Course Code	**PSI_ME706**				
Category	**Project work, Seminar and Internship**				
Course Title	**Final Year Project (Stage-I)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 7 (Seven)**
	0	**0**	**10**	**5**	
Pre requisites	**-**				

Objectives:

Final Year Project represents the culmination of study at the end of the B.Tech degree. It helps the students to explore and strengthen the practical knowledge by performing hands-on real-time projects. In this part of the curriculum, students can use the best facilities and platforms like hardware & software, where engineers can showcase their talent while performing innovative projects that strengthen their profile and increase the chance of employability at large.

Course Plan:

Projects will be undertaken individually or in small groups (Max of 5). Assessment will be by means of a presentation, submission of a report, and a demonstration of work undertaken. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Each student/ group of students shall identify a topic(s) from mechanical engineering discipline or interdisciplinary type, approved from **Project and Training Incharge (PTI)** and eventually, it will be later on assessed before an expert committee constituted by the concerned department on the basis of:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Report writing based on the start of art, fundamentals of the topic and its viability.

Course Code	**PEC1_ME801**				
Category	**Professional Elective Course**				
Course Title	**Fundamentals of Tribology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**Material science, Machine Design, Fluid Mechanics and Heat Transfer**				

Objectives:

To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components. To understand the field of tribology and its historical development and also learn the surface phenomena related to relative motion and the nature of friction. To understand the role of tribology in industry and also reveal the basic understanding of friction. To Introduce the concept of lubricants, compare boundary lubrication, mixed lubrication hydrodynamic lubrication, hydrostatic lubrication.

M. No:	Topic	No. of Hrs
Module 1.	Introduction to tribology and its historical background, factors influencing tribological phenomena engineering surfaces - surface characterization, computation of surface parameters, surface measurement techniques, apparent and real area of contact, contact of engineering surfaces- Hertzian and non-Hertzian contact, contact pressure and deformation in non-conformal contacts.	12
Module 2.	Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction, stick slip friction behavior, frictional heating and temperature rise, friction measurement techniques, friction in tribo-systems, frictional devices in mechanical systems.	14
Module 3.	Wear and wear types, mechanism of wear-adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., wear of metals and non-metals, Wear models- asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage, Wear in various mechanical components, wear controlling techniques.	09
Module 4.	Introduction to lubrication regimes- boundary lubrication, hydrodynamic, hydrostatic, elastohydrodynamic lubrication and their applications.	07
	Total number of Hours	**42**

Course Outcomes:

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

- ***Understand*** principles of Friction **(L2).**
- ***Understand*** the wear rate, its causes and prevention means **(L2)**.
- ***Understand*** the lubrication studies such as hydrodynamics and hydrostatics **(L2).**
- ***Apply*** the basic theories of friction, wear and lubrication to predictions about the frictional behavior of basic tribology related problems **(L6)**.

S.No:	Text Books	Author	Publisher
1.	A system approach to science and Technology of Friction, Lubrication and Wear	Czichos, H.	Volume I, Tribology series, Elsevier Publications, 1978.
2.	Friction, wear, Lubrication	Ludema, K.C.	CRC Press, NY., 1996
	References		
1.	Wear control Handbook	Peterson M.B.,Winner W.O	Sponsored by The Research Committee on Lubrication, 1980.
2.	The principles of Lubrication	Cameron A.	Longman, London, 2000

Course Code	**PEC1_ME801L**				
Category	**Professional Elective Course**				
Course Title	**Tribology Lab**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	0	**0**	**2**	**1**	
Pre requisites	**Material science, Machine design, Heat transfer and Fluid Mechanics**				

Objectives:

To impart hands-on practical exposure on tribological tests and equipment. To study and practice the various tribological tests that can be performed on pin-on-disk tribometer and equip students with the practical knowledge required in the tribological field.

S.No:	**Topic**
Module 1.	Preparation of samples for tribological tests.
Module 2.	Tribological study of different tribopairs in dry conditions at room temperature.
Module 3.	Tribological study of different tribopairs in dry conditions at high temperature.
Module 4.	Tribological study of different tribopairs in lubricating conditions at room temperature.
Module 5.	Tribological study of different tribopairs in lubricating conditions at high temperature.

Course Code	**PEC2_ME801**				
Category	**Professional Elective Courses**				
Course Title	**Composite Material**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**Materials Engineering**				

Objectives:

To train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories and appropriate strength criteria, and be familiar with the properties and response of composite structures subjected to static and cyclic loading.

M. No:	**Topic**	**No. of Hrs**
Module 1.	Introduction, classifications of engineering materials, concept of composite materials; matrix and reinforcement, characteristics of fibers and matrices, types of reinforcements, types of matrices, types of composites, properties of composites in comparison with standard materials, applications of metal, ceramic and polymer matrix composites, mechanical properties of fibres, engineering potential of composites	9
Module 2.	Manufacturing methods, hand and spray lay-up, injection molding, resin injection. filament winding, pultrusion, centrifugal casting and prepregs, fibre/ matrix interface, measurement of interface strength, characterization of systems- carbon fibre/epoxy, glass fibre/ polyester, *etc. manufacturing defects in composites.*	11
Module 3.	Mechanical properties- stiffness and strength, geometrical aspects, volume and weight fraction, unidirectional continuous fibres, discontinuous fibers, short fiber	10

	systems, woven reinforcements, mechanical testing- determination of stiffness and strengths of unidirectional composites- tension, compression, flexure and shear.	
Module 4.	Laminates, plate stiffness and compliance, assumptions, strains, stress resultants, plate stiffness and compliance, computation of stresses, types of laminates- symmetric laminates, antisymmetric laminates, balanced laminates, quasi-isotropic laminates, cross-ply laminates, angle ply laminates, orthotropic Laminates. Laminate Moduli. hygrothermal stresses, joining methods and failure theories, advantages and disadvantages of adhesive and mechanically fastened joints, typical bond strengths and test procedures.	12
Total number of Hours		**42**

Course Outcomes:

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

- ***Explain*** the mechanical behavior of layered composites compared to isotropic materials **(L5).**
- ***Apply*** constitutive equations of composite materials and understand mechanical behavior at micro and macro levels **(L3).**
- ***Determine*** stresses and strains relation in composites materials **(L3).**

S.No:	**Text Books**	**Author**	**Publisher**
1.	Mechanics of Composite Materials,	M. Mukhopadhyay	University Press
2.	Mechanics of Composite Materials	R. M. Jones	CRC Press
	References		
1.	Structural Composite Materials	F.C. Campbell	ASM International
2.	Principles of Composite Material Mechanics	Gibson R.F	second edition, McGraw Hill

Course Code	**PEC2_ME801L**				
Category	**Professional Elective Course**				
Course Title	**Composite Material Lab**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	0	**0**	**2**	**1**	
Pre requisites					

M. No:	**Topic**
Module 1.	Manufacturing of fibre reinforced composites with different types of orientation of fibers (0^0,90^0, 45^0 & combination of them) by hand and spray lay-up method.
Module 2.	Manufacturing of fibre reinforced composites with different types of orientation of fibers (0^0,90^0, 45^0 & combination of them) by resin transfer moulding method.
Module 3.	Compare tensile & compressive strength of identical fibre reinforced composites, manufactured by hand and spray lay-up method and resin transfer moulding method.
Module 4.	Compare shear strength of identical fibre reinforced composites, manufactured by hand and spray lay-up method and resin transfer moulding.
Module 5.	Methods of identifying *manufacturing defects in composites.*
Module 6.	Study of failure modes viz. Delamination, fibre pull out, matrix cracking etc. in fibre reinforced composites

Course Code	**OEC1_ME802**				
Category	**Open Elective Course**				
Course Title	**Value Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**None**				

Objectives:

To understand various phases of value engineering.

M. No:	**Topic**	**No. of Hrs**
Module 1.	Introduction to value engineering & value analysis, value management, value analysis versus traditional cost reduction techniques, applications, advantages and limitations of value analysis.	12
Module 2.	Value engineering job plan- introduction, orientation, information phase, speculation phase, analysis phase, selection and evaluation of value engineering projects, project selection, methods selection, value standards, application of value engineering methodology.	15
Module 3.	Value engineering technique- advanced value engineering techniques- function, cost-worth analysis (*FCWA*) technique, function analysis system (*FAST*) technique, weighted evaluation method, evaluation matrix, break even analysis, life cycle cost (*LCC*), applications of value analysis/ value Engineering.	15
Total number of Hours		**42**

Course Outcomes:

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

- ***Analyze*** the function, approach of function and evaluation of function **(L4).**
- ***Determine*** the worth and value **(L3).**
- ***Understand*** the different value engineering techniques **(L2).**
- **Emphasize** the use of FAST,FCWA,WEM **(L4).**
- ***Determine*** the sales volume, also known as the break-even point **(L3).**

S.No:	**Text Books**	**Author**	**Publisher**
1.	Value Engineering- A Systematic Approach	Arthur E. Mudge	McGraw Hill
	References		
1.	Techniques of value Analysis and Engineering	Miles L.D	McGraw Hill Book
2.	Value Engineering: Concepts Techniques and applications	Anil Kumar	SAGE Publications

Course Code	**OEC3_ME802**				
Category	**Open Elective Course**				
Course Title	**Total Quality Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**Industrial Engineering, Statistical Quality Control**				

Objectives:

Provides the knowledge required to assess and improve product quality through process control procedures and quality improvement techniques.

M. No:	**Topic**	**No. of Hrs**
Module 1.	Quality management- meaning and significance of 'quality', fitness levels of quality- characteristic features and limitations of each type, essential components of quality, product features, freedom from deficiencies, characteristics and attributes under each for products and services, phases or elements of building quality in a product: quality of design, quality of conformance, quality of performance, history of quality, evolution of the concepts of quality, big q vs small q: changing scope of quality activities, Ishikawa's seven quality tools, quality circles, *TQM* meaning and tqm culture.	10
Module 2.	Quality system economics- different obvious quality costs, hidden quality costs, economic models of quality costs: conventional and modern models, cost curves: different zones and actions to be taken for each zone.	08
Module 3.	Quality control:control charts for variables,underlying principle, advantages, limitations and applications of- $\overline{X}$ & R charts, $\overline{X}$ & S charts, *X* & *MR* charts, control charts for attributes, underlying principle, advantages,limitations and applications of- *P*, *NP, C* and *U* charts.	10
Module 4.	Tools and techniques for quality management- quality functions development (*QFD*), failure mode and effect analysis (*FMEA*), seven new management tools, poka yoke, total preventive maintenance (*TPM*), implementing *TQM*, an integrated system's approach.	10
	Total number of Hours	**42**

Course Outcomes:

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

- ***Analyze*** various obvious and hidden quality costs of a firm for quality system economics **(L4)**.
- ***Apply*** various quality control tools for troubleshooting to reduce sporadic quality problems **(L6).**
- ***U*nderstand** the different definitions of quality **(L2).**
- ***Und*erstand** the various techniques for quality management **(L2).**

S.No:	**Text Books**	**Author**	**Publisher**
1	Quality Planning & Analysis ,.	Juran and Gryna,	McGraw Hill
2	Statistical Quality Control	Grant, E. L.	McGraw Hill
	References		
1.	Total Quality Control	Armand V.Feignbaum	McGraw Hill

Course Code	**OEC1_ME804**				
Category	**Open Elective Course**				
Course Title	**Numerical Methods for Engineers**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**Engineering Mathematics, Programming language.**				

Objectives:

To provide the student with different numerical techniques in order to find approximate numerical solutions to the numerical problems where exact solutions are not available. To develop the concepts of making and solving mathematical models of different engineering problems. To develop the concepts of writing computer programs for solving engineering problems.

M. No:	**Topic**	**No. of Hrs**
Module 1.	Numerical solution of nonlinear equations, Regula-Falsi method, Bolzano's process or bisection of intervals, Newton-Raphson method and its geometrical significance, convergence of iterative methods, solutions of systems of nonlinear equations by Newton Raphson method and method of successive approximations.	10
Module 2.	Solution of system of linear equations, Jacobi and Gauss Siedel Method, Eigen value problem and power method.	06
Module 3.	Interpolation and approximation, finite differences and difference tables, Newton's methods of Interpolation, Lagrange's Interpolation formula, error propagation in difference and error estimation in interpolation, Gauss interpolation formula.	08
Module 4.	Curve fitting, method of least squares, fitting a straight line, polynomial, geometric curve, hyperbola, exponential curve and trigonometric functions, multiple regression.	06
Module 5.	Numerical differentiation and integration, differentiation of tabulated functions with equal and unequal intervals, Simpson's one-third and three-eight rules, trapezoidal Rule, double integrals and Improper integrals.	06
Module 6.	Numerical solution of ordinary and partial differential equations, numerical solution of ordinary differential equations, Taylor's series method, Runge-Kutta methods, system of differential equations, classification of partial differentiation equations, finite difference method for solving partial differential equations.	06
	Total number of Hours	**42**

Note: ***In each module and for each numerical technique the algorithms and MATLAB programs must be used to solve the problems.***

Course Outcomes:

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

- ***Write*** algorithms for solving mathematical problems using numerical techniques **(L1).**
- ***Write*** programs in the programming language *(MATLAB)* to solve mathematical problems **(L1).**
- ***Solve*** the mathematical problems using numerical techniques **(L3).**

S.No:	**Text Books**	**Author**	**Publisher**
1.	Introductory Methods of Numerical analysis	S.S.Sastry	Prentice -Hall of India
	References		
1.	Numerical Methods using MATLAB	George Lindfield and John Penny	Academic Press
2.	An introduction to MATLAB programming and Numerical Methods for Engineers	Timmy Siauw and Alexandre .M Bayen	Academic Press
3.	Numerical Methods for Engineering & Scientists	Joe. D Hofmann	CRC Press

Course Code	**OEC2_ME804**				
Category	**Open Elective Course**				
Course Title	**Mechatronic Systems**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	2	**1**	**0**	**3**	
Pre requisites	**Automatic Control**				

Objectives:

To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

M. No:	**Topic**	**No. of Hrs**
Module 1.	Introduction to mechatronics, mechatronic design approach, system interfacing, instrumentation and control systems, microprocessor based controllers and microelectronics, mechatronics a new direction in nano-, micro- and mini- scale, electromechanical system design, physical system modelling, electromechanical system structures and materials, modelling of mechanical systems for mechatronic applications.	10
Module 2.	Sensors and actuators, fundamentals of time and frequency, sensor and actuator characteristics, linear and rotational sensors, acceleration sensors, force measurement, torque and power measurement, flow measurement, temperature measurement, distance measuring and proximity sensors, light detection- image, and vision systems, integrated micro sensors, actuators- electromechanical actuator, electrical machines, piezoelectric actuators, hydraulic and pneumatic actuation systems.	14
Module 3.	Micro transducer analysis, design and fabrication, role of controls in mechatronics, role of modelling in mechatronics design, response of dynamics systems, introduction to computer and logic systems.	10
Module 4.	Logic concepts and design system interfaces, communication and computer networks, fault analysis in mechatronic systems, logic system design, programmable logic controllers, software and data acquisition.	08
	Total number of Hours	**42**

Course Outcomes:

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

- ***Define*** the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology **(L1).**
- ***Define*** Define sensor, transducer and understand the applications of different sensors and transducers **(L1).**
- ***Explain*** the signal conditioning and data representation techniques **(L2).**
- ***Design*** pneumatic and hydraulic circuits for a given application **(L3).**
- ***Apply*** a PLC program using Ladder logic for a given application **(L3 L4).**
- ***Understand*** applications of microprocessor and micro -controller ***(L2).***
- ***Analyse*** *PI*, *PD* and *PID* controllers for a given application **(L4).**

S.No:	**Text Books**	**Author**	**Publisher**
	Mechatronic system design	Shetty. D and Richard A. K	Cengage learning, 2011
	References		
	Mechatronics	Dan. S. N	Prentice Hall, 2002

Course Code	**PSI_ME806**				
Category	**Project work, Seminar and Internship**				
Course Title	**Final Year Project (Stage-II)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	0	**0**	**16**	**8**	
Pre requisites	-				

Course Plan:

- It is a continuation of **Final Year Project (Stage-I)** started in semester - **7 (Seven)**
- The student has to submit the report in departmental prescribed format/ template
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Head/coordinator and corresponding Supervisor from the Institute.
- The candidate has to be in regular contact with his/ her Supervisor / co- Supervisor

Guidelines for awarding Marks in End of the Semester		
Evaluated by	**Evaluation percentage**	**Max. Marks Evaluation Criteria / Parameter**
Supervisor(s)	10.0	Punctuality during project work
	10.0	Work Progress over all
	30.0	Quality of the work throughout
	10.0	Analytical / programming / experimental Skills
	10.0	Report preparation in a standard format/ template
External Examiner	20.0	Presentation
	50.0	Quality of work
	30.0	Innovations, society applicable and future scope.
	20.0	Viva-voce

Course Outcomes:

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

- ***Use*** different experimental techniques and will be able to use different software/ computational /analytical tools **(L3).**
- ***Design*** and develop an experimental set up/ equipment/ test rig **(L6)**.
- ***Explore*** results***/ demonstrate*** on existing set ups/ equipment and draw logical conclusions from the results after analysing them, either work in a research environment or in an industrial environment **(L3)**.
- ***Present*** and convince their topic of study to the engineering community supported with technical report writing.

Course Code	**PSI_ME806**				
Category	**Project work, Seminar and Internship**				
Course Title	**Internship**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8 (Eight)**
	0	**0**	**0**	**4**	

Objectives:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship

- Will ***expose*** Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry **(L3).**
- ***Provide*** possible opportunities to learn, ***understand*** and sharpen the real time technical / managerial skills required at the job **(L2, L3).**
- will ***Expose*** to the current technological developments relevant to the subject area of training **(L3).**
- will ***Create*** conditions conducive to quest for knowledge and its applicability on the job **(L6).**
- will ***Learn*** to apply the technical knowledge in real industrial situations **(L1).**
- To ***Write*** Technical reports/ projects by gaining experience.
- To ***Expose*** students to the engineer's responsibilities and ethics **(L3).**
- Familiarize yourself with various materials, processes, products and their ***application*** along with relevant aspects of quality control **(L3).**.
- Expose the students to future employers **(L3).**.
- ***Understand*** the social, economic and administrative considerations that influence the working environment of industrial organizations **(L2).**
- ***Understand*** the psychology of the workers and their habits, attitudes and approach to problem solving **(L3).**

Internships may be full-time or part-time; they are full-time in the vacation and part-time during the academic session. The Framework for Internship as per AICTE Guidelines.

Schedule	**Duration**	**Activities**
During Vacation after 5th Semester	4-6 weeks	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship
During Vacation after 7th Semester	4-6 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship

Monitoring/ surprise visit by Project and Training Incharge (PTI)/ staff

PTI/ Staff of the institutes will make a surprise visit to the internship site, to check the student's presence physically, if the student is found absent without prior intimation to the PTI, entire training will be cancelled. Students should inform the PTI, as well as the industry supervisor at least one day prior to availing leave by email. Students are eligible to avail 1-day leave in 4 weeks and 2 days leave in 6 weeks of the internship period apart from holidays and weekly offs.

Evaluation through Seminar Presentation/ Viva-Voce

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department on the basis of:

- Quality of content presented
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary