**	
CO4	1			2							**1**			
CO5		1		2								**1**	**2**	

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

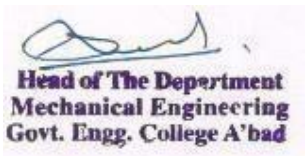
1) Simulation
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industrial processes

Assessment table:

Course outcomes	CO1				CO2				CO3				CO4			
Assessment Tool	K1	K2	K3	K5	K1	K2	K3	K5	K1	K2	K3	K5	K1	K2	K3	K5
Class Test-I (15 Marks)	2	1	6	6	0	0	0	0	0	0	0	0	0	0	0	0
Class Test-II (15 Marks)	0	0	0	0	2	1	6	6	0	0	0	0	0	0	0	0
Teachers Assessment (10Marks)	1	1	0	0	1	1	0	2	0	0	0	2	0	0	0	2
ESE Assessment (60 Marks)	4	0	5	10	2	0	5	10	2	0	0	10	2	0	0	10

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test1	Test2	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	2	2	2	10
K2	Understand	1	1	2	10
K3	Apply	06	06	00	20
K4	Analyze	06	06	06	20
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total(100 Marks)		15	15	10	60



ME 4003 : CAD/CAM	
Teaching Scheme Lectures:3Hrs/Week Credits:3	**Examination Scheme** Class Test I 15 Marks Class Test II 15 Marks Teacher Assessment 10Marks 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:

1) To introduce new field of CAD/CAM
2) To understand mathematical representation of curve and surfaces.
3) To model the object using Wireframe, surface and solid modeling techniques
4) To design a basic automation system and its applications
5) 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 and transform object using various transformation methods.
CO2	Understand modelling of curves, surfaces and solids.
CO3	Generate tool path for part and to create CNC manual part program and APT part
CO4	Prepare prototype using different rapid prototyping process.

Detailed Syllabus:

Unit1	**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. transformation, Oblique Projections.
Unit2	**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.
Unit3	**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
Unit4	**NC and CNC Technology:** Introduction to automation. Need and future of NC, CN 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, G and M Codes APT Part programming, Problems on Programming APT language structure, APT-Geometry, motion commands, post processor commands, Introduction to group technology.
Unit5	**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,"computational geometry for design and manufacture"-Ellis Horwood
2) Kundra T. K., Rao P. N. and Tewari M. K., "Numerical Control and Computer Aided Manufact uring", Tata McGraw Hill, 1990.
3) Groover M.P. and Zimmers E.W., "Computer Aided Design and Manufacturing ", Prentice Hall India, 1997.
4) Rao P N., "CAD/CAM Principles and Applications ", Tata McGraw Hill, 2006
5) Ibrahim Zeid, "CAD/CAM—theory and practice, McGraw-Hill, New York, 1991.
6) Adithan, M. , Pabla, B.S. ," CNC Machines", New Age International (P) Ltd

Mapping of Course outcome with Program Outcomes

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2	1	2											1	
CO3	1												1	
CO4			1		3						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) Technical quizzes
2) Drawing CAD Models and Kinematics in CAD software
3) Industrial case studies
4) Question & answer / Numerical solutions

Assessment pattern

Assessment Pattern Level No.	Knowledge Level	Test I	TEST II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	02	02	2	10
K2	Understand	03	03	2	10
K3	Apply	05	05	3	20
K4	Analyze	05	05	3	20

ME4004 Industrial Training	
Teaching Scheme Minimum Three week Industrial Training Credits: 1	**TW- 25**

Prerequisite: - ME2001Engineering thermodynamics, ME 2002- Machine Drawing, ME2003-Manufacturing processes, ME2011 Applied thermodynamics, ME1001-Basics of mechanical engineering, ME 3002 Design of Machine Elements-I, ME3004 Fluid mechanics and Hydraulics Machines.

Course description: After completing this course, students will have a broad and fundamental understanding of concerned Industry, Industrial activities , Industrial behavior. Student will understand the Industrial layouts/Plant layout, process layouts, Manufacturing processes, Standard Quality Control Practices. Students should understand the purchase and sales process, reduction of scrap or wastages of material. Student get conversant with Standard Inventory Control, Costing and Cost Control

Course Objectives:

1. To make the student conversant with industrial activities, organizational behavior and ethics
2. To understand various industrial aspects viz. manufacturing processes, industrial design, productivity improvement, value engineering, quality control.

Course Outcomes:

After completing the course, students will be able to:

CO1.	Understand various industrial aspects.
CO2.	Develop professional ethics required to work in industry.

General Guidelines to students for Industrial Training

- Students shall undergo industrial in-plant Training for ***the period of Three week.***
- Students shall undergo training in small/medium/large multi-national Industry or shall to visit various departments or government industry or Research Centre.
- Industrial training co-ordinator of department shall allot Faculty Advisor to this Course. It is duty and responsibility of Faculty Advisor to give the standard formats of Industrial report and contact with the industries authorities and support the students to gather technical information.
- The student shall submit detail report on for Industrial Training

Term Work

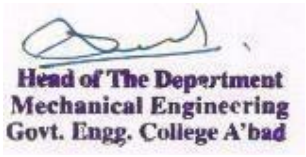
Term work shall consist of a comprehensive report based on student's observations, training received during three week of training.

The report shall also include drawings, figures, process sheets, machine/ product specifications etc.

Students shall obtain a Certificate of successful completion of training from concerned industry authority in standard format.

Mapping of Course out come with program outcome

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



ME 4015: Industrial Management	
Teaching Scheme Lectures: 3 hrs/week Credits: 3	**Examination Scheme** Class Test 1 – 15 marks Class Test 2 – 15 marks Teacher's Assessment – 10 marks End Sem Exam-60

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:

1) To understand the dynamics nature of private and public administration related to production activity.

2) To understand the concept of human resource and its development in production related activities.

3) To study the financial implications of production.

4) To evaluate the different types of industrial ownerships.

5) To understand the different administrative controls operating on the employees.

Course Outcome

After completing the course, students will be able to:

CO 1	Understand the principles of management.
CO 2	Apply human relation skills for motivating the employees.
CO 3	Analyze and solve problems related to production activity.
CO 4	Understand the working of public sector undertakings and their problems.

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, Privatization ,Globalization.
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-WeberianDevelopments ,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, "OrganisationBehaviour", 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 out come with program outcome

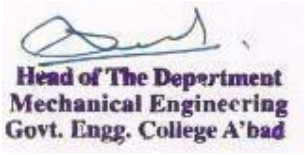
Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**1**	
CO2			1		2	1							**2**	
CO3			1		3	2							**1**	
CO4											**1**		**3**	

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	02	10
K2	Understand	10	03	10
K3	Apply	10	03	20
K4	Analyze	05	02	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		30	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
COs	CO1	CO1	CO3	CO4	CO5
Class Test (15+15 Marks)	06	06	06	06	06
Teachers Assessment (10 Marks)	02	03	01	02	02
ESE Assessment (60 Marks)	12	12	12	12	12



ME 4016 COSTING & COST ESTIMATION	
Teaching Scheme Lectures: 3 hrs/week Credits: 3	**Examination Scheme** Class Test 1 – 15 marks Class Test 2 – 15 marks Teacher's Assessment – 10 marks End Sem Exam-60

Objectives:

1. To, understand the principles costing, estimation and control of industrial product

2. Be able to apply costing tools.

3. To understand and analyze the effect of product cost on customer and manufacturer

4. To understand the contemporary trends in costing and cost control in industries

Course Outcomes:

After completing the course, students will be able to:

CO1	Understand the procedure of Estimation & Budget cost estimation
CO2	Apply basic calculation in manufacturing processes.
CO3	Analyze the cost components.
CO4	Estimate the total cost from raw materials to finished product including Power cost.
CO5	Apply cost control and cost reduction techniques

Unit 1:**Introduction of cost & Cost Estimation**: Concept of cost, cost unit, cost center, classification &element of cost, different costs for different purposes. Costing methodology for raw materials, Products and Services, cost-price-profit equation Cost Estimation: Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures. Source of finance
Unit 2:Estimation of Weight, Material and fabrication Cost: Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost Review of purchasing procedure, recording of stock and consumption of material by LIFO, FIFO, direct cost and indirect cost, Procedure of estimation of fabrication cost, forging cost, machining cost and of machine hour rate
Unit 3:Cost Accounting Methods: Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing, for industrial products
Unit 4 :Cost Control: Use of cost data for policymaking and routine operation, control techniques such as budgetary control, standard cost, variance analysis, marginal cost and break even analysis
Unit 5:**Cost Reduction Areas**: Procedures and systems in product, methods and layouts, administrative and marketing, rejection analysis, cost of poor quality, value analysis and value engineering, Zero Base Budgeting

Reference Books

1. Process Planning & Cost Estimation Edited by Dennis Lock, B & H Ltd. 2 Handbook of Engineering Management Edited by Dennis Lock, B & H Ltd
2. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
3. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
4. Cost Accounting: B. Jawaharlal (TMH)
5. Cost Accounting: R.R. Gupta.
6. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)
7. Cost Accounting: Jain, Narang (Kalyani Publishers)
8. A Text Book of Estimating and Costing Mechanical – J.S. Charaya& G. S. Narang (SatyaPrakashan)
9. Mechanical Estimation and Costing – TTTI, Chennai (TMH)
10. Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain (TMH)

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

Student's Presentation on related topics

Mapping of Course out come with program outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				3										
CO2	3				2		2		2				**3**	
CO3		2				3							**3**	
CO4					3									
CO5		3										**1**		

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	K5
COs	CO1	CO1/CO5	CO3	CO4/CO2	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 4010: 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:

CO 1	Identify the various types of I.C. Engines and Cycles of operation.
CO 2	Express the effect of various operating variables on engine performance
CO 3	Demonstration of fuel metering and fuel supply systems for different types of engines
CO 4	Analyze & Justify the suitability of conventional and non-conventional fuels for IC engines
CO 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 program outcome

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**												1	
CO2		**2**											1	
CO3	**2**												1	
CO4	**2**												1	
CO5						**2**	**3**						1	

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 4011: Lab Mechatronics	
Teaching Scheme Practical: 2 Hrs/Week Credits: 1	**Examination Scheme** Term Work : 25 Marks Practical and viva : 25 Marks

Course Outcome

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

CO 1	Study of sensors, Hydraulic and Pneumatic actuators and experiment ion of its characterization for industrial applications
CO 2	Study of data acquisition system and its industrial applications
CO 3	Understand the architecture of microprocessor and microcontroller
CO 4	Develop pneumatic circuit /hydraulic circuit for industrial applications and measure its Performance.
CO 5	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	PO11	PO12	PSO1	PSO2
CO1	1		2	3									2	
CO2	1		2	3									2	
CO3	1	2		3										
CO4	1	1	2			2	3				3		1	
CO5	1	1	2			2	3				3		2	

1 – High 2 – Medium 3 – Low

Assessment Table

Assessment Tool	S2	S1	S1	S3	S3
	CO1	CO2	CO3	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**

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad

ME 4012: Lab CAD/CAM	
Teaching Scheme	Examination Scheme
Practical: 2 Hrs/Week Credits: 1	Term Work : 25 marks Practical examination and viva voce: 25 marks

Course Outcome

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

CO 1	Study of program in C or MATLAB for 2 D Transformations.
CO 2	Developing program in C or MATLAB for graphical output of any one type of curve / surface.
CO 3	Creating 3 D Model on any CAD software like Pro/E, UG, CATIA, etc. and get its hard copy
CO 4	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	PO11	PO12	PSO1	PSO2
CO1	1		2										1	
CO2	1				3								1	
CO3	1	1				2							1	
CO4	1		2										1	

1 – High 2 – Medium 3 – Low

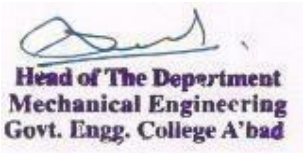
Assessment Table

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 4013: Seminar	
Teaching Scheme Practical: 2 Hrs/Week Credit: 1	Examination Scheme Practical/ Viva-Voce : 25 Marks

Course description: After completing this course, students will develop the life-long learning habit ofarchiving, assessing, and sharing their learning by creating a portfolio to honour, 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	Prepare a well organized report employing elements of technical writing and critical thinking.
CO2	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 Out come	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		2		3			2	1	3			**1**	
CO2			3				2	2						

1 – High 2 – Medium 3- Low

Assessment Pattern

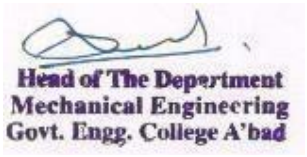
Assessment Pattern Level No.	**Skill Level**		**Practical Examination & viva voce**
S1	Imitation		07
S2	Manipulation		08
S3	Precision		10
S4	Articulation		00
55	Naturalization		00
Total			25

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

Assessment Table

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

Special Instructions if any: Nil



ME 4014: Project-I	
Teaching Scheme Practical: 2 Hrs/Week Credit: 1	Examination Scheme Term Work: 25 Marks 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	Review literature to identify gaps and define objectives & scope of the work.
CO2	Prepare and present detail plan of project.

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

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2							1	
CO2				2	2							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
	CO1	CO2	CO3
Term Work (25 Marks)	07	08	10
Practical Examination & Viva Voce (25 Marks)	07	08	10

Special Instructions if any: Nil

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad

ME 4017 AUTOMATIC CONTROL SYSTEM	
Teaching Scheme **Lectures: 3 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 15 Marks** **Class Test II : 15 Marks** **Teachers Assessment : 10 Marks** **End Semester Exam : 60 Marks**

Prerequisites: ME 3017: 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:

1. To provide a clear view of operational characteristics of sensors for its use in control system.
2. To accustom with different industrial control system.
3. To impart knowledge of pneumatic and hydraulic control actions.
4. 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	Apply the knowledge of different types of pneumatic and hydraulic control system.
CO4	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. GopalaRao, "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 Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1			3									1	
CO2		1	2	3									2	
CO3	1	2	3									2	2	
CO4			1	2							1			

1 – High 2 – Medium 3 – Low

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -I	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	05	10
K2	Understand	07	07	05	10
K4	Analyze	03	03	05	20
K5	Evaluate	00	00	00	00
Total Marks 100		15	15	10	60

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination offew 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 table:

Assessment Tool	K1	K2	K3	K4
	CO1	CO2	CO3	CO4
Class Test (15 Marks)	05	07	03	00
Class Test (15 Marks)	05	07	03	00
Teachers Assessment (10 Marks)	02	03	02	00
ESE Assessment (60 Marks)	12	18	12	18

Special Instructions if any: Nil

ME 4018 : Tool Design	
Teaching Scheme	**Examination Scheme**
Lectures:2Hrs/Week	Class Test I : 15Marks
Tutorial: 1 Hr/Week	Class Test II : 15 Marks
Credits:3	Teachers Assessment : 10Mark
	End Semester Exam :60Mark

Prerequisites: ME2002: Machine Drawing, ME2003:Manufacturing Process, ME2013: Machine Tools, ME3002: Design of Machine Elements.

Course Description: After completing this course, students will have abroad 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 and multi-point cutting tool.
CO2	Design jigs and fixtures for various applications.
CO3	Design of dies for piercing, blanking, bending and Drawing 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.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 2	**Introduction to Press Tools**: The fundamentals of die cutting operation, power press types, general press operation, cutting action in punch and die operations, types of dies, simple, compound, combination &progressive dies. Design of Die Set for Cutting Operations: theory of metal cutting, cutting force & blank holding force estimation, punch & die clearance e, scrap strip layout, design of punches, design of dies, pilots strippers, stock stops, finger stops, auto stops centre of

	pressure, selection of die set.
Unit 3	**Design of Drawing Die**: Blank size determination, no. of draws, stage wise achievement of drawn component, stage wise components drawing, drawing radii & clearance, drawing force, **Design of Bending Die**: Bending methods, Estimation of bend radius, bend allowance, developed length, bending pressure, bottoming force, spring back effect in bending operation, spanking.
Unit 4	**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 5	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

Text and Reference Books

1. Amitabh Bhattacharyya, "Metal Cutting Theory and Practice", Central Book Publication, Calcutta

2. Cyril Donaldson, "Tool Design",Tata McGraw-Hill Publishing Co. Ltd, New Delhi

3. Kempster, "Introduction to Jig and Tool Design", M.H.A .English Language 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 "Production Engineering", S .Chand Company Ltd New Delhi

8. S K Basu and S N Mukharjee,"Fundamentals of tool engineering design",Oxford and IBH publication Co. Pvt. Ltd Bombay

9. P.H.Joshi "Press Tools Design and Construction" Wheeler Publishing

Mapping of Course outcome with Program Outcomes

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

1–High 2–Medium 3-Low

Teacher's Assessment: Teachers Assessment of 10marks is based on one of the/or combination of few of following

1) Presentation of case studies
2) Question & answer/ Numerical solution
3) Design and Drawing of Jig and fixture for different automobile components
4) Design and drawing of Dies for different automobile components in CAD software

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	02	02	2	10
K2	Understand	03	03	2	10
K3	Apply	05	05	3	20
K4	Analyze	05	05	3	20

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad

ME 4019 : Refrigeration and Air Conditioning	
Teaching Scheme	**Examination Scheme**
	Class Test I : 15 Marks
Lectures: 2 Hrs/Week	Class Test II : 15 Marks
Tutorial: 1 Hr/Week	Teachers Assessment : 10 Marks
Credits: 3	End Semester Exam : 60 Marks

Prerequisites: ME2001 Engineering Thermodynamics, ME 2011Applied 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	Analyze performance of various refrigeration systems.
CO2	Analyze the air conditioning processes and systems using principles of Psychrometry.
CO3	Evaluate cooling and heating loads in air conditioning systems.
CO4	Identify refrigerants according to load and environment conditions.

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

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination offew 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	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	04	04	00	12
K2	Understand	03	03	03	12
K3	Apply	05	05	02	06
K4	Analyze	03	03	03	12
K5	Evaluate	00	00	00	18
K6	Create	00	00	02	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1/K2	K2/K3	K3/K4	K2	K5	K6
	CO1	CO2	CO3	CO4	CO5	CO6
Class Test (15 Marks)	04	03	05	03	00	00
Class Test (15 Marks)	04	03	05	03	00	00
Teachers Assessment (10 Marks)	03	02	03	00	02	00
ESE Assessment (60 Marks)	12	12	06	12	18	00

Special Instructions if any: Nil

ME 4020 : Automobile Engineering	
Teaching Scheme Lectures: 4 hrs/week Credits: 4	**Examination Scheme** Class Test I -15 Marks Class Test II -15 Marks Teachers Assessment-10 Marks End Semester Exam – 60 Marks

Prerequisite: - ME2001Engineering thermodynamics, ME2011 Applied thermodynamics, ME1001-Basics of mechanical engineering, ME 3004 Fluid Mechanics and Hydraulics Machines

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:

After completing the course, students will be able to:

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, ,multi viscosity 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 platefriction clutch and multi plate 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 vacuumbrakes 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.Ivol II. 9th Ed; Standard pub&Distributors,
2. Ramalingum K.K." Automobile Engineering; Scitech publications", Chennai
3. Srinivasan S." Automotive Engines", Tata McGraw Hill,
4. Crouse W.H."Automotive Mechanics", Tata McGraw Hill
5. JosephHeitner," 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 Program outcome

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

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination offew of following

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	03	03	02	15
K2	Understand	07	07	03	20
K3	Apply	05	05	02	15
K4	Analyze	00	00	03	10
K5	Evaluate	00	00	00	00
K6	Create	00	00	02	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1, K2	K1, K2	K3	K3, K4
	CO1	CO2	CO3	CO4
Class Test (15 Marks)	05	05	02	03
Class Test (15 Marks)	05	05	02	03
Teachers Assessment (10 Marks)	03	02	01	04
ESE Assessment (60 Marks)	17	18	12	13

ME 4021: Energy Audit & Management	
Teaching Scheme Lectures: 4 hrs/week Credits: 4	**Examination Scheme** Class Test I -15 Marks Class Test II -15 Marks Teachers Assessment-10 Marks End Semester Exam – 60 Marks

Prerequisites: ME 2001 Engineering Thermodynamics, ME 2011 Applied Thermodynamics

Course description: After completion of the course, students will have understanding of importance ofenergy 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 Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												1	
CO2			1	1	2								2	
CO3		1	2	1									2	
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 offew of following

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	03	10
K2	Understand	05	05	02	10
K3	Apply	02	03	03	20
K4	Analyze	03	02	02	20
K5	Evaluate	00	00	00	00
K6	Create	00	00	02	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K4
	CO1	CO2	CO3/CO5	CO4/CO6
Class Test-1(15 Marks)	05	03	02	05
Class Test-2 (15 Marks)	05	02	03	05
Teachers Assessment (10 Marks)	03	02	02	03
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad

ME 4022 : RELIABILITY ENGINEERING	
Teaching Scheme **Lectures: 4 Hrs/Week** **Credits: 4**	**Examination Scheme** **Class Test I : 15 Marks** **Class Test II : 15 Marks** **Teachers Assessment : 10 Marks** **End Semester Exam : 60 Marks**

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 behavior of components.
CO3	Build system reliability models for different configurations.
CO4	Asses reliability of components and systems using field and test data.

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, Time dependent& 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, Load sharing 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 out come with Program outcome

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

1 – High 2 – Medium 3 – Low

Assessment table:

Course outcomes	CO1				CO2				CO3				CO4			
Assessment Tool	K1	K2	K3	K5	K1	K2	K3	K5	K1	K2	K3	K5	K1	K2	K3	K5
Class Test-I (15 Marks)	2	1	6	6	0	0	0	0	0	0	0	0	0	0	0	0
Class Test-II (15 Marks)	0	0	0	0	2	1	6	6	0	0	0	0	0	0	0	0
Teachers Assessment (10 Marks)	1	1	0	2	1	1	0	2	0	0	0	2	0	0	0	2
ESE Assessment (60 Marks)	4	0	10	10	4	0	10	10	2	0	0	10	2	0	0	10

Teacher's Assessment: Teachers Assessment of 10 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	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	2	2	2	10
K2	Understand	1	1	2	0
K3	Apply	06	06	00	20
K4	Analyze	00	00	00	00
K5	Evaluate	06	06	06	06
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

ME4023: Robotics and Automation	
Teaching Scheme Lectures: 4 Hrs/week Credits: 4	Examination Scheme Class Test I : 15 Marks Class Test II : 15 Marks Teachers Assessment : 10 Marks End Semester Exam : 60 Marks

Prerequisites: ME3017:Mechanical Measurement, ME3005:Theory 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:

1. To understand basic terminologies and concepts associated with Robotic Automation To study various Robotic sub-systems and Automation systems
2. 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 nomenclature of robotics and automation.
CO2	Evaluate and plan robotic path.
CO3	Understand the various end effectors along with selection criterion.
CO4	Analyze robot matching with workplace.

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 Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												1	
CO2		2			1						1		1	
CO3	1	1								1			2	
CO4			1				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) Quiz
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industrial processes and its presentation

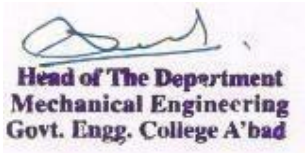
Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	00	00	00	00
K2	Understand	02	02	01	12
K3	Apply	03	05	02	12
K4	Analyze	05	05	04	12
K5	Evaluate	05	03	03	18
K6	Create	00	00	00	06
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K4	K5
	CO1	CO2	CO3	CO4	CO5
Class Test-1(15 Marks)	00	03	02	10	00
Class Test-2 (15 Marks)	00	03	05	05	02
Teachers Assessment (10 Marks)	03	02	00	03	02
ESE Assessment (60 Marks)	12	18	12	12	06

Special Instructions if any: Nil



ME 4024 : TRIBOLOGY	
Teaching Scheme **Lectures: 4 Hrs/week** **Credits: 4**	**Examination Scheme** **Class Test I : 15 Marks** **Class Test II : 15 Marks** **Teachers Assessment : 10 Marks** **End Semester Exam : 60 Marks**

Prerequisites: ME 3002: Design of Machine Elements, ME3021: Advance machine design

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:

1. To impart knowledge about lubricants and its properties
2. To provide a clear view on types of wears, sources of frictions and lubrication systems To accustom with hydrodynamic lubrication
3. 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. Andras Z. Szerl, "Fluid Film Lubrication Theory and Design", Cambridge University Press.

Mapping of Course out come with Programme outcome

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

1 – High 2 – Medium 3 – Low

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -I	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	05	05	10
K2	Understand	07	07	05	10
K4	Analyze	03	03	05	20
K5	Evaluate	00	00	00	00
Total Marks 100		15	15	10	60

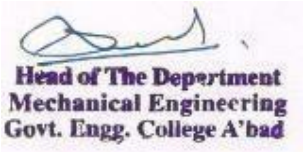
Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

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

Assessment table:

Assessment Tool	K1	K2	K3	K4
	CO1	CO2	CO3	CO4
Class Test-1(15 Marks)	05	07	03	00
Class Test-2 (15 Marks)	05	07	03	00
Teachers Assessment (10 Marks)	02	03	02	00
ESE Assessment (60 Marks)	12	18	12	18

Special Instructions if any: Nil



ME 4025: Advanced Joining Techniques	
Teaching Scheme Lectures: 4 Hrs/week Credits: 4	**Examination Scheme** Class Test I : 15 Marks Class Test II : 15 Marks Teachers Assessment : 10 Marks End Semester Exam : 60 Marks

Prerequisites: ME 2003: Manufacturing Process, ME 1005: Lab-Workshop-I, ME 1006: Lab-Workshop-II, ME 2008: Workshop Practice –III, ME 2021: Workshop Practice –IV, ME 3003: Engineering 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:

CO 1	Understand advance joining process for ceramics, plastics, composites and metals .
CO 2	Design and test the welded joint.
CO 3	Understand the effect of process parameters on quality of weld.
CO 4	Understand and apply the stress relief method for weld joints.

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, New York, 1979.

L. P.Connur , "Welding Handbook, Vol. 1 & 2", American Welding Society, 1989, 1990.

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	3										
CO2	1	2	3	3									1	
CO3		1	2	3									1	
CO4	1	2	2	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. 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	Class Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	02	10
K2	Understand	10	02	10
K3	Apply	10	02	20
K4	Analyze	05	02	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		30	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	CO1	CO2	CO3	CO4
Class Test (30 Marks)	10	05	10	05
Teachers Assessment (10 Marks)	03	02	02	03
ESE Assessment (60 Marks)	10	10	20	20

Special Instructions if any: Nil

E4032 : Advanced Materials	
Teaching Scheme Lectures: 4 Hrs/week Credits: 4	**Examination Scheme** Class Test I : 15 Marks Class Test II : 15 Marks Teachers Assessment : 10 Marks End Semester Exam : 60 Marks

Prerequisites: ME3003 Engineering 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 Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2			1	3									1	
CO3		2		1	1							1	2	
CO4	3		1	2							1			
CO5	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) Mini project on design of composites
3) Question & answer

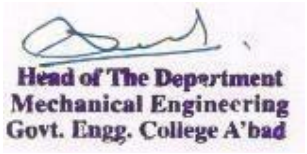
Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	10	02	12
K2	Understand	10	03	12
K3	Apply	00	00	06
K4	Analyze	10	03	12
K5	Evaluate	00	02	18
Total Marks 100		30	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
	C01	C02	C03	CO4	CO5
Class Test (30 Marks)	10	10	00	10	00
Teachers Assessment (10 Marks)	03	00	03	02	02
ESE Assessment (60 Marks)	12	12	06	12	18

Special Instructions if any: Nil



ME 4130: Engineering Economics and Costing	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	Class Test I : 15 Marks
Credits: 3	Class Test II : 15 Marks
	Teachers Assessment : 10 Marks
	End Semester Exam : 60 Marks

Prerequisites:ME4015-Industrial Management

Course description: This course consists of basic understanding of various types renewable energies like solar energy, wind energy, biomass energy, hydro energy etc and their sources and applications. It will give the knowledge of conversion of renewable energies into useful form of electrical energy.This also consist of various types of power plants based on renewable energy and their economical analysis**.**

Course Objectives

1. Introduction to engineering economics
2. Understand profit loss philosophy and break-even analysis
3. Understand various aspects of costing, budgeting and payback period.
4. Understanding cost control and various expenses.
5. Understanding Measurement of Cost of Capital and methods of cost allocations.

Course Outcome.

After completing the course, students will be able to:

CO1	Apply concepts of economic analysis to a industry.
CO2	Understand Break Even Analysis, Standard Costing, Marginal Costing.
CO3	Apply probabilistic risk analysis methods.
CO4	Understand budgeting

Detailed Syllabus:

Unit1	Introduction :Engineering and Economics, Definition and scope of Engineering Economics, Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison
Unit2	Fund flow analysis, concepts, objectives, techniques of Fund flow statement. Ratio analysis: Classification of ratios, structural group, standards for comparison limitations of Ratio analysis, returns on investment and integral ratio. Cost volume profit analysis: mechanics of break even chart, profit planning and break-even analysis, margin of safety..
Unit3	Standard Costing:- Concept, Development and use of Standard Costing, Budget and Budgetary Control, Variance Analysis. Marginal Costing:- Use of Marginal Costing in Decision Making. Allocation of Resources: Capital Budgeting: Control of Capital Expenditure, Evaluation Process – Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return.
Unit4	Introduction to Cost Control, Significance for Engineers, Limitations of Financial Accounting, Corporate Objectives, Profitability and other objectives, Product, Services and Market Mix. Elements of Cost:- Material, Labor , Expenses, Overheads, Direct and Indirect Cost, Fixed and Variable Cost, other classifications
Unit5	Cost of Capital: Relevant Cost, Measurement of Cost of Capital, Cost of Debt, Preference Shares, Equity Shares, Internal Financing, Dividends, Cost of Retained Earnings Concept Cost Allocation:- Cost Accumulation and Allocation, Allocation of cost of Service Departments – Reciprocal Method, Allotting cost from one department to other Depreciation, Various methods for calculation.

Text Books

1. Prasad N. K., Cost Accounting Book Syndicate Pvt. Ltd.. Kolkata
2. C. B.Gupta, Fundamentals of Business, Sultan Chand & Co

Reference Books .

1. Henry M. Stenier, engineering economics Principles, Mc Grow hill Publication.
2. P. A. Samualson, Economics, Mc Grow hill International.
3. Colin Drury, management and Cost Accounting, English Language Book Society, Chapman & Hall Landon.
4. Basu S.K., Sahu K.C and Rajiv B, Industrial Organization and Management –. PHI New Delhi, 2012.

Mapping of Course outcome with Program Outcomes

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

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Question & answer / Numerical solution

2) Power point presentation of case studies of thermodynamic system

3) Test consisting of multiple choice questions

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test I	Test II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	03	03	02	10
K2	Understand	04	04	02	10
K3	Apply	03	03	02	20
K4	Analyze	05	05	02	20
K5	Evaluate	00	00	02	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
Cos	CO1	CO1/CO5	CO3	CO4/CO2	CO5
Class Test (15 Marks)	03	04	03	03	02
Class Test (15 Marks)	03	04	03	03	02
Teachers Assessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	05	10	15	18

ME 4031: Renewable Energy Engineering.	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	Class Test I : 15 Marks
Credits: 3	Class Test II : 15 Marks
	Teachers Assessment : 10 Marks
	End Semester Exam : 60 Marks

Prerequisites: ME1001Basics of Mechanical Engineering

Course description: This course consists of basic understanding of various types renewable energies like solar energy, wind energy, biomass energy, hydro energy etc and their sources and applications. It will give the knowledge of conversion of renewable energies into useful form of electrical energy.This also consist of various types of power plants based on renewable energy and their economical analysis**.**

Course Objectives

1. Introduction to solar energy, their resources and collections.
2. Introduction to wind energy and wind turbines.
3. Understand biomass and biogas and their conversions.
4. Introduction to fuel cells, types and applications.
5. Introduction to various power plants.
6. Analyze economic analysis of power plants.

Course Outcome.

After completing the course, students will be able to:

CO1	Accustom with type of renewable energies and systems.
CO2	Understand various types of renewable energy sources and applications.
CO3	Analyze the economic considerations of power plants.
CO4	Define various renewable energy terms.
CO5	Understand various energy storage systems.

Detailed Syllabus:

Unit1	**Solar Energy.** Introduction, Applications, terms and definitions, merits and demerits, solar constant, solar insolation, Tilt angle of the fixed flat plate collector, different types of collectors(solar thermal modified flat plate ,parabolic through, paraboloidal dish),solar photovoltaic cell principal, V-I characteristics, efficiency of solar cell.
Unit2	**Wind energy.** Introduction, application, merits and limitations, wind energy quantum, wind power density, power in wind stream, wind turbine efficiency, wind velocity duration curve, Wind turbines. Terms and definitions, types, horizontal axis propeller type wind turbine, three blade horizontal axis wind turbine, vertical axis wind turbine, power duration curve, economic considerations.
Unit3	**Biomass and Hydro Energy.** Biomass. Introduction, origin of biomass, biomass energy resources, biomass conversion processes, direct combustion of biomass, thermochemical conversion of biomass, biochemical conversion, fermentation, raw biomass material for conversion to biogas, agriculture waste and energy, aquatic biomass, raw material for biogas production, significance of biogas plants in India's energy strategy, average composition of biogas, anaerobic fermentation, types of biogas plants. Hydro energy. Introduction, merits and demerits, hydro-electric energy resources in India, types of hydro-electric plants, energy conservation scheme, terms and definitions, typical hydro-electric power plants, classification of hydro-electric turbines, impulse turbine and reaction turbine, merits of hydro turbine
Unit4	**Energy Storage Systems and Fuel Cells.** Energy Storage. Introduction, pump hydro energy storage plant, underground pumped hydro, compressed air energy storage(CAES), solar energy storage, battery energy storage systems, thermal energy storage systems Fuel Cells. Introduction, advantages of fuel cell, theory of electro-chemistry, principal and operation, classification and types, fuels for fuel cells, schematic of fuel cell power plant, acidic and alkaline electrolyte fuel cells, molten carbonate fuel cells, solid oxide fuel cells, methanol and hydrazine fuel cells
Unit5	**Power Plants.** Solar thermal power plants, solar pond, wind turbines, wind power plants, generators sets,horizontal axis, vertical axis, wind energy farms, fuel cells power plants, biogas power plants, hydraulic turbines, hydraulic power plant , fluctuating loads on power plants, economic analysis of power plants and tariffs.

Text Books

1. G. D. Rai, "Non Conventional Energy Sources", Standard Publishers Distributors.
2. R. K. Rajput, "Non Conventional Energy Sources and Utilisation", S. Chand Publications
3. Sukhatme, "Solar Energy: Principles of thermal collection and storage", TMH Publication

Reference Books

1. S. Rao, Dr B. B. Parulekar, "Energy Technology", Khanna Publishers.
2. G. N. Tiwari, R. K. Mishra, "Advanced Renewable Energy sources", RSC Publishing
3. Garg and Prakash, H. P. Garg, "Solar energy: Fundamentals and Applications", TMH Publication
4. Arora and Domkundwar," Power Plant Engineering" DhanpatRai& Co. Publishing.

Mapping of Course outcome with Program Outcomes

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1		1	2	1						**1**	
CO2	3	1	1	1	2	1							**1**	
CO3	3	2	2	1	1	2							**2**	
CO4	3	2	3		1	1					**1**			
CO5	3	2	1				1					**1**	**1**	

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Question & answer / Numerical solution
2) Power point presentation of case studies of thermodynamic system
3) Test consisting of multiple choice questions

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test I	Test II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	03	03	02	10
K2	Understand	04	04	02	10
K3	Apply	03	03	02	20
K4	Analyze	05	05	02	20
K5	Evaluate	00	00	02	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
Cos	CO1	CO1/CO5	CO3	CO4/CO2	CO5
Class Test (15 Marks)	03	04	03	03	02
Class Test (15 Marks)	03	04	03	03	02
Teachers Assessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	05	10	15	18

ME 4026: 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	PO10	PO10	PSO1	PSO2
CO1	1												1	
CO2		2				3							1	
CO3	1					3							2	
CO4								1	2	3			1	

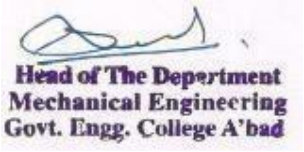
1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S4
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	08	08	04	05
Practical Examination & Viva Voce (25 Marks)	08	07	05	05

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 4027 LAB- AUTOMATIC CONTROL SYSTEM	
Teaching Scheme **Practical : 2 Hrs/Week** **Credits: 1**	**Examination Scheme** **Term Work : 25 Marks** **Practical examination : 25 Marks**

Course Objective:

To understand and apply practical application of automatic control system.

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	PO11	PO12	PSO1	PSO2
CO1	1		2	3									1	
CO2	1	2		3									2	
CO3	1							2	3				2	
CO4								1						

1 – High 2 – Medium 3 – Low

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 4028: Lab Tool Design

Teaching Scheme	Examination Scheme	
Practical: 2 Hrs/Week	Term Work	: 25Marks
Credit: 1	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)

Serial No.	List of Experiment
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	PO11	PSO1	PSO2
CO1	1		2		3							1	
CO2	1	2						3				2	
CO3	1	2	3		3								
CO4	1	2	3		3							3	

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 4029: Project-II	
Teaching Scheme Practical: 6 Hrs/Week Credit: 3	**Examination Scheme** Term Work : 50 Marks Practical/Viva-Voce : 100 Marks

Prerequisites: ME 4014: 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

Course Out come	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**1**	**1**	**2**	**2**	**3**			**3**		**3**			**1**	
CO2	**2**		**2**										**1**	
CO3			**1**			**1**		**3**			**1**		**1**	
CO4						**1**		**2**					**1**	
CO5				**2**		**1**		**2**				**2**	**2**	

1 – High 2 – Medium 3 - Low

Assessment Pattern

Assessment Pattern Level No.	Skill Level	Term Work	Practical Examination & viva voce
S1	Imitation	10	20
S2	Manipulation	20	30
S3	Precision	30	50
S4	Articulation	00	00
55	Naturalization	00	00
Total		50	100

Preparation (S1)	10	15
Conduct of Experiment (S2)	05	30
Observation and Analysis of Results (S3)	20	40
Record (S2)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	10	10
Total	**50**	**150**

Assessment Table

Assessment Tool	S1	S2	S3	S3	S3
	CO1	CO2	CO3	CO4	CO5
Term Work (50 Marks)	05	25	10	05	05
Practical Examination & Viva Voce (100 Marks)	15	30	20	20	15

Special Instructions if any: Nil

Head of The Department
Mechanical Engineering
Govt. Engg. College A'bad