KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(Deemed to be University)
Anand Nagar, Krishnankoil - 626 126
Srivilliputhur Taluk, Virudhunagar District, Tamil Nadu, India

CURRICULUM AND SYLLABUS

(2018)

B. TECH

(AUTOMOBILE ENGINEERING)

Regulation 2018

SCHOOL OF AUTOMOTIVE AND MECHANICAL ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

Program Educational Objectives:

PEO 1: Pursue higher studies or be employed in automobile or allied disciplines.
PEO 2: Be a successful entrepreneur in creating jobs related to automobile or related engineering fields.
PEO 3: Promote ethics, sustainability and environmental responsibility in their practice.

Student outcomes as described by ABET:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and

modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:

PSO1: Employ mathematical, science and engineering technology to analyze real time problems involving design and development of automotive technology.

PSO2: Design, investigate, and build virtual and real models, using applied computer technologies to satisfy the emerging needs of automotive society.

PSO3: Sustain a position as an administrator, leader or supporter of a team in an automotive industrial environment with ethical standards.

PSO4: Continue to enrich domain knowledge through lifelong learning to communicate and manage futuristic automotive system.

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Anand Nagar, Krishnankoil – 626 126.
School of Automotive and Mechanical Engineering
DEPARTMENT OF AUTOMOBILE ENGINEERING

Curriculum Structure:

S.No	Category		Credits
I.	Basic Sciences and Mathematics	25	31
	Open Elective (Basic Science Stream)	6	
II.	Humanities and Social Science		12
	Soft Skills	3	
	Humanities Elective	6	
III.	Basic Engineering		24
IV.	**Program Core**		
	a) Core Courses	48	61
	b) Community service Project	3	
	c) Project work	10	
V.	**Elective Courses**		
	a) Professional Elective	18	30
	b) Open Elective (Engineering Stream)	12	
VI.	Internship/Industrial Training		2
VI.	Mandatory Courses		-
	Total Credits		**160**

I. Basic Sciences and Mathematics-Common to all Students

S.No.	Course Code	Course Name	Course Type	L	T	P	C
1.	MAT18R101	Calculus and Linear Algebra	T	3	1	0	4
2.	MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	T	3	1	0	4
3.	MAT18R203	Partial Differential equations, Probability and statistics	T	3	1	0	4
4.	PHY18R173	Oscillations, Waves and optics	IC	3	1	2	5
5.	CHY18R171	Chemistry	IC	3	1	2	5
6.	BIT18R101	Biology for Engineers	T	3	0	0	3
		Total		**18**	**5**	**4**	**25**

II. a. Humanities and Social Science-Common to all Students

S.No.	Course Code	Course Name	Course Type	L	T	P	C
1.	HSS18R151	English for Technical Communication	T	3	0	0	3
		Total		**3**	**0**	**0**	**3**

b. Soft Skills-Common to all Students

S.No	Course Code	Course Name	Course Type	Credits
1.	HSS18R101	Soft skills-I	T	1
2.	HSS18R102	Soft skills-II	T	1
3.	HSS18R201	Soft skills-III	T	1
		Total		**3**

III. Basic Engineering

S.No.	Course Code	Course Name	CT	L	T	P	C
1.	CSE18R171	Programming for Problem Solving	IC	3	1	2	5
2.	EEE18R172	Basic Electrical Engineering	IC	3	1	2	5
3.	MEC18R151	Engineering Graphics & Design	TP	2	0	2	3
4.	MEC18R211	Engineering Mechanics	TP	3	1	0	4
5.	MEC18R152	Engineering Practice	TP	2	0	2	3
8.	AUT18R171	Basic Instrumentation	IC	3	0	2	4
		Total		**16**	**3**	**10**	**24**

IV. Program Core

a. Core Courses

Code	Course	Pre-Requisite	CT	L	T	P	C
AUT18R271	Mechanics of Materials	-	IC	3	1	2	5
AUT18R201	Applied Thermodynamics	-	T	3	0	0	3
AUT18R272	Manufacturing Processes and Machining	-	IC	3	0	2	4
AUT18R202	Automotive Chassis	-	T	3	0	0	3
AUT18R273	Fluid Mechanics and Pumps	MEC18R211	IC	3	1	2	5
AUT18R274	Automotive Engines	-	IC	3	0	2	4
AUT18R275	Automotive Fuels and Lubrications	-	IC	3	0	2	4
AUT18R301	Automotive Transmission Systems	AUT18R202	T	3	0	0	3
AUT18R302	Automotive Component Design	AUT18R271	T	3	0	0	3
AUT18R303	Hybrid Electric Vehicle	EEE18R172	T	3	0	0	3
AUT18R305	Automotive Pollution and Control	AUT18R274	T	3	0	0	3
AUT18R281	Automotive Components Laboratory	-	L	0	0	2	2
AUT18R381	Automotive Component Design Laboratory	-	L	0	0	2	2
AUT18R382	Vehicle Testing Laboratory	-	L	0	0	2	2
AUT18R481	Modelling and Simulation Laboratory	-	L	0	0	2	2
Total							**48**

b. Community Service Project

S.No	Course Code	Course Name	Credits
1.	AUT18R399	Community Service Project	3

c. Project Work

S.No	Course Code	Course Name	Credits
1.	AUT18R499	Project work	10

V. a. Professional Elective

Code	Course	Pre-Requisite	CT	L	T	P	C
Automotive Engines and Emission							
AUT18R203	Mechanics of Machines	MEC18R211	T	3	0	0	3
AUT18R204	Alternate Fuels and Energy Systems	-	T	3	0	0	3
AUT18R205	Modern Vehicle Technology	AUT18R274	T	3	0	0	3
AUT18R206	Advanced Theory of IC Engines	AUT18R274	T	3	0	0	3
AUT18R304	Unconventional Engine and Hybrid Vehicle	-	T	3	0	0	3
AUT18R401	Hydrogen and fuel cells	-	T	3	0	0	3
AUT18R402	Heat Transfer and Combustion	-	T	3	0	0	3
AUT18R332	Automotive Control System	-	T	3	0	0	3
AUT18R411	Automotive Component Reconditioning	-	T	3	0	0	3
AUT18R412	Modern Automobile Accessories	-	T	3	0	0	3
Automotive Electrical and Electronics							
AUT18R207	Automotive Electrical and Electronics Systems	EEE18R172	T	3	0	0	3
AUT18R306	Instrumentation and Metrology	AUT18R171	T	3	0	0	3
AUT18R307	Microprocessor Application in Automobiles	AUT18R171	T	3	0	0	3
AUT18R308	Automotive Embedded Systems	AUT18R171	T	3	0	0	3
Design and Analysis							
AUT18R309	Automotive Aerodynamics	-	T	3	0	0	3
AUT18R310	Chassis Component Design	AUT18R271	T	3	0	0	3
AUT18R311	Theory and Design of Jigs and Fixtures	-	T	3	0	0	3
AUT18R312	Noise Vibration and Harshness	-	T	3	0	0	3
AUT18R313	Vehicle Body Engineering	-	T	3	0	0	3
AUT18R403	Vehicle Dynamics	-	T	3	0	0	3
AUT18R404	Experimental Method in Fluids	-	T	3	0	0	3
AUT18R405	Computer Simulation of IC Engines Process	AUT18R201	T	3	0	0	3
Special Vehicles							
AUT18R208	Off road Vehicles	AUT18R274	T	3	0	0	3
AUT18R314	Two and Three wheeled Vehicles	AUT18R274	T	3	0	0	3
AUT18R315	Tractor and Farm Equipment	-	T	3	0	0	3
Vehicle Maintenance and Management							
AUT18R316	Automotive Safety	-	T	3	0	0	3
AUT18R317	Vehicle Maintenance	-	T	3	0	0	3
AUT18R318	Fleet Management	-	T	3	0	0	3
AUT18R319	Automotive Air-conditioning	-	T	3	0	0	3
AUT18R406	Terotechnology	MAT18R203	T	3	0	0	3
Materials and Manufacturing							
AUT18R320	Foundry Engineering	-	T	3	0	0	3
AUT18R321	Automotive Materials	-	T	3	0	0	3
AUT18R322	Composite Materials for Automotive Applications	-	T	3	0	0	3

Code	Course	Pre-Requisite	CT	L	T	P	C
Automotive Engines and Emission							
AUT18R323	Metal Forming Processes	AUT18R272	T	3	0	0	3

V b. Open Elective (For other Departments)

Code	Course	Pre-Requisite	CT	L	T	P	C
AUT18R204	Alternate Fuels and Energy Systems	-	T	3	0	0	3
AUT18R205	Modern Vehicle Technology	-	T	3	0	0	3
AUT18R207	Automotive Electrical and Electronics Systems	EEE18R172	T	3	0	0	3
AUT18R208	Off road Vehicles	-	T	3	0	0	3
AUT18R314	Two and Three Wheeled Vehicles	-	T	3	0	0	3
AUT18R316	Tractor and Farm Equipment	-	T	3	0	0	3
AUT18R317	Vehicle Maintenance	-	T	3	0	0	3
AUT18R319	Automotive Air-conditioning	-	T	3	0	0	3
AUT18R401	Hydrogen and Fuel Cells	-	T	3	0	0	3
AUT18R403	Vehicle Dynamics	-	T	3	0	0	3

V c. List of Open Electives: (Science Courses)

Course id	Course name	CT	L	T	P	C
OEE18R009	Laser Technology	T	3	0	0	3
OEE18R003	Mathematical Biology	T	3	0	0	3
OEE18R005	Combinatorics	T	3	0	0	3
OEE18R008	Photonics and Optoelectronic Devices	T	3	0	0	3
OEE18R006	Industrial Chemistry for Engineers	T	3	0	0	3
OEE18R004	Mathematical Modelling	T	3	0	0	3

V. d. Humanities Elective

Course Code	Course Name	L	T	P	C
HSS18R001	Management Concepts and Techniques	3	0	0	3
HSS18R002	Marketing Management	3	0	0	3
HSS18R003	Organizational Psychology	3	0	0	3
HSS18R004	Project Management	3	0	0	3
HSS18R005	Stress Management and Coping Strategies	3	0	0	3
HSS18R006	Engineering Economics	3	0	0	3
HSS18R007	Human Resource Management and Labour Law	3	0	0	3
HSS18R008	Entrepreneurship Development	3	0	0	3
HSS18R009	Cost Analysis and Control	3	0	0	3
HSS18R010	Product Design and Development	3	0	0	3
HSS18R011	Business Process Re-Engineering	3	0	0	3
HSS18R012	Political Economy	3	0	0	3
HSS18R013	Professional Ethics	3	0	0	3
HSS18R014	Operations Research	3	0	0	3
HSS18R015	Total Quality Management	3	0	0	3

VI. Internship/Industrial Training

S.No	Course Code	Course Name	Credits
1.	AUT18R397/398	Internship/Industrial Training	2

VII. Honours Courses

Course Code	Course Name	Pre-Requisite	CT	L	T	P	C
AUT18R328	Tribology	AUT18R271	T	3	0	0	3
AUT18R329	Combustion Engineering	AUT18R274	T	3	0	0	3
AUT18R330	Advanced Thermodynamics and Heat Transfer	AUT18R201	T	3	0	0	3
AUT18R331	Energy Conservation and Management	-	T	3	0	0	3
AUT18R407	Advanced Vibration Engineering	AUT18R315	T	3	0	0	3
AUT18R408	Autotronics and vehicle intelligence	AUT18R309	T	3	0	0	3
AUT18R409	Computational Fluid Dynamics and Applications	AUT18R404	T	3	0	0	3
AUT18R410	Finite Element Analysis for Design Engineers	-	T	3	0	0	3

I - BASIC SCIENCES AND MATHEMATICS

MAT18R101	Calculus and Linear Algebra (Common to all Branches of B.Tech) (For those who have joined in June 2018 and later)	L	T	P	C
		3	1	0	4
	Course Category: Basic Sciences and Mathematics **Course Type:** Theory Course				

Course Objective:
To enable the students to acquire knowledge and skills in basic components of calculus, to handle the situations involving multivariable calculus, and to diagonalize a symmetric matrix using eigenvalues and eigenvectors.

Course Outcomes:
Upon successful completion of this course, students will be able to

1. Know the fundamental theorems such as Rolle's theorem, Mean value theorem, Taylor's theorem and its applications.
2. Understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.
3. Solve the real world problems using differentiation and integration.
4. Understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.
5. Find the solution of simultaneous linear equations using matrices and to find the eigen values and eigen vectors of a matrix, Cayley-Hamilon theorem and orthogonal transformations.

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3												3			
CO2	3												3			
CO3	3												3			
CO4	3												3			
CO5	3												3			

Unit 1: Calculus:
Rolle's Theorem- Mean value theorems - Taylor's and Maclaurin theorems with remainders - indeterminate forms and L'Hospital's rule - Maxima and minima.

Unit 2: Multivariable Calculus (Differentiation):
Limit, continuity and partial derivatives - directional derivatives - total derivative - Maxima, minima and saddle points - Method of Lagrange multipliers.

Unit 3: Calculus (Applications):
Curvature (Cartesian coordinates) - Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 4: Sequences and series:
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions;

Unit 5: Matrices:

System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem - Diagonalization of matrices - Orthogonal transformation- Reduction of Quadratic form to Canonical form.

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers, New Delhi, 43rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited,
   Singapore , 10th Edn., 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publishing company Limited, 2008.

MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	L	T	P	Credits
		3	1	0	4
Course Category: Basic Sciences and Mathematics **Course Type:** Theory Course					

Course Objective:

To enable the students to understand the concepts of multiple integrations, their applications, and to handle analytic functions on complex plane and perform complex integration.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Understand the concepts of double and triple integral and its applications.
2. Know about the applications of double and triple integral in vector calculus.
3. Know the methods of solving differential equations of first and second orders.
4. Understand the concepts of analytic functions, conformal mappings and bilinear transformations.
5. Understand the concepts of singularity, residues and evaluation of certain improper integrals.

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3												3			
CO2	3												3			
CO3	3												3			
CO4	3												3			
CO5	3												3			

Unit 1: Multivariable Calculus (Integration):

Multiple Integration: Double integrals (Cartesian), change of order of integration in double
integrals, Change of variables (Cartesian to polar), Applications: areas and volume; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds;

Unit 2: Integral theorems:

Gradient, curl and divergence. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 3: Ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equations.

Unit 4: Complex Variable – Differentiation:

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Unit 5: Complex Variable – Integration:

Contour integrals, Cauchy Integral formula (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (Integration around small semicircles and rectangular contours).

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers, New Delhi,43rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publishing company Limited, 2008.

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Singapore , 10th Edn., 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publishing company Limited, 2008.

MAT18R203	Partial Differential equations, Probability and statistics	L	T	P	Credits
		3	1	0	4
Course Category: Basic Sciences and Mathematics **Course Type:** Theory Course					

Course Objective:

To enable the students to solve the partial differential equations and to apply them, to understand the concepts of probability and statistics, and to solve real world problems using statistical methods.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Know the method of solving first and second order partial differential equations.
2. Classify the second order partial differential equations and to know about solving of initial and boundary value problems.
3. Understand the concepts of probability, random variable, probability density functions, probability mass function, cumulative distributions and expectation.
4. Know about standard distributions such as binomial, poisson and normal distributions and their applications.
5. Evaluate moments, skewness and kurtosis for standard distributions and know about correlation and regressions.

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3												3			
CO2	3												3			
CO3	3												3			
CO4	3												3			
CO5	3												3			

Unit 1:Partial Differential Equations

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method.

Unit 2:Applications of Partial Differential Equations

Flows, vibrations and diffusions, second-order linear equations and their classification, Initial and boundary conditions, solution of the wave equation and diffusion equation by the method of separation of variables, The Laplacian in plane, cylindrical and spherical polar coordinates and solutions.

Unit 3: **Basic Probability and Random Variables:**

Axiomatic definition of Probability - Conditional probability – Independent events - To probability – Bayes theorem - Random variables – Discrete random variable - Probabi mass function – Continuous random variable - Probability density functions – Cumulat distribution function- Properties- Expectation.

Unit 4: **Standard Distributions and Bivariate Distributions:**
Binomial, Poisson, Uniform, Exponential and Normal distributions and their properties. Two dimensional random variables – Joint probability density function – Cumulative distribution function – Marginal density function

Unit 5: Statistics:
Moments, skewness and Kurtosis - evaluation of statistical parameters for Binomial, Poisson and Normal distributions, Correlation and regression – Rank correlation- Curve fitting by the method of least squares- fitting of straight lines and second degree parabolas.

TEXT BOOKS:

1. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
2. Veerarajan T, *Probability,Statistics and Random process*, Fourth edition, Tata McGraw-Hill Education(India) Pvt. Ltd., 2016.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004.

PHY18R173	Oscillations, Waves and optics	L	T	P	Credits
		3	1	2	5
Pre-requisite: Basic knowledge in Mathematics		**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective:

- To provide the students a firm understanding of the basics of Electricity and Magnetism.
- To introduce the students, the application of Electricity and Magnetism and Electromagnetism

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: To learn the concepts of simple harmonic motion, damped and forced simple harmonic oscillators.

CO2: Understand the nature of transverse and longitudinal waves in one dimension and dispersion

CO3: Understand the basics of geometric optics and light as an electromagnetic wave.

CO4: Apply the concepts of interference and diffraction in optical instruments.

CO5: Gain the knowledge about different types of lasers and their applications.

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3												3			
CO2	3												3			
CO3	3												3			
CO4	3												3			
CO5	3												3			

Unit 1: H**armonic oscillators**

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, forced mechanical and electrical oscillators, electrical and mechanical impedance, power absorbed by oscillator

Unit 2: Wave equations

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit 3: Light and geometrical optics

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Lenses and optical instruments based on them, and the matrix method

Unit 4: Wave optics

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Unit 5: Lasers

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (CO_2), solid-state lasers (Nd-YAG), semiconductor laser(Homo junction); Properties of laser beams, laser speckles, applications of lasers.

List of Experiments

1. Sonometer - Determination of frequency of tuning fork.
2. Melde's string - Determination of frequency of tuning fork.
3. Spectrometer – Determination of wavelength of Hg source using grating.
4. Spectrometer - Determination of dispersive power of a prism.
5. Determination of wavelength of laser light and particle size using grating.
6. Determination of Radius of curvature of convex lens using Newton's rings.
7. Determination of Refractive Index of given liquid using Newton's rings.
8. Determination of thickness of given thin wire by Air wedge method.
9. Determination of wavelength of laser source using Michelson interferometer.
10. Determination of the thickness of thin wire using laser beam
11. Determination of acceptance angle and numerical aperture of the fibre using Laser

Text Book(s):

1. Ian G. Main, vibrations and waves in physics, Cambridge University Press, 3rd edition, 2012.
2. A. Ghatak, Optics, Tata McGraw-hill, 6th edition, 2016.

Reference Books:

1. H.J. Pain, The physics of vibrations and waves, Wiley, 6th edition, 2005.
2. Brijlal and subrahmanyam, A text book of optics, 25th Edition, S. Chand, 2016.
3. O. Svelto, Principles of Lasers, 5th edition, Springer, 2010.

CHY18R171	Chemistry	L	T	P	Credits
		3	1	2	5
Pre-requisite : Nil		**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective(s):

Introducing the fundamental concepts and applications of Chemistry to the engineering students to understand, analyse and apply the same to complex technical issues

Course Outcome(s):

CO1	Demonstrate a knowledge on the significance and role of water quality parameters in the domestic and engineering applications and analysing the same through modern methods
CO2	Explain the principles of thermodynamics for solving engineering problems
CO3	Explain the basic concepts of electrochemistry, batteries, corrosion and to apply the same for the betterment of society
CO4	Explain about synthesis, characteristics and applications of technologically important polymers, composites and nanomaterials
CO5	Explain the underlying principles, instrumentation and applications of analytical techniques

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3												3			
CO2	3												3			
CO3	3												3			
CO4	3												3			
CO5	3												3			

Unit -I: Atomic and Molecular Structure

Schrodinger wave equation: Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory: MOT concept, MO diagrams of homo-nuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory: CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe^{2+}& Fe^{3+}) in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

Unit-II: Periodic Properties

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle (Building-up principle): Application of Aufbau principle in

writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

Unit-III: Free Energy and Chemical Equilibrium

Thermodynamic functions: Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation: Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis: Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion.

Unit-IV: Organic Reactions

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of S_N1, S_N2, S_Ni and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons: Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones): Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and $NaHSO_3$ addition. Electrophilic addition reactions (case alkenes): General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff & Anti-Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene). Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl halides - E_1 and E_2 mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

Unit-V: Stereochemistry & Spectroscopic Techniques

Stereochemistry - Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy: Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (^{1}H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound C_3H_6O from ^{1}H-NMR data). X-ray diffraction: Principle, instrumentation and applications X-ray diffraction.

List of Experiments (Any 10):

1. Determination of Viscosity by Ostwald Viscometer.
2. Determination of surface tension by stalagmometer.
3. Adsorption of acetic acid by charcoal.

4. Determination of chloride content of water.
5. Estimation of hardness of water by EDTA method.
6. Determination of the rate constant of a reaction
7. Thin layer chromatography.
8. Determination of the partition coefficient of a substance between two immiscible liquids
9. Determination of Saponification /acid value of oil.
10. Preparation of Aspirin
11. Potentiometric titration of strong acid vs strong base.
12. Potentiometric titration of weak acid vs strong base.
13. Determination of cell constant and conductance of solutions.

Text Books

1. Engineering Chemistry, 2nd Edition, Wiley India (P) Ltd., 2018.
2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2017.
3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11th Edition, Noida, 2017.
4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018.

Reference Books

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4th Edition, New Delhi, 2008.
2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10th Edition, 2014.
3. Modern Inorganic Chemistry, R. D. Madan, 4th Edition S. Chand & Company Ltd., 2009.
4. Organic Chemistry, Paula Y. Bruice, 7th Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47th Edition, Vishal Publishing Co., 2017.
6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8th Edition, Wiley India (P) Ltd., 2010.
7. Inorganic Chemistry, Peter Atkins, Mark Weller, Fraser Armstrong, Jonathan Rourke, Tina Overton, Michael Hangerman 5th Edition, Oxford press, 2015.
8. Organic Chemistry, Volume 1, I. L. Finar, 6th Edition, Pearson (Thomson press India (P) Ltd.) 2014.

BIT18R101	BIOLOGY FOR ENGINEERS	L	T	P	Credits
		3	0	0	3
Pre-requisite : Nil		**Course Category:** Basic Engineering **Course Type:** Theory Course			

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Describe the fundamentals of cell structure and cell cycle

CO2: Understand the classification and functions of biomolecules

CO3: Elaborate the basic cellular mechanisms such as replication, transcription and translation

CO4: Describe the underlying concepts of infection and immunity.

CO5: Explain various applications of biology

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2		2		3							2	1		
CO2	3	2		3		2							2	2		
CO3	3			3		2							1	3		
CO4	3	2		3		3							2	3		
CO5	3	2		2									2	1		

Unit I: INTRODUCTION **9 hours**

Fundamental difference between science and engineering- comparison between eye and camera, Bird flying and aircraft; major discoveries in biology- ; Classification based on: Cellularity- Unicellular and Multicellular; Ultra structure - prokaryotes and eukaryotes; three major kingdoms of life; Cell structure, intracellular organelles and their functions, comparison of plant and animal cells- Overview of Cell cycle and cell division

Unit II: BIOMOLECULES **9 hours**

Chemistry of biomolecules: Carbohydrates, Lipids, Proteins; classification of amino acids; classification of proteins based on structure and functions; Nucleic acids -types, structure and function of DNA and RNA

Unit III: GENES TO PROTEINS **9 hours**

Gene, Genome and chromosome; Central dogma of molecular biology; Classical experiments of DNA: Griffith and, Avery, McCarty and MacLeod, Meselson and Stahl - DNA replication, Transcription and Translation

Unit IV: MICROBIOLOGY **9 hours**

Microscopy; Microbes as infectious agents - malaria, tuberculosis, typhoid, polio, dengue, AIDS;; cultivation of bacteria. Immunity - innate and acquired immunity - organs and cells of the immune system - classification of antibodies - types of T cells - transplantation, autoimmunity overview

Unit V: APPLICATIONS OF BIOLOGY **9 hours**

Healthcare-antibiotics, vaccines, monoclonal antibodies, insulin and interferons; Beneficial bacteria - probiotic bacteria, nitrogen fixing bacteria, fermentation and fermented foods and products Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for medical and environmental applications; Biosensors;

TEXT BOOKS:

1. De Robertis, E.D.P. and De Robertis, E.M.F. - Cell and Molecular Biology- Lippincott Williams & Wilkins- Philadelphia- USA- 8th Edition- 2010.
2. Voet, D., Voet, G., - Biochemistry - John Wiley and Sons, Singapore - 3rd Edition- 2001.
3. Pelczar MJ, Chan ECS and Krieg NR - Microbiology - Tata McGraw Hill, India- 7th Edition- 2010

REFERENCES:

1. Friefelder. D. -Molecular Biology- McGraw-Hill Companies- New York, USA- 5th Edition- 2013.

CSE18R171	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	Credits
		3	1	2	5
Pre-requisite : NIL		**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective:

To make the students to understand the basic concepts of programming language, rules to be followed while writing a program and how to compile and execute C programs.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1 : Understand the basic programming concepts and syntax of C language
CO2 : Develop efficient code using pointers, arrays and dynamic memory allocation
CO3 : techniques
CO4 : Create user defined data types and functions to solve given problems.
CO5 : Design an efficient algorithm for a given problem
CO6 : Build efficient code to solve the real world problem
CO7 : Elucidate the programming constructs of C during interviews

CO, PO and PSO Mapping:

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1		2						2					1		1	
CO2		2		1		2		2					1		2	
CO3		2		1				2					1		1	
CO4		2		1		2							1		2	
CO5						2										

UNIT 1: INTRODUCTION TO PROGRAMMING **12 hours**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory, locations, Syntax and Logical Errors in compilation, object and executable code, Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT 2: ARRAYS AND STRINGS **12 hours**

Introduction - One dimensional and two dimensional arrays – Declaration of arrays – Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization - String Manipulation - Multidimensional Arrays - Arrays of Strings

UNIT 3: BASIC ALGORITHMS **12 hours**

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT 4: FUNCTION **12 hours**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT 5: STRUCTURE, POINTERS & FILE HANDLING **12 hours**

Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling (only if time is available, otherwise should be done as part of the lab)

TEXT BOOKS

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

REFERENCE BOOKS

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

LIST OF EXPERIMENTS **15 hours**

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

EEE18R172	Basic Electrical Engineering	L	T	P	Credits
		3	1	2	5
Pre-requisite : NIL		**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective:

To focus the fundamental ideas of the Electrical Engineering by providing wide exposure to the basic concepts of Electrical Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments and electrical installations etc.

Course Outcomes:

Upon successful completion of this course, students will be able to
CO1: To Apply basic laws of electricity in DC Circuits
CO2: To Apply basic laws of electricity in AC Circuits
CO3: To study the working principles of dc Machines and Transformers.
CO4: To study and working principle of AC Machines
CO5: To study the basic components of Low Voltage Electrical Installations

CO MAPPING WITH PO:

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1		2						1					1		1	
CO2		2		2				1					1	1	1	
CO3		2		2				1					1	1	1	
CO4		2						1					1		1	
CO5		2		3				1					1	1	1	

UNIT 1: DC CIRCUITS

DC Circuits: Electrical quantities – Electric Circuit Elements - Resistors - Inductors - Ccapacitors - Ohm's Law - Kirchhoff's Laws - Series and Parallel circuits - Analysis of DC circuits – Mesh - Nodal – Superposition - Thevenin - Norton Theorems - Simple problems

UNIT II: AC CIRCUITS

Sinusoidal functions - Phasor representation - Real power - Reactive power - Aapparent power - Power factor - RMS value - Average value - Form and Peak factors - Analysis of single-phase AC series circuits consisting of RL, RC, RLC combinations – Problems - concept of three phase system.

UNIT III: DC MACHINES AND TRANSFORMERS

DC Machines: Construction and working principle of DC Generator and DC Motor - EMF equation – Torque equation - Related problems

Transformer: Construction - working and types - Ideal and practical transformer - Equivalent circuit - Losses in transformers - Regulation and Efficiency –problems

UNIT IV: AC MACHINES

Synchronous machine: Construction - working of alternator – EMF Equation – Problem – Working principle of synchronous motor

Three phase induction motor: Constructional details - Principle of operation – Types - Torque-slip characteristics - Starting torque - Relation between torque and slip - Losses and efficiency.
Single phase induction motor: Construction – Working principle - Types of single phase induction motor

UNIT V: ELECTRICAL INSTALLATIONS
Components of LT Switchgear - Switch Fuse Unit (SFU) – MCB – ELCB – MCCB - Domestic wiring - accessories - types - Staircase wiring - Fluorescent tube circuits – Earthing - Types of Batteries - Important Characteristics for Batteries - Elementary calculations for energy consumption - power factor improvement and battery Backup

LIST OF EXPERIMENTS

1. Verification of Kirchoff's Laws.
2. Verification of Mesh and Nodal analysis
3. Verification of Thevinin's and Norton's theorems
4. Measurement of electrical quantities-voltage current, power & power factor in RL and RC series circuits
5. Determine the power and power factor of RLC series circuit
6. Open circuit and load characteristics of Separately excited DC Generator
7. Open circuit and load characteristics of Self excited DC Generator
8. Draw the characteristic between output power versus efficiency of DC shunt motor
9. Verification of turns ratio on single phase transformer
10. Load test on single phase transformer
11. Load test on three phase squirrel cage induction motor.
12. Load test on single phase induction motor.
13. Load test on Alternator
14. Study of basic electrical installation components for LT switchgear
15. Residential house wiring using fuse, two way switches and lamp
16. Wiring layout for Fluorescent lamp
17. Experiment for Calculation of charging and discharging current of battery

TEXT BOOK(S):

1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2012
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

REFERENCE(S):

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill, 2006.

3. Sunil S.Rao., Switchgear Protection and Power system, Khanna Publishers, New Delhi, 13th Edition, 1999.
4. Ravindranath B., Chander, N., Power Systems Protection and Switch Gear, Wiley Eastern (P) Ltd., Second Edition, 2011.

MEC18R151	ENGINEERING GRAPHICS & DESIGN	L	T	P	Credits
		3	0	2	3
Pre-requisite: Nil		**Course Category:** Basic Engineering **Course Type:** Theory with Practical			

Course Objective:

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, Demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

Course Outcomes:

After completing this course, the student will be able to:

CO1: Create the projection of points in all quadrants and straight lines

CO2: Construct the projections of planes and solid objects with refer to reference planes

CO3: Illustrate the true shape of truncated solids in both the manual and computerized manner

CO4: Develop surfaces of truncated solids in both the manual and computerized man

CO5: Apply orthographic and isometric projections in both the manual and computerized man

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1			3						2				1		1	
CO2			3		2				2				1	1	1	
CO3			3		2				2				1	1	1	
CO4			2										1			
CO5			2		2				3				1	1	2	

Unit 1: Projection of Points and Straight Lines **9 Hours**

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

Unit 2: Projection of Planes and Solids **9 Hours**

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

Unit 3: Section of Solids **9 Hours**

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

Unit 4: Development of Surfaces **9 Hours**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

Unit 5: Orthographic and Isometric Projection **9 Hours**

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones. Introduction to CAD software – menus and tools – drafting platform demonstration

Practical Modules

1. Construction of conic sections using CAD software
2. Construction of simple planes using exclusive commands like extend, trim etc.,
3. Construction of 3D model – solids and sectional views
4. Generating 2D orthographic blue prints from 3D part models
5. Vectorization of simple building plan and elevation

Text Book(s):

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2013.
2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.
3. K. Venugopal, Engineering Drawing + AutoCAD, New Age; Fifth edition, 2011.

Reference(s):

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Paul Richard, Jim Fitzgerald., Introduction to AutoCAD 2017: A Modern Perspective, Pearson, 2016.
4. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2014.
5. Luzadder and Duff, “Fundamentals of Engineering Drawing”, Prentice Hall of India Pvt. Ltd., 2009.
6. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009.

MEC18R211	ENGINEERING MECHANICS	L	T	P	Credits
		3	1	0	4
Pre-requisite: Nil		**Course Category:** Basic Engineering **Course Type:** Theory with Practical			

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the vectorial and scalar representation of forces and moments of particles and rigid bodies both in two dimensions and in three dimensions.

CO2: Apply the knowledge of trusses in frames, beams and machine components.

CO3: Contrast the effect of friction on equilibrium.

CO4: Illustrate the importance of properties of surfaces and solids.

CO5: Demonstrate the dynamic equilibrium equation.

CO MAPPING WITH PO:

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2			3			2						1	1	1	
CO2	2						2			3			1		1	1
CO3	2			2			2			3			1	1	1	1
CO4							2								1	
CO5	1			2			2							1	1	

Unit 1. Statics of Particles and Rigid bodies (9+3)

Six Fundamental principles and concepts - vector algebra - Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D - System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant - Equations of Equilibrium of Coplanar Systems and Spatial Systems. Rigid Body equilibrium in 2-D & 3-D - Moment of Forces and its Application - Couples and Resultant of Force System - Equilibrium of System of Forces, Free body diagrams - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Unit 2. Analysis of Trusses (9+3)

Basic Structural Analysis- Equilibrium in three dimensions - Method of Sections- Method of Joints- How to determine if a member is in tension or compression- Simple Trusses- Zero force members- Beams & types of beams- Frames & Machines.

Unit 3. Friction (9+3)

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction - Motion of Bodies, simple contact friction, sliding block, wedge friction, screw jack & differential screw jack, rolling resistance.

Unit 4. Properties of Surfaces and Solids (9+3)

Centroid of simple figures from first principle, centroid of composite sections - Centre of Gravity and its implications - Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment

of inertia of standard sections (T section and I section) - Mass moment inertia of circular plate, Cylinder, Cone, Sphere- Principal moment of inertia.

Unit 5. Dynamics (9+3)

Review of particle dynamics - Displacements, velocity and acceleration, their relationship - Equations of motions - Rectilinear motion- Plane curvilinear motion - Newton's 2nd law- Impulse, momentum, impact - D'Alembert's principle and its applications in plane motion and connected bodies - Work energy principle and its application in plane motion of connected bodies - Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies.

Text Book(s):

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units.2014

Reference(s):

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.2016
2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition, 2017

MEC18R152	ENGINEERING PRACTICE	L	T	P	Credits
		3	0	2	3
Pre-requisite: Nil		**Course Category:** Basic Engineering **Course Type:** Theory with Practical			

Lectures & videos:
Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Carpentry **(1 lecture)**
5. Plastic moulding, glass cutting **(1 lecture)**
6. Metal casting **(1 lecture)**
7. Welding (arc welding & gas welding), brazing **(1 lecture)**

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and Publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:

1. Machine shop **(10 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(6 hours)**
4. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**
5. Casting **(8 hours)**
6. Smithy **(6 hours)**
7. Plastic moulding & Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

AUT18R171	BASIC INSTRUMENTATION	L	T	P	Credits
		3	0	2	4
Pre-requisite: Nil		**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective(s):

To provide basic knowledge of instruments used in Automotive Industries.

Course Outcome(s):

After completing this course, the student will be able to:

1. Understand the basics of functional elements of a measurement system
2. Understand the basics of error generated from a instrument and types of error in instrument.
3. Know about the principle of operation of various type of sensors and transducers used for measurement of various parameters.
4. Know about the various type of instruments used for measurement of force, acceleration and torque .
5. Know about application of instruments in automobile industry for measurement of various parameters.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2		2			2				1	3	2	1		2
CO2	2				3				2				1	1		1
CO3		2		1			2				1	2	1	1	1	1
CO4	2				2				1			3	1	1		1
CO5		3		1			3				1	3	1		1	2

Unit 1: Instruments and Their Representation **9 Hours**

Introduction, Functional Elements of a Measurement System, Classification of Instruments, Standards: International, Primary, secondary, working standards, Calibration, Static Characteristics: Accuracy, Sensitivity, Reproducibility, drift, Static error, Dead Zone, Dynamic characteristics: Speed of response, measuring lag, fidelity, dynamic error, Zero, ramp and sinusoidal input signals

Unit 2: Errors in Measurement **9 Hours**

Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, Rejection of test data

Unit 3: Sensors and Transducer **9 Hours**

Introduction, Pressure sensor: Boudontube, Temperature sensor: RTD, Density measurement: Float type densitometers, Viscosity measurement: saybolt viscometer Luminosity sensor: Photometric detective system, Classification- Resistive transducer:

Potentiometer, strain gauge, Capacitive transducer: parallel plate capacitive transducer, Inductive transducer: Rotary Variable Differential Transformer (RVDT) Self generating Transducer: Piezo-electric transducer

Unit 4: Force, Acceleration and Torque Measurement **9 Hours**

Force Measurement: Resistance strain gauge, Acceleration measurement: Seismic transducer, Potentiometric type accelerometer, Torque measurement: Inductive torque transducer, digital method of torque measurement.

Unit 5: Measurements in Automotive Industries **9 Hours**

Modern Automotive Instrumentation, Study of automotive sensors and actuators, Pressure, Level, Temperature, Density, Viscosity, Vibration, Luminosity, Crank angle position and flow, Data Acquisition Systems, Data processing, Data Display and Storage.

Text Book(s):

1. A. K. SawhneyAnd P. Sawhney., A Course in Electrical and Electronic Measurements and Instrumentation, 12th edition, DhanpatRai, New Delhi 2001.

Reference(s):

1. B.G Liptak, „Instrument Engineer□sHandbook : Process measurement and Analysis□, Chilton Book Company, 2003.
2. RobertBoschGmbh ,"BOSCH– Automotive Handbook", 7thEdition,John Wiley & Sons, ISBN: 0470519363, 2008.
3. Denton.T, "Automobile Electrical and Electronic System", Elsevier Butterworth–HeinemannPublications,3rd Edition,2004.
4. William.T.M, "Automotive Electronic System",Elsevier Science,6th Edition,2003.
5. Kiencke,, Nielsen, "Automotive Control Systems" 2nd Edition.2005.

Practical Components

1) Characteristics of resistive potentiometer transducer
2) Study of strain gauge characteristics
3) Characteristics of Thermocouple
4) Measurement of photoelectric tachometer
5) Measurement of torque using strain gauge
6) Measurement of level using differential pressure transmitter
7) Measurement of viscosity using saybolt viscometer
8) Measurement of speed using electromagnetic transducer
9) Measurement of natural frequency using Accelerometer
10) Measurement of speed using stroboscope

II – PROGRAM CORE

AUT18R271 Mechanics of Materials	L	T	P	Credits
	3	1	2	5
Pre-requisite: -	**Course Category:** Program Core **Course Type:** Integrated Course			

Course Objective(s):

Students will be able to understand the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior. Exposures to systematic methods of problem solving techniques. Knowledge on solving structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analyse yield strength, ultimate strength, working stresses, thermal stresses in various bars.

CO2: Evaluate two dimensional stresses in shells and cylinders

CO3: Illustrate shear force and bending moment diagram for various types of load.

CO4: Classify bending stress and shear stress distributions in beams.

CO5: Design shafts and springs under torsion.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1						2			3	1		1	
CO2	3	2							1			2	2			1
CO3	3		1			1							1	1		
CO4	2	1				2			2			2	1	1	1	1
CO5	1		2			1						3	1	1		1

Unit 1: Stress, Strain and Deformation in Solids **12 Hours**

Tension, compression and shear stresses – Hook's law – stress- ultimate stress and working stress – Deformation of simple and compound bars under axial load - Elastic constants and their relationship - Stresses in Stepped shafts and varying sections.

Unit 2: Stress and Deformation in 2d Bodies **12 Hours**

Biaxial state of stresses - Thin cylindrical and spherical shells - Deformation in thin cylindrical and spherical shells -Biaxial stresses at a point - Stresses on inclined plane - Principal Planes Hoop stress and stresses - Mohr's circle for biaxial stresses - Maximum shear stress.

Unit 3: Beams and Supports **12 Hours**

Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever, simply supported and Overhanging beams -Point of contra Flexure - Stresses in beams: Bending and shear stress.

Unit 4: Deflection of Beams **12Hours**

Elastic curve of Neutral axis of the beam under normal loads - Evaluation of beam deflection and slope: Double integration method, Macaulay Method

Unit 5: Torsion and Springs **12 Hours**

Elastic theory of torsion – stresses and deformation in solid circular and hollow shafts – stepped shafts – composite shaft – stress due to combined bending and torsion– strain energy due to torsion-deformations and stresses in helical springs – design of buffer springs -leaf springs.

Name of the Experiments:

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals - Brinell hardness number
5. Deflection test on beams
6. Corrosion test on mild steel plate.
7. Pin on disk – exercise on mild steel plate.

Text Book(s):

1. Popov, E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi, 8th Edition 2014.

Reference(s):1

1. Kazimi, S. M. A., Solid Mechanics, Tata McGraw Hill Book Co Ltd., 1998.
2. R.K.Rajput, ―Strength of Materials‖ , S. Chand and Company Ltd., New Delhi 2015,
3. Bansal, R. K., Strength of Materials, Laxmi Publications, 4th Edition, 2015

AUT18R201 Applied Thermodynamics	L	T	P	Credit
	3	0	0	3
Pre-requisite: -	**Course Category:** Program Core **Course Type**: Theory			

Course Objective(s):

- The course is intended to build up necessary background for understanding the working cycles of petrol, diesel engines
- To apply the thermodynamic concepts into various thermal applications like turbines, compressors and refrigeration systems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the laws of thermodynamics.
CO2: To conceptualize different types of thermodynamic air standard cycles.
CO3: Analyze the performance of reciprocating air- compressor
CO4: To design and analyze refrigeration and air conditioning systems.
CO5: Able to classify the different types of jet engines.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1								2	3	1			1
CO2	1		1				2				2	1	1		1	1
CO3	1		2		1						1	2	1	1		1
CO4	2						2				1		1		1	
CO5			3		1							3	1			1

Unit 1: Basic Thermodynamics **9 Hours**

Introduction, Systems, Zeroth law, First law, steady flow energy equation. Heat and work transfer in flow and non flow processes. Second law, Kelvin – planck statement, clausies statement, concept of entropy, clausius inequality, entropy change in non-flow processes.

Unit 2: Gas Power Cycles **9 Hours**

Introduction to air standard cycles, Air standard efficiency, Mean effective pressure, Otto, diesel, dual and Brayton cycles.

Unit 3: Air Compressors **9 Hours**

Introduction, Classification of Air compressors, Operation of a single stage reciprocating compressor, work input through p-v diagram, volumetric efficiency, isothermal and mechanical efficiencies, multistage compressor.

Unit 4: Refrigeration and Air Conditioning **9 Hours**

Introduction, Refrigeration, vapour compression, vapour absorption – coefficient of performance, Refrigerants, properties of refrigerants, Air-conditioning, Air-conditioning Cycle, types of air conditioning.

Unit 5: Jet Propulsion **9 Hours**

Introduction, Turbines, Nozzles, Propeller, Turbo-jet Engine, Turbo-prop Engine, Ram-jet, Pulse-jet, and Rocket Engines.

Text book(s):

1. Rajput, R.K, Thermal Engineering, S.Chand publishers, 2015.

Reference(s):

1. Desmond E. Winterbone and Ali Turan, Advanced Thermodynamics For Engineers, Butterworth-Heinemann, 2015.
2. Rudramoorthy, R., Thermal Engineering, Tata McGraw-Hill, New Delhi, 2003.

AUT18R272 Manufacturing Processes and Machining	L	T	P	Credit
	3	0	2	4
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Integrated Course			

Course Objective(s):
To impart knowledge on the various manufacturing processes and machining processes for selecting suitable process for the required automobile application

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Explain various casting methods and choose suitable method for required application
CO2: Explain the various welding processes and can distinguish between the welding, brazing and soldering
CO3: Illustrate the various bulk deformation processes
CO4: Choose the suitable sheet metal forming process based on the application and explain some of the advanced forming techniques
CO5: Choose and explain the various basic machining processes required for the automotive applications

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1	2							1	2	2	1		1
CO2	3	2	1					2			2	2	2		1	2
CO3	3	2						2			2	2	2		1	2
CO4	2	1	1								1	1	2			1
CO5	1			2				1				3	1	1		1

Unit 1: Fundamentals of Casting **9 Hours**
Mold Casting Processes - mold types - sand casting - types - pattern - cores - solidification of metals - cast structures - fluidity of molten metals - heat transfer - shrinkage - casting defects - Investment Casting Processes - ceramic mold casting - plaster mold casting - shell mold casting - centrifugal casting - squeeze casting - cleaning/finishing methods – inspection/testing methods for castings.

Unit 2: Metal Joining Processes **9 Hours**
Classification of welding process - principle of gas welding – Oxy acetylene welding – types of flames, arc welding – MIG, TIG and submerged arc welding, resistance welding – spot, seam and projection welding - solid state welding – forge welding, friction welding – Thermit welding - radiant energy welding – Electron beam welding, laser beam welding, plasma arc welding - brazing – methods and soldering

Unit 3: Bulk Deformation Processes **9 Hours**

Forging - classification of forging processes, forging defects and inspection - rolling - classification of rolling processes, rolling mill, rolling of bars and shapes - extrusion - classification of extrusion processes - direct, indirect, tube extrusion, hydrostatic extrusion, impact extrusion - drawing - wire drawing, tube drawing.

Unit 4: Sheet Metal Forming Process **9 Hours**

Sheet metal operations – blanking, punching, nibbling, notching, trimming, shaving, bending, drawing, deep drawing, spinning, embossing, coining, forming. Explosive forming – confined and unconfined system, electro hydraulic forming – electromagnetic forming

Unit 5: Machining **9 Hours**

single point cutting tool – nomenclature, lathe operations, milling – types of milling cutters, drilling, reaming, boring, tapping, gear cutting - forming and generation principles, gear hobbing and gear shaping , grinding – types – cylindrical grinding, surface grinding, centreless grinding and internal grinding

List of Experiments **15 Hours**

- Plain turning, step turning, taper turning on three jaw chuck
- Knurling, Thread cutting, Eccentric turning, parting off
- Drilling: Through hole, Eccentric turning, , reaming, tapping
- Special operation in Capstan lathe
- Grinding a V-tool
- Make mould of a square pattern
- Make mould of a stepped pulley pattern
- To make square out of round rod
- To make straight rod into bend
- Butt joint, Lap joint and T-joint using ARC welding

Text book(s):

1. Sharma P. C., Production Technology, S. Chand publishing, 2007.
2. Hajra Choudhry, Elements of Workshop Technology-Vol I and Vol II, Media promotors and publishers, Reprint 2014

Reference(s):

1. HMT Production Technology, Tata Mc Graw-Hills Publishing Co. Ltd, 1994
2. Chapman, W.A.J., Workshop Technology-Vol - II, Oxford and IBH Publishing
3. Jain, R.K., Production Technology, Khanna Publishers, 2002

AUT18R202 Automotive Chassis	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Theory			

Course Objective(s):

- To discuss different types of chassis.
- The student shall gain appreciation and understanding function of front axle, types of stub axle, types of steering gear box etc.
- State modern drive line.
- Shall be able to understand need of suspension.
- Student shall gain knowledge of design consideration braking system, suspension system and for chassis etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the chassis, frames and chassis materials used in automobile.

CO2: Recognize the different types of steering system and geometry adopted in modern vehicle.

CO3: Demonstrate the modern drive line technology in vehicle.

CO4: Compare and analyse the suspension systems in automobile.

CO5: Design and develop the modern braking system.

Mapping of Course Outcome(s):

CO /	PO												PSO			
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2		3			1						2	1	1	
CO2	2		2				3					1	2		1	1
CO3	3	1		2						1		2	2	1		1
CO4	3		2				2			3		1	2		1	1
CO5	3	1	2	1						2		1	2	1		1

Unit 1: Introduction **9 Hours**

Types of chassis layout with reference to power plant locations and drive, Vehicle frames, various types of frames. Constructional details, Materials. Testing of vehicle frames. Unitised frame body construction: Loads acting on vehicle frame.

Unit 2: Front Axle and Steering System **9 Hours**

Types of front axles. Construction details. Materials. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe-in Conditions for true rolling motion of wheels during steering. Steering geometry. Ackerman and Davis steering system. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkages and layouts. Power and power assisted steering - Steering of crawler tractors.

Unit 3: Drive Line and Differential **9 Hours**

Effect of driving thrust and torque reactions. Hotch kiss drive, torque tube drive and radius rods. Propeller shaft. Universal joints. Constant velocity universal joints. Front wheel drive. Different types of final drive. Worm and worm wheel, straight bevel gear, Spiral bevel gear and hypoid gear final drives. Double reduction and twin speed final drives. Differential principles. Construction details of differential unit. Non-slip differential. Differential locks - Differential housings.

Unit 4: Rear Axle and Suspension System **9 Hours**

Construction of rear axles. Types of loads acting on rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi axle vehicles. Construction details of multi drive axle vehicles. Need of suspension system - Types of suspension - Suspension springs - Constructional details and characteristics of leaf, coil and torsion bar springs - Independent suspension - Rubber suspension – Pneumatic suspension - Shock absorbers

Unit 5: Braking System **9 Hours**

Classification of brakes - Drum brakes and Disc brakes. Constructional details - theory of braking, Mechanical hydraulic and pneumatic brakes - Servo brake. Power and power assisted brakes - Different types of retarders like eddy current and hydraulic retarder-Anti lock braking systems.

Text book(s):

1. Kirpal Singh, " Automobile Engineering-Vol.1" Standard Publishers Distributors, Delhi,2013

Reference(s):

1. Heldt P.M., "Automotive chassis ", Literary Licensing, LLC, 01-Jun-2012.
2. Tim Gilles," Automotive Chassis" Thomson Delmar learning, 2005
3. Reimpell .J, Stoll. Betzler J.W, " The Automotive Chassis" Butterworth – Heinemann, 2001
4. Steed W., "Mechanics of Road vehicles ", Illiffe Books Ltd., London, 1960,digitized, 26 Jul 2011
5. Judge A.W., "Mechanism of the car ", Chapman and Halls Ltd., London, 1966, digitized 8 Aug 2006.
6. Crouse W.H., "Automotive Chassis and Body ", McGraw Hill. Newyork. 1971.

AUT18R281 Automotive Components Laboratory	**L**	**T**	**P**	**Credit**
	0	**0**	**2**	**2**
Pre-requisite: -	**Course Category:** Program Core **Course Type**: Laboratory course			

Course Objective(s):
To understand the concept construction and working of automotive components.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Acquire the knowledge in axles, differential and steering systems
CO2: Able to differentiate filters, types of starter motor of automotive
CO3: Know the functions of air-condition, power window, CVT and blower units

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2			2									1	1		
CO2			1		3				2				1	1	1	
CO3				2							3			1		1

List of Experiments:
1. Study of Car front axle and rear axle
2. Study, dismantling and assembling of Differential unit
3. Dismantling and assembly of Steering systems
4. Study of oil, Air and fuel filters
5. Study of Starter Motor system and kicker mechanism.
6. Study of air conditioning Air-conditioning system of car comportment.
7. Connections and functional study of Hand brake and centre locking mechanism.
8. Comparative study of mechanical to Power window.
9. Functional Study of CVT and Blower unit
10. Calibration of inline and rotary diesel fuel pump.

Text book(s):
1. Internal Combustion Engineering by Ganesan V, Tata McGraw –Hill Publishing Co., New Delhi. 4th Edition 2016

Reference(s):

2. John. B, Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York, 1990.

AUT18R273 Fluid Mechanics and Pumps	**L**	**T**	**P**	**Credits**
	3	**1**	**2**	**5**
Pre-requisite: MEC18R211- Engineering Mechanics	**Course Category:** Program Core **Course Type:** Integrated Course			

Course Objective(s): To study the various fluid flow properties and analyze the complexities involved in solving the practical fluid flow problems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain different properties of fluid and gain the knowledge of different type of pressure measuring devices

CO2: Demonstrate the kinematics and dynamics of fluid flow and apply Bernoulli's equation to real time problems

CO3: Analyze the losses in flow of fluid through pipes.

CO4: Discuss the working principle of different turbines and solve performance calculations

CO5: Elaborate the working principle of different pumps and examine its performance

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2											2			
CO2	3	3	2	2	2								3	2		
CO3	2	3	2	2									3	1		
CO4		3											1			
CO5		3											1			

Unit 1: Basic Concepts and Properties **12 Hours**

Fluid – definition, distinction between solid and fluid - units and dimensions, properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - fluid statics - concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers.

Unit 2: Fluid Kinematics and Fluid Dynamics **12 Hours**

Fluid kinematics - flow visualization, lines of flow, types of flow, velocity field and acceleration, continuity equation (one and three dimensional differential forms) - equation of streamline, stream function, velocity potential function, circulation, flow net, fluid dynamics - equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's theorem applications - similarity laws and models.

Unit 3: Incompressible Fluid Flow 12Hours

Viscous flow - Navier-Stoke's equation (Statement only) - shear stress, pressure gradient relationship - laminar flow between parallel plates, Laminar flow through circular tubes (Hagen Poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy - Weisback's equation - friction factorminor losses – flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation.

Unit 4: Centrifugal Pump 12 Hours

Centrifugal pump - classifications, working principle, velocity triangles, specific speed, efficiency and performance curves

Unit 5: Other Hydraulic Pumps 12 Hours

Reciprocating pump classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps - working principles of gear and vane pumps, performance of positive displacement pump.

Name of the Experiments:

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of Centrifugal pump / Submergible pump.
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic Kaplan turbine

Text Book

1. Streeter, V.L., and Wylie, E.B., Fluid Mechanics, McGraw-Hill, 2010.

References

1. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd, New Delhi, 7th edition, 2002.
2. Vasandani, V.P., Hydraulic Machines - Theory and Design, Khanna Publishers, 11th Edition 2010.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi, 9th edition,2010.
4. White, F.M., Fluid Mechanics, Tata McGraw-Hill, c, 5th Edition, 2003.
5. Ramamirtham, S., Fluid Mechanics and Hydraulics and Fluid Machines, Dhanpat Rai and Sons, Delhi, 3rd edition 1998.
6. Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGrawHill, New Delhi, 3rd Edition, 2011.

AUT18R274 Automotive Engines	**L**	**T**	**P**	**Credits**
	3	**1**	**2**	**5**
Pre-requisite: -	**Course Category:** Program Core **Course Type:** Integrated Course			

Course Objective(s):
The main objective of the course is to give the students an introduction to reciprocating internal combustion engines with emphasis on automotive and stationary applications.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Describe the basics of automobile components and its working
CO2: Analyse the air standard cycle and correlate with actual engine cycle.
CO3: Explain the working of various Spark Ignition and Combustion Ignition Engine Fuel system.
CO4: Understand the operation of the Ignition, supercharging, cooling and Lubrication system of for various automotive segments
CO5: Summarize the constructional difference between combustion chambers of C. I. Engines.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1									2						1	
CO2	3			3		2				3			1	2		1
CO3		2		2									1	1		
CO4		2							1				1		1	
CO5							1		2					1	1	

Unit 1: Introduction **12 Hours**
Historical Development of Automobiles classification of Automobiles - Type of Automobile Engines - Principle of engine operation, two and four stroke engine CNG/LPG engine - classification of engine - engine parts and their function cylinder

head piston, piston rings, piston pin, connecting rod, crank shaft, flywheel, camshaft, valve and valve mechanism and crank case.

Unit 2: Air Cycles For Automotive Use **12 Hours**

Air standard cycles-Otto and Diesel , Fuel air cycles, , performance parameters & characteristics variable's affecting performance characteristics, measurement of F.H.P., I.H.P. & B.H.P.

Unit 3: S.I& C.I Engine Fuel System **12 Hours**

Classification of I.C. Engines - carburation, factors affecting carburation, air fuel mixture requirements, working principle of simple carburettor, drawbacks of a simple carburettor, introduction to basic electronics petrol injection system, Introduction, requirements of diesel fuel injection system, classification of injection systems, injection pumps- Jerk type and distributor type, injection Nozzles, Common Rail Direct Injection System (CRDI)

Unit 4: Ignition, Super Charging, Lubrication & Cooling system **12 Hours**

Ignition systems, requirements, types battery, magneto ignition system and spark plug ignition timing , demerits of conventional ignition system, Introduction to electronic ignition system, supercharging, Turbo charging, Need for cooling system, Types of cooling system: air cooling system, liquid cooling system, forced circulation system, pressure cooling system. Lubrication system; mist wet sump lubrication system

Unit 5: Fuels and Combustion **12 Hours**

Combustion equation, conversion of gravimetric to volumetric analysis - Determination of theoretical minimum quantity of air for complete combustion - Determination of air fuel ratio for a given fuel. Properties and rating of fuels (petrol and diesel), chemical energy of fuels, reaction equation, combustion temperature, combustion chart.

List of Experiments

- Performance test of four stroke diesel engine
- Heat balance test on four stroke diesel engine
- Performance test of four stroke Petrol engine
- Heat balance test on four stroke Petrol engine
- Retardation test to find frictional power of diesel engine

Text book(s):

1. Ganesan V, "Internal combustion engines", 4th edition, Tata McGraw Hill Education, 2012.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 3rd edition, Laxmi Publications (P) Ltd, 2016.

Reference(s):

1. John. B, Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990.
2. Ramalingam K. K, "Internal Combustion Engines", Second Edition, Scitech Publications.

3. Sharma S. P, Chandramohan, "Fuels and Combustion", Tata McGraw Hill Publishing Co, 1987
4. Mathur and Sharma, "A course on Internal combustion Engines", Dhanpat Rai & Sons, 1998.
5. Edward F, Obert, "Internal Combustion Engines and Air Pollution", Intext Education Publishers.

AUT18R275 Automotive Fuels and Lubrications	**L**	**T**	**P**	**Credit**
	3	**1**	**2**	**5**
Pre-requisite: -	**Course Category:** Program Core **Course Type**: Integrated Course			

Course Objective(s):
The aim of undergoing this course is to develop basic understanding about the production of automotive fuels and lubricants. Special emphasis is also given on how these fuels and lubricants affect the performance and functioning of an internal combustion engines.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand the sources and production of automotive fuels and lubricants **,** Explain the process of production from raw crude oil
CO2: Understand the concepts of testing the fuels for their properties; Mention the standards for testing the fuels
CO3: Describe the stages of combustion in gasoline and diesel engines. Able to identify the factors influencing the combustion of a fuel
CO4: Knowledge in various alternate fuels like Biodiesel, Hydrogen, Biomass, LPG, CNG etc., Understand the purpose of alternate fuels
CO5: Know the uses and standards adopted in lubrication process. Distinguish between the fuels and lubricants. Describe the testing of lubricants

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1		3		3				2					1	1	1	
CO2	2	2		2	3								2	2		

CO3				2	3									2		
CO4	3			3			3						1	1	1	
CO5	2	2		3	3		3	3				2	2	2	2	

Unit 1: Manufacture of Fuels and Lubricants **9 Hours**

Structure of petroleum refining process - classification of petroleum fuels - thermal cracking - catalytic cracking – polymerization - alkylation isomerisation - blending products of refining process - Manufacture of lubricating oil base stocks - manufacture of finished automotive lubricants.

Unit 2: Properties & Testing of Fuels **9 Hours**

Thermo-chemistry of fuels - properties and testing of fuels & Lubricants - relative density - calorific value - fire point - distillation - vapour pressure - flash point spontaneous ignition temperature - viscosity - pour point - flammability - ignitability diesel index - API gravity - aniline point Viscosity index

Unit 3: Fuel Rating & Combustion **9 Hours**

Cetane rating - Fuel requirements additive – mechanism, requirements of an additive petrol fuel additives and diesel fuel additives – specifications of fuels SI Engine – flame propagation and mechanism of combustion - normal combustion knocking – octane – rating - fuel requirements CI engine - mechanism of combustion - diesel knock.

Unit 4: Alternate Fuels **9 Hours**

Use of alternate fuel in engines- LPG, CNG need for alternate fuels - availability & their properties - general use of alcohols, LPG, CNG, LNG, hydrogen, ammonia, vegetable oils – bio diesel and bio gas – merits and demerits of alternate fuels. Introduction to alternate energy sources like, electric vehicle, hybrid, fuel cell & solar cars

Unit 5: Lubricants **9 Hours**

Classification of lubricating oils, properties of lubricating oils, tests on lubricants, Grease- classification, properties, test. Specific requirements for automotive lubricants, oxidation, deterioration and degradation of lubricants, additives, synthetic lubricants

List of Experiments **15 Hours**

- Determination of temperature dependence of viscosity of lubrication oil using Redwood viscometer and Saybolt Viscometer
- Determination of flash point and fire point for Diesel oil, Kerosene oil and Bio-Diesel.
- Determination of dropping point temperature of grease.
- Determination of Calorific Value for Liquid and gaseous fuel.
- Determination of flash point and fire point for Lubricants
- Determination of Mechanical Penetration of grease
- Determination of volatility characteristic of fuels by ASTM distillation method

Text book(s):

1. Internal Combustion Engineering by Ganesan V, Tata McGraw –Hill Publishing Co., New Delhi. 4th Edition 2016

Reference(s):

1. Fuels – Solids, Liquids, Gaseous by Brame, J.S.S. and King, J.G, 2014
2. Fuels and Fuel Technology by Francis, W, Vol. I & II, 2012
3. Modern Petroleum Technology by Hobson, G.D. & Pohl. W, 2th Edition 2016
4. Lubrication, Raymond G.Gunther, Chipton Book Co.- 1971

AUT18R301 Automotive Transmission Systems	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R202 - Automotive Chassis	**Course Category:** Program Core **Course Type**: Theory			

Course Objective(s):

To develop the basic knowledge of the students in mechanics, torque conversion areas. To develop the skills of the students in the areas of alternative drives and concepts. To serve as a pre-requisite course for other courses in UG and PG programs specialized studies and research.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the concept of clutches and gear boxes

CO2: Know about the fluid coupling and torque converters, performance characteristics

CO3: Study about Automatic transmission

CO4: Learn about the different drive systems.

CO5: Know the applications of Automatic Transmission

Mapping of Course Outcome(s):

CO	PO												PSO			
/ PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	1									3	1		

CO2	3	2		2	1						2		2	1		1
CO3									2						1	
CO4		2							2				1		1	
CO5			1										1			

Unit 1: Clutch and Gear Box **9 Hours**

Requirement of transmission system - Different types of clutch, principle, construction, torque capacity and design aspects. Determination of gear ratios for vehicles - Performance characteristics in different speeds - Different types of gear boxes -conventional gear boxes.

Unit 2: Hydrodynamic Drive **9 Hours**

Fluid coupling - Principle of operation, constructional details, torque capacity, performance characteristics and reduction of drag torque. Torque converter-Principle of operation, constructional details, performance characteristics, converter coupling, multistage torque converters and polyphase torque converters.

Unit 3: Automatic Transmission **9 Hours**

Ford - T-model gear box, Wilson Gear box, Cotal electromagnetic transmission, Automatic over drive, Hydraulic control system for automatic transmission.

Unit 4: Hydrostatic Drive and Electric Drive **9 Hours**

Hydrostatic drive - Various types of hydrostatic systems - principles of hydrostatic drive system, advantage and limitations, comparison of hydrostatic drive with hydrodynamic drive - construction and working of typical Janny hydrostatic drive. Electric drive - principle of early and modified Ward Leonard control system, advantage & limitations and performance characteristics.

Unit 5: Automatic Transmission Applications **9 Hours**

Chevrolet "Turboglide" Transmission - Powerglide Transmission - Toyota "ECT-i" Automatic Transmission with Intelligent Electronic control system - Clutch Hydraulic Actuation system.

Text book(s):

1. Newton and Steeds, “Motor vehicles ", llliffe Publishers, 12th Edition, 2016.

Reference(s):

1. Heldt.P.M., " Torque converters ", Chilton Book Co., 1992.
2. Judge.A.W., " Modern Transmission systems ", Chapman and Hall Ltd., 1990.
3. SAE Transactions 900550 & 930910.
4. Hydrostatic transmissions for vehicle applications ", I Mech E Conference, 1981-88.
5. Crouse. W.H., Anglin., D.L., " Automotive Transmission and Power Trains construction ", McGraw-Hill, 5th Edition, 1976.

AUT18R302 Automotive Component Design	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R271 – Mechanics of Material	**Course Category:** Program Core **Course Type**: Theory			

Course Objective(s):
To make the students understand the design concept and principles of various engine components.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand the basic design methodology, design terms and theories
CO2: Apply engineering principles and analytical techniques in designing shafts and springs.
CO3: Knowledge in designing the cylinder and its assembly, piston
CO4: Integrate various machine elements and components into the design of a engine components
CO5: Design the valves for both inlet and exhaust with its mechanism and fly wheel.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**

CO1			1									1	1			1
CO2	1	3		2					2				2		1	
CO3			1	2								2	1	1		1
CO4	2	1		3									1	1		
CO5			1				3						1		1	

Unit 1: Introduction **9 Hours**

Engineering materials –Tolerances - limits, types of fits, design considerations. Theories of failures – Rankine's Theory, Tresca's Theory, Saint Venant's Theory, Haigh's Theory, Hencky and Von Misses Theory.

Unit 2: Design of Shafts and Springs **9 Hours**

Transmission shafts – design based on strength, Torsional Rigidity, ASME code for shaft design. Hollow shaft – design based on Strength, Torsional Rigidity. Flexible shafts. Springs – Types, Materials used, standard size. Design of Helical spring. Leaf spring- construction, equalised stresses.

Unit 3: Design of Cylinder and Piston **9 Hours**

Cylinder and Cylinder liner – Choice of material for cylinder, Design consideration, Design of cylinder. Piston - Design consideration, Materials used, Design of piston head or crown, piston pin, piston rings, piston failures, lubrication of piston assembly

Unit 4: Design of Connecting Rod and Crankshaft **9 Hours**

Connecting Rod - Material, determining minimum length, small end and big end design, shank design, design of big end cap bolts, connecting rod failures, balancing of IC engines, significance of fire order. Crank Shaft - material for crank shaft, design of crankshaft under bending and twisting, balancing weight calculations

Unit 5: Design of Valves and Flywheel **9 Hours**

Valves - Design aspects of inlet and exhaust valves, valve springs, tappets, valve train. Flywheel - Materials and design procedure

Text book(s):

1. R.S Khurmi, J. K Gupta, "A Text book of Machine Design", Eurasia Publisher (2015).
2. Design data book, PSG college of Technology, Coimbatore, 2000. Kalailathir Publications

Reference(s):

1. R. K. Jain, "Machine Design", Khanna Publishers, New Delhi, 1997
2. V.B. Bhandari, "Design of Machine elements" , Tata Mc Graw Hill, 3rd Edition.

AUT18R303 Hybrid Electric Vehicle	L	T	P	Credit
	3	0	0	3
Pre-requisite: EEE18R172 - Basic Electrical Engineering	**Course Category**: Program Core **Course Type**: Theory			

Course Objective(s):

To provide a comprehensive knowledge of overall basic of hybrid, electric and fuel cell technologies.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Interpret the basic of electric vehicle and its performance characteristics

CO2: Ability to understand the concept of hybrid vehicle technology.

CO3: Apply the propulsion techniques and control system principles by using AC, DC motors and generators.

CO4: Capable to understand the energy storage devices and its importance

CO5: Gain knowledge on the importance of solar and fuel cell technology in automotive

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1												1			
CO2			3				2	1	3		2		1		2	1
CO3		3	3				2	1	2		2		2		2	1
CO4	2	2	1				2		3		2		2		2	1
CO5	2		3				3		3							

Unit 1: Introduction to Electric Vehicles **9 Hours**

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system

Unit 2: Hybrid Vehicles **9 Hours**

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

Unit 3: Propulsion and Control Systems **9 Hours**

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking. DC generators, AC generators, voltage and frequency regulations. Control system principles, speed and torque control – DC motors and AC motors

Unit 4: Energy Storages **9 Hours**

Electromechanical batteries- types of batteries – nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultracapacitors

Unit 5: Fuel Cells & Solar Cars **9 Hours**

Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars-photovoltaic cells, tracking, efficiency and Cost comparison

Text book(s):

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, ―Modern Electric, Hybrid and fuel cell vehicles, CRC Press, 2nd revised edition 2009.

Reference(s):

1. James Larminie and John Loury, ―Electric Vehicle Technology-Explained□, John Wiley & Sons Ltd., 2003.

2. Sandeep Dhameja, ―Electric Vehicle Battery Systems‖ , Butterworth – Heinemann, 2002.
3. Ronald K Jurgen, ―Electric and Hybrid – Electric Vehicles□, SAE, 2002.

AUT18R305 Automotive Pollution and Control	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R274 - Automotive Engines	**Course Category:** Professional Elective **Course Type**: Theory			

Course Objective(s):
To study about the Automobile Pollution and its control. It enhances the technical knowledge in controlling and maintaining environment from pollution. It also helps to understand the concepts and devices used for emission and pollution controlling.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand the sources and effects of pollutant.
CO2: Apply the chemistry of SI engine fuels after combustion.

CO3: Describe chemistry of CI engine fuels after combustion.
CO4: Choose the control techniques to reduce the formation of pollutants in SI and CI engine.
CO5: Test Procedures, Devices and Standards used to follow pollution control.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1			3	1						2		1	2		1
CO2		3		1	2								1	1		
CO3		2			3				1	2			1	1		1
CO4		3		1	2					1			1	1		1
CO5	3			2					1	1			1	1	1	1

Unit 1: Introduction **9 Hours**
Pollutants - sources - formation – effects of pollution on environments - effects of automotive pollution on global warming – effect of pollution on human health - transient operational effects on pollution.

Unit 2: SI Engine Combustion And Pollutant Formation **9 Hours**
Chemistry of SI engine combustion - HC and CO formation in 4-stoke and 2-stroke SI engines - NO formation in SI engines - Particulate emissions form SI engines - Effects of operating variables on emission formation.

Unit 3: CI Engine Combustion and Emissions **9 Hours**
Basics of diesel combustion - Smoke emission in diesel engines - NO emission from diesel engines – Particulate emission in diesel engines. Colour and Aldehyde emissions from Diesel engines - Effects of operating variables on emission formation.

Unit 4: Control Techniques For SI and CI Engine Emission Reduction 9 Hours
Design changes - Optimization of operating factors - Exhaust gas recirculation - Fumigation - Air injection PCV system - Exhaust treatment in SI engines - Thermal reactors - Catalytic converters - Catalysts - Use of unleaded petrol.

Unit 5: Test Procedure & Instrumentation for Emission Measurement and Emission Standards **9 Hours**
Test procedures - NDIR analyser - Flame ionization detectors - Chemiliuminescent analyser – Gas chromatograph - Smoke meters - Emission - standards.

Text book(s):

1. Springer and Patterson, Engine Emission, Plenum Press, 1990.

Reference(s):

1. Ganesan.V., " Internal Combustion Engines ", Tata McGraw Hill Co., 2012.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi
3. Publications (P) Ltd, 2007.
4. SAE Transactions, " Vechicle emission ", 1982 (3 volums).

5. Taylor.C.F., " Internal Combustion Engines ", MIT Press, 1972.
6. Heywood.J.B., " Internal Combustion Engine Fundamentals ", McGraw Hill Book Co., 1995.
7. Automobiles and Pollution SAE Transaction, 1995.

AUT18R381 Automotive Component Design Laboratory	**L**	**T**	**P**	**Credit**
	0	**0**	**2**	**2**
`Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Laboratory course			

Course Objective(s):
To familiarise the students to use modelling software to model engine components and chassis design.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Modelling the Automotive components using Design software

CO2: Assemble the Automotive components

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1			1									1	1			1
CO2	1	3		2					2				2	1	1	

List of Experiments:

Modelling of automobile components such as

1. Piston,
2. Connecting Rod,
3. Valves,
4. Crank Shaft,
5. Cam Shaft
6. Fly wheel
7. Clutch

Assembly drawing of

1. Piston and its components,
2. Connecting Rod and Crank shaft assembly,

Software Required: Creo, Solid Works

Text book(s):

1. Gopalakrishna, K. R., "Machine Drawing", Subhas Publications, Bangalore.2007

AUT18R382 Vehicle Testing Laboratory	**L**	**T**	**P**	**Credit**
	0	**0**	**2**	**2**
Pre-requisite: -	**Course Category:** Program Core **Course Type**: Laboratory course			

Course Objective(s):

To execute the on road testing of vehicles by chassis dynamometer, various emission testing and reconditioning of vehicle parts.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the concept of vehicle and engine performance evaluation

CO2: Ability to conduct on road testing of vehicles by chassis dynamometer
CO3: Apply the emission measurement technique in different vehicle operating condition

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	3		2							2		2	1		1
CO2		2	1		3				2		3		1	1	1	1
CO3		2		2							3		1	1		

List of Experiments:

1. Study of IC engine testing dynamometers
2. Study of 2 wheeler chassis dynamometer
3. Study of 4 wheeler chassis dynamometer
4. Study of Wheel Balancing and Wheel Alignment
5. Study of pressure pickup, charge amplifier, storage oscilloscope and signal analyzers used for IC engine pressure testing
6. Testing of 2 wheeler with chassis dynamometer.
7. Testing of 4 wheeler with chassis dynamometer.
8. On road testing of vehicles for Braking, Acceleration, Fuel Economy in 2 wheeler.
9. On road testing of vehicles for Braking, Acceleration, Fuel Economy in 4 wheeler.
10. Measurement of HC, CO, CO_2, O_2 and NOx using exhaust gas analyzer in 2 wheeler.
11. Measurement of HC, CO, CO_2, O_2 and NOx using exhaust gas analyzer in 4 wheeler.
12. Diesel smoke measurement.

Reference(s):

1. Manufacturer's Manual
2. Giles J.G, "Vehicle Operation and performance", Iliffe Books Ltd., London,1989.
3. Crouse W.H, Anglin D.L, "Motor Vehicle Inspection", McGraw Hill Book Co.,1978. Digitized 15 Dec 2007

AUT18R481 Modelling and Simulation Laboratory	**L**	**T**	**P**	**Credit**
	0	**0**	**2**	**2**
Pre-requisite-	**Course Category:** Program Core **Course Type**: Laboratory course			

Course Objective(s):
To develop skill to use CAD software to create 2D, 3D Part drawings and simulate.

Course Outcome(s):
After completing this course, the student will be able to:

CO1: Students able to understand the system concept and apply functional modeling, Method to model the components
CO2: Simulate the operation of static, dynamic and thermal systems and make improvement according to the simulation results
CO3: Students able to analyse the failure and deformation of particular component

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3		1						3		3	1		1
CO2		3	3		3			1		2	2		2	1	1	2
CO3		3	3		3			1		2	2		2	1	1	2

List of Experiments:

1. Introduction of Modelling Software, Formatting of 2D and 3D objects CREO / CATIA / NX
2. 3D Part Modeling – Protrusion, cut, sweep, draft, loft, blend, rib, round, chamfer Editing- Move, Pattern, Mirror Assembly
3. Creating assembly from parts-assembly constrains Conversions of 3D solid model to 2D drawing
4. Stress analysis of a plate with a circular hole.
5. Stress analysis of rectangular L - bracket
6. Stress analysis of an axi-symmetric component
7. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
8. suspensions Simulations
9. Finite Element Modelling (FEA) and failure analysis Stress, deformation calculations

Software Requirements:

ANSYS Workbench 2018, CATIA V6, PTC Creo 2.0, NX 8.5

III – ELECTIVE COURSES

Professional Electives

AUT18R203 Mechanics of Machines	L	T	P	Credit
	3	0	0	3
Pre-requisite: MEC18R211- Engineering mechanics	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

The course provides brief knowledge on various mechanisms.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the concept of various mechanisms and its uses
CO2: Understand the concept of friction, belt and rope drives.
CO3: Use the Knowledge of MOM to design gear and cam.
CO4: Isolate and Balance the vibrations occur in a machine.
CO5: Identify and isolate the vibrations in a machine.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2			2			2			2		2	1	1		2
CO2	1	2		1						2			1	1		1
CO3	2	2			1							1	2	1		1
CO4	1									2		1	1			1
CO5	1	1		2			3						1	1	1	

Unit 1: Mechanisms **9 Hours**

Introduction, Machine, Structure, Kinematic link, Pair and Chain, Constrained motion, Degrees of freedom, Gruebler's criteria, Four bar chain, single slider crank chain, double slider crank chain and its inversions, applications

Unit 2: Belt, Rope and Chain Drives **9 Hours**

Introduction, Selection of a belt drive, Types of belt drives, Types of belts, Types of flat belt drives, Velocity ratio, Slip, Creep, Length of open and cross belt drive, Power transmitted by a belt, Ratio of belt tensions, Angle of contact, Centrifugal Tension, Maximum Tension, Condition for transmission of maximum power.

Unit 3: Gearing and Cams **9 Hours**

Introduction, Classification of Gears, Terms used in Gears, Law of gearing, Velocity of Sliding, Forms of Teeth, Length of path of contact, Length of arc of contact, Contact ratio, Gear trains, Types of gear trains, Velocity ratio, Cam profile, Different types of followers.

Unit 4: Balancing **9 Hours**

Introduction, Balancing of rotating masses, Single and several masses in same and different planes, Balancing of reciprocating masses, Primary and secondary balancing of reciprocating masses, Partial balancing of Locomotives, Variation of tractive force, Swaying couple, Hammer blow, Single and multi cylinder engines, Inline, V and W arrangements of engines.

Unit 5: Vibration **9 Hours**

Introduction, Terms used in vibratory motion, Types of vibratory motion, Types of free vibrations, Natural frequency of longitudinal and transverse vibrations, Whirling speed of shaft, Damping, Vibration Isolation, Torsional vibrations, Natural frequency of Torsional vibrations.

Text book(s):

1. R.K. Bansal and J.S. Brar, Theory of Machines, Laxmi Publications, 2016.

Reference(s):

1. John J. Uicker, Jr., Joseph E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 2016.
2. R.S. Khurmi and J.K.Gupta, Theory of Machines, S. Chand Publishers, 2015.

AUT18R204 Alternate Fuels and Energy Systems	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To study about the Alternate Fuels and Energy Systems. It enhances the technical knowledge in alternate fuel for automotive vehicle. It also helps to understand the concepts and method used for Energy Systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the sources of Alternate Fuels.

CO2: Apply the chemistry of alternate fuels in internal combustion engine.

CO3: Describe the performance and emission characteristics of alternate fuels after combustion.

CO4: Choose the combustion techniques to reduce the formation of pollutants and increase the performance of vegetable oil.

CO5: Identify the automotive devices and methods to design the electric, hybrid and solar powered vehicle.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1			3	1						2		1	1		1
CO2	3	3		1	2								2	1		
CO3		3			3				1	2	1		1	1		1
CO4		3		1	2					1			1	1		
CO5	3			2					1	1	1		1	1		1

Unit 1: Introduction **9 Hours**

Estimation of petroleum reserve - Need for alternate fuel - Availability and properties of alternate fuels - general use of alcohols - LPG - Hydrogen - Ammonia, CNG, and LNG - Vegetable oils and Biogas - Merits and demerits of various alternate fuels. Introduction to alternate energy sources. Like EV, Hybrid, Fuel cell and solar cars

Unit 2: Alcohols and Oxygenates **9 Hours**

Properties as engine fuel, alcohols and gasoline blends, performance in SI engine. Methanol and gasoline blends - Combustion characteristics in engines - emission characteristics, Oxygenate, Performance in SI & CI engines.

Unit 3: Natural Gas, LPG, Hydrogen and Biogas **9 Hour**

Availability of CNG, properties, modification required to use in engines - performance and emission characteristics of CNG using LPG in SI & CI engines. Performance and emission for LPG - Hydrogen - Storage and handling, performance and safety aspects

Unit 4: Vegetable Oils **9 Hours**

Various vegetable oils for engines - Esterification - Performance in engines - combustion and emission characteristics - Bio diesel and its characteristics

Unit 5: Electric, Hybrid, Fuel Cell and Solar Powered Vehicles **9 Hours**

Layout of an electric vehicle - Advantage and limitations - Specifications - System component. Electronic control system - High energy and power density batteries - Hybrid vehicle - Fuel cell vehicles - Solar powered vehicles.

Text book(s):

1. Richard.L.Bechfold - Alternative Fuels Guide Book - SAE International Warrendale 199, Digitized 4 Jan 2008

Reference(s):

1. Michael F. Hordeski, "Alternative Fuels: The Future of Hydrogen", The Fairmont Press, Inc., 2008.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. "Society of Automotive Engineers", Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000.
4. Thipse S. S, "Alternative Fuels: Concepts, Technologies and Developments", Jaico Publishing House, 2010.
5. Maheswar Dayal, "Energy today & tomorrow ", I & B Horishr India, 1982.
6. Bechtold. R.L., "Alternative Fuels Guide Book ", SAE, 1997.

AUT18R205 Modern Vehicle Technology	L	T	P	Credit
	3	0	0	3

Pre-requisite: AUT18R274 – Automotive Engines	**Course Category**: Professional Elective **Course Type**: Theory

Course Objective(s):

To impart knowledge about the latest developments in Vehicle Technology

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the recent trends in power plants.

CO2: Explain about recent development in vehicle suspension, Brakes, and Safety in automobiles

CO3: Analyse the various Noise and pollution in automobiles

CO4: Explain the modern Vehicle operation and control using microcontrollers

CO5: Basic knowledge in Vehicle automation systems

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2												1			
CO2							2								1	
CO3			3		2								1	1		
CO4			3		2								1			
CO5	2		3				1						2		1	

Unit 1: Introduction **9 Hours**

Hybrid vehicles - Stratified charged / learn burn engines - Hydrogen engines - battery vehicles – Electric propulsion with cables - Magnetic track vehicles.

Unit 2: Suspension Brakes and Safety **9 Hours**

Air suspension - Closed loop suspension – anti skid braking system, Retarders, Regenerative braking safety cage - air bags - crash resistance - passenger comfort.

Unit 3: Noise & Pollution **9 Hours**

Reduction of noise - Internal & external pollution control through alternate fuels / power plants – Catalytic converters and filters for particulate emission.

Unit 4: Vehicle Operation and Control **9 Hours**

Computer Control for pollution and noise control and for fuel economy - Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.

Unit 5: Vehicle Automated Tracks **9 Hours**

Preparation and maintenance of proper road network - National highway network with automated roads and Vehicles - Satellite control of vehicle operation for safe and fast travel.

Text book(s):

1. " Bosch Automotive Hand book ", 7th Edition, SAE, 2007.

Reference(s):

1. Beranek.L.L. “Noise Reduction ", Peninsula Publishing Co., 2010.

AUT18R206 Advanced Theory of IC Engines	L	T	P	Credit
	3	0	0	3
Pre-requisite: AUT18R274- Automotive Engines	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To gain knowledge about the working of I.C engines and the phenomena of combustion and modelling.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To gain knowledge on different operating cycles of an IC engine

CO2: Acquire the information on fuels and their properties related to combustion in engine

CO3: To learn about different engines which are specially used on marine and locomotives

CO4: To know about the performance of the IC engines.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1		3			3		2						1	2		
CO2		2	2					3	3				2		2	
CO3				3							3			1		1
CO4				1					3	2	3			1	1	2
CO5		2		3				1	2	3	3		1	1	1	2

Unit 1: Cycle Analysis **9 Hours**

Operating cycles of S.I. and C.I. engines and Gas turbines - Comparison of Air standard cycle - Fuel air cycle and actual cycle.

Unit 2: Combustion of Fuels **9 Hours**

Combustion stoichiometry of petrol, diesel, alcohol and hydrogen fuels - Chemical energy and heating values -Chemical equilibrium and maximum temperature - SI engine combustion - Flame velocity and area of flame front - CI engine combustion. Fuels spray characteristics - droplet size, penetration and atomization.

Unit 3: Advances in IC Engines **9 Hours**

Adiabatic and L.H.R. engines - MAN combustion chamber and multifuel engines - Stratified charged and lean burn engines - Locomotive and marine engines.

Unit 4: Operation and Performance **9 Hours**

Computer control of engine parameters for pollution control and better efficiency - Closed loop control of engine parameters - Hybrid operation - performance maps.

Unit 5: Electronic Engine Management **9 Hours**

Computer control of SI & CI engines for better performance and low emissions, closed loop control of engine parameters of fuel injection and ignition

Text book(s):

1. Ganesan.V., " Internal combustion engines ", Tata McGraw Hill Publishing Co, 2012.

Reference(s):

1. Ganesan.V., " Computer Simulation of Spark Ignition engine process ", Universities Press (India) Ltd, Hyderabad, 1996.
2. John.B., Heywood, “Internal Combustion Engine Fundamentals ", McGraw Hill Publishing Co., New York, 1990.

AUT18R304 Unconventional Engines and Hybrid Vehicle	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite:-	**Course Category:** Program Core **Course Type**: Elective			

Course Objective(s):
The aim of undergoing this course is to develop basic understanding about the production of automotive fuels and lubricants. Special emphasis is also given on how these fuels and lubricants affect the performance and functioning of an internal combustion engines.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand the construction and working of Stirling engine.
CO2: Understand the working concepts and construction of Wankel and VCR Engine.
CO3: Describe the concept of free piston engine and its application
CO4: Understand the basic working principle of Electric and Hybrid vehicle
CO5: Know the uses Fuel cell and solar penal for automotive applications.

Mapping of Course Outcome(s):

CO /	PO												**PSO**			
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO6		1		1				2					1	1	1	
CO7	2	2		2	2								1	1		
CO8				2	2									1		
CO9	1			1			1						1	1		
CO10	2	2		1	1		1	1					2	1	1	

Unit 1: STIRLING ENGINE **9 Hours**
Working Principle, two piston engine, control system, fuel requirement, emissions, merits and demerits, applications

Unit 2: WANKEL ENGINE &VCR ENGINE **9 Hours**
WANKEL ENGINE: Special features, construction and working, engine sealing, lubrication and cooling, fuel requirement and combustion, performance, emissions, merits and demerits, applications.
VARIABLE COMPRESSION RATIO ENGINE: Necessity, theoretical analysis, different methods.

Unit 3:FREE PISTON ENGINE **9 Hours**
Different types, construction and working, stability and speed of pistons, performance, merits and demerits, applications

Unit 4: ELECTRIC & HYBRID VEHICLES **9 Hours**
Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy, and power density batteries, hybrid vehicle–types, merits and demerits.

Unit 5: FUEL CELLS & SOLAR CARS **9 Hours**

Fuel cell, Structures, construction, working, Operations, and properties of Fuel cells – possible fuel sources, (Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Molten Carbonate Fuel Cell) equations, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and cost comparison.

Text book(s):

1. Mathur L and Sharma R P, ―Internal Combustion Engines‖ DhanpatRai Publications(P), Ltd., 2016. (Unit – I, II, III, IV & V)

2. MehrdadEhsani, YiminGao, sebastien E. Gay and Ali Emadi, ―Modern ,HybridElectric and Fuel Cell Vehicles: Fundamentals, Theory and Design□, CRSPress,2010.(Unit – IV & V)

Reference(s):

1. H N Gupta, ―Internal combustion engines‖ , PHI Learning Pvt Ltd., 2013. (Unit – I, II,III, IV & V)

2. V. Ganesan, ―Internal Combustion Engines‖ , Tata McGraw Hill Publishing Company,New Delhi, 2016. (Unit – I, II, III & IV)

3. Tom Denton, ―Electric and Hybrid vehicles‖ , Taylor & Francis group., 2016. (Unit – IV& V)

4. Chris Mi; M. AbulMasrur& David WenzhongGao,―Hybrid Electric Vehicles:Principles and Applications with Practical Perspectives□, John Wiley & Sons ltd., 2011.(Unit IV & V)

5. James Larminie and John Loury, ―Electric Vehicle Technology-Explained□, John Wiley& Sons Ltd., 2003. (Unit – V)

AUT18R207 Automotive Electrical and Electronics Systems	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: EEE18R172 - Basic Electrical Engineering	**Course Category:** Professional Elective **Course Type**: Theory			

Course Objective(s):

To understand the concepts behind the electrical and electronics instruments in an automobile and to get practical knowledge.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the fundamentals of electrical and electronics systems.
CO2: Understand the concept of battery, sensor and actuators operation and its necessity
CO3: Examining the working of starting system and charging system of automotive.
CO4: To analyse engine ignition system characteristics.
CO5: Recognize and understand the different wiring diagrams used in automobile manuals.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3		3									1	2			
CO2		2			1		3		2				2	1	2	1
CO3	3							1					1		1	
CO4			3			1			2				1	1	1	1
CO5				1								2		1		1

Unit 1: Fundamental of Electrical & Electronics **9 Hours**

Vehicle systems - Open loop systems - Closed loop systems - Electrical wiring, terminals and switching - Colour codes and terminal Designations - Printed circuits - Fuses and circuit breakers – Switches - Multiplexed wiring systems - Components for electronic engine management. Electronic management of chassis system - Vehicle motion control.

Unit 2: Batteries, Sensors and Actuator **9 Hours**

Principle and construction of lead-acid battery - Characteristics of battery – rating - capacity and efficiency of batteries - Various tests on battery condition - charging methods - Details of modern storage batteries. Sensors - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, solenoids, stepper motors, relays.

Unit 3: Starting System & Charging System **9 Hours**

Condition of starting Behaviour of starter during starting - Series motor and its characteristics - Principle & construction of starter motor - Working of different starter drive units - Care & maintenance of starter motor - Starter switches. Function - Components of DC and AC Charging System for Automobile – construction -

operating principle - characteristics, charging circuit controls – cut out, relays, voltage and current regulators – troubleshooting.

Unit 4: Ignition System **9 Hours**

Types, construction & working of battery coil-magneto ignition systems. Relative merits – centrifugal and vacuum advance mechanisms – Types and construction of spark plugs – Electronic Ignition systems – Digital ignition systems - Electronic control of carburation - Distributor less ignition.

Unit 5: Lighting System & Accessories **9 Hours**

Insulated earth returns systems - Positive & negative earth systems. Details of head light & side light - Head light dazzling preventive methods - Electrical fuel-pump, Speedometer - Fuel, oil & temperature gauges – Horn - Wiper system - wiring system. (Accessories) - Parking assit, Button starter - Satellite navigation - Electronic dash board instruments.

Text book(s):

1. Tom Denton., Automobile electrical and electronic systems, Elsevier Butterworth-Heinemann, 3rd revised edition 2013.

Reference(s):

1. Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
2. Young, A.P. & Griffiths,L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.
3. Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi, 1975
4. Vinal, G.W., Storage Batteries, John Wiley & Sons Inc., New York, 1985.

AUT18R306 Instrumentation and Metrology	L	T	P	Credit
	3	0	0	3
Pre-requisite: AUT18R171 - Basic Instrumentation	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To study about the metrology about liner measuring and angular measuring Instruments
- To know about the various special purpose machine and their operation.
- To give exposure to various precision measuring instruments.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Measure the given mechanical elements and assemblies using linear and angular analog /digital measuring instruments.

CO2: Measure and derive important dimensions of various thread forms and gears.

CO3: Explain surface roughness checking instruments and check the dimensions using the gauges

CO4: Apply the concept of measurements in inspecting various parameters.

CO5: Select and measure variables using appropriate sensors and transducers.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3				3								1	1		
CO2		3			2			2			2		1	1		1
CO3			3									3	1			1
CO4	1	1				3				2			1	1		1
CO5	3				3								1	1		

Unit 1: Linear and Angular Measurements **9 Hours**

Errors in measurement & calibration - Length standards - Length measuring instruments - Vernier, micrometers, dial gauges, comparators, Limits, fits, tolerances. Gauges and their types - Angular measuring instruments - bevel protractor, spirit level, sine bar - measurement of straightness anf flatness - Measurement of surface finish.

Unit 2: Measurement of Screw Thread and Gear **9 Hours**

Various elements of thread - Two wire & three wire method - thread gauge - Various elements of gears - Various gear tooth measurement methods, composite error measurement.

Unit 3: Pressure & Flow Measurement **9 Hours**

Diaphragm - various elastic elements - Transduction methods - Potentiometric strain gauge, variable reluctance and capacitive device, LVDT type transducer, piezo electric transducers and its application to high speed engine. Farnboro Engine indicator.Low pressure measurement - McLeod gauge, pirani gauge, thermocouple type conductivity gauge. Classification of flow meters - Orifice plate, venturimeter, flow nozzles, pitot tubes, rotameter, electromagnetic flow meters, anemometers, ultrasonic and magnetic flow meters, alcolck viscous flow meter.

Unit 4: Temperature Measurement **9 Hours**

Temperature scales - Mechanical temperature sensors - liquid in glass, vapour pressure, bimetal - resistance type temperature sensors and their measuring circuits - Thermistors, thermocouples, laws, types, construction, circuits - Radiation methods - Optical pyrometer

Unit 5: Load and Torque Measurement **9 Hours**

Force measuring devices, balances, platform scale weigh bridges, load cells. Torque measurement, prony brake, rope brake. Dynamometers. Electric cradle dynamometer, Eddy current dynamometers.Hydraulic dynamometer, Transmission and chasis dynamometer.

Text book(s):

1. Jain.R.K., " Engineering Metrology " Khanna Publishers, New Delhi, 1994.
2. Rangan.C.S., Sarma.G.E. and Mani.V.S.V., " Instrumentation Devices and Systems" Tata McGraw Hill Publishing Co., New Delhi, 1990.

Reference(s):

1. Patranabis.D, “Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Co., New Delhi, 1996.
2. Beckwith.T.G. & Buck.N.L., “Mechanical Measurements", Oxford and IBH Publishing, New Delhi, 1990.
3. Jain.R.K., " Mechanical & Industrial Measurements ", Khanna Publishers, New Delhi, 1990.
4. Gaylor.F.W. and Shotbolt.C.R., " Metrology for Engineers ", ELBS Edition, 1990.
5. Khare and Vajpayee, “Dimensional Metrology ", Oxford IBH Publishing Co, New Delhi, 1990.

AUT18R307 Microprocessor Application in Automobiles	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R171 - Basic Instrumentation	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To make student to understand the operations of microprocessor and its language programming, interfacing devices

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To recognize different types of microprocessor and its architecture.

CO2: To understand the function of 8085 MPU-T-STATE instruction set.

CO3: To acquire knowledge in microprocessor language programming.

CO4: To appraise various type of interrupt data transfer schemes.

CO5: To dramatize temperature control, stepper motor control in automotive applications.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3												1			
CO2	1	2											1			
CO3					1									1		
CO4										1						1
CO5									2		3				1	1

Unit 1: Architecture **9 Hours**

General 8 bit microprocessor and its architecture 8085, Z-80 and MC 6800 MPU and its pin function - Architecture - Function of different sections.

Unit 2: Instruction Set **9 Hours**

Instruction format - addressing modes - instruction set of 8085 MPU-T-STATE - Machine cycle and instruction cycles - Timing diagrams - Different machine cylces - Fetch and execute operations - estimation of execution times.

Unit 3: Assembly Language Programming **9 Hours**

Construct of the language programming - Assembly format of 8085 - Assembly Directive - Multiple precision addition and subtraction - BCD to Binary and Binary to

BCD, Multiplication, Division, Code conversion using look up tables - Stack and subroutines.

Unit 4: Data Transfer Schemes **9 Hours**

Interrupt structure - Programmed I/O - Interrupt driven I/O, DMA - Serial I/O.

Unit 5: Interfacing Devices and Applications **9 Hours**

Types of interfacing devices - Input / Output ports 8212, 8255, 8251, 8279. Octal latches and tristate buffers - A/D and D/A converters - Switches, LED's ROM and RAM interfacing.

Data acquisitions - Temperature control - Stepper motor control - Automotive applications Engine control, Suspension system control, Driver information systems), Development of a high speed, high precision learning control system for the engine control.

Text book(s):

1. Ramesh, Goankar.S. “Microprocessor Architecture Programming and Applications ", Wiley Eastern Ltd., New Delhi, 1986.

Reference(s):

1. Aditya.P.Mathur, “Introduction to Microprocessors ", III Edition, Tata McGraw-Hill Publishing Co Ltd., New Delhi, 1989.
2. Ahson.S.I. “Microprocessors with Applications in Process Control ", Tata McGraw-Hill, New Delhi, 1986.
3. SAE Transactions, 1986 Sec 3.
4. Jabez Dhinagar.S., “Microprocessor Application in Automoblies ".
5. L.Bianco and A.Labella., "Automotive Micro Electronics ", Elsevier science publishers. 1986.

AUT18R308 Automotive Embedded System	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R171 - Basic Instrumentation	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To support the automotive parts industry by focusing on the electronics control system and relevant software. To constantly strengthen our human resources.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Design and develop automotive embedded systems.

CO2: Analyze various embedded products used in automotive industry.

CO3: Evaluate the opportunities involving technology, a product or a service required for developing a start-up idea used for automotive applications

CO4: Will be able to interface devices and build a complete system.

CO5: Develop Communication systems for automotive applications.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2		2		1					3			1	1		1
CO2	3		1	2					1				1		1	
CO3		1		2	3		2		2	1			1	1	1	1
CO4	1						2			1			1		1	1
CO5						3	2	1						1	1	

Unit 1: Electronics in the Automobile **9 Hours**

Introduction- Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR, ESP passive safety systems: Restraint systems and their associated sensors in an automobile. Powertrain Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems navigation systems multimedia systems cross application technologies. 42V vehicle power supply system

Unit 2:Drive By Wire **9 Hours**

Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-bye wire, gas-by-wire, power-by-wire, shift by wire.

Unit 3: Hardware Modules **9 Hours**

Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering vehicle speed sensors and destination sensors, Attitude sensor, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, solenoids, stepper motors, relays

Unit 4: Electronic Ignition Systems

Electronic ignition systems. Types of solid state ignition systems and their principle of operation Digital engine control system. Open loop and closed loop control system, Engine cranking and warm up control. Acceleration enrichment.

Deceleration learning and ideal speed control Distributor less ignition – Integrated engine control system, Exhaust emission control engineering

Unit 5: Automotive Embedded System **9 Hours**

Automotive Embedded systems. PIC, Freescale microcontroller based system. Recent advances like GLS, GPSS, GMS. Multiprocessor communication using CAN bus. Case study- cruise control of car.Artificial Intelligence and engine management.

Text book(s):

1. "Embedded System Design: A unified Hardware / Software Introduction" – Frank Vahid and Tony Givargis, Wiley India Publishers.

Reference(s):

1. "A Practical Introduction to Hardware/Software Co-Design"- Patrick R. Schaumont, Springer Publishers.

AUT18R309 Automotive Aerodynamics	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category:** Professional Elective **Course Type**: Theory			

Course Objective(s):
To impart knowledge on the structure, properties, treatment, testing and applications automobile components and parts.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Summarize the flow related parameters and problems around a vehicle
CO2: Interpret the aerodynamic drag around a car.
CO3: Explain the ways available to optimize the shape to get an aesthetic and stylish look to a car considering the modifications to be done
CO4: Analyze the various aerodynamic forces around a vehicle to reduce the drag in commercial vehicles
CO5: Evaluate the pressure, velocity and other forces around a vehicle using its scale model with the help of wind tunnel testing

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1						1			1					1	1	
CO2		2		1									1	1		
CO3		3			2				1				1	1	1	
CO4		3							1				1		1	
CO5	2								1				1		1	

Unit 1: Introduction **9 Hours**
Scope - historical development trends - Fundamental of fluid mechanics - Flow phenomenon related to vehicles - External & Internal flow problem - Resistance to vehicle motion - Performance - Fuel consumption and performance - Potential of vehicle aerodynamics.

Unit 2: Aerodynamic Drag of Cars **9 Hours**
Cars as a bluff body - Flow field around car - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic

development - low drag profiles.

Unit 3: Shape Optimization of Cars **9 Hours**

Front end modification - front and rear wind shield angle - Boat tailing - Hatch back, fast back and square back - Dust flow patterns at the rear - Effects of gap configuration - effect of fasteners.

Unit 4: Vehicle Handling **9 Hours**

The origin of forces and moments on a vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics Under side winds - the effects of forces and moments - Characteristics of forces and moments - Dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles

Unit 5: Wind Tunnels for Automotive Aerodynamic **9 Hours**

Introduction - Principle of wind tunnel technology - Limitation of simulation - Stress with scale models – full scale wind tunnels - measurement techniques - Equipment and transducers - road testing methods – Numerical methods

Text book(s):

1. Hucho.W.H., “Aerodynamic of Road vehicles ", Butterworths Co. Ltd., 1997.

Reference(s):

1. Pope. A., " Wind Tunnel Testing ", John Wiley & Sons, 2nd Edn, New York, 1974.
2. Automotive Aerodynamic : Update SP-706, SAE, 1987.
3. Vehicle Aerodynamic, SP-1145, SAE, 1996.

AUT18R310 Chassis Component Design	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R271 – Automotive Engines	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To make the students understand the basic principles involved in the computer aided vehicle design and apply the same for the optimum designing of the vehicle Components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Utilization of computer tools to design the vehicle frame and suspension system

CO2: Development of model of vehicle axle and the steering system with computer aided design

CO3: Creating computer aided design for the clutch and its components.

CO4: To learn about the design of Gear system with modelling in computer

CO5: Computer aided design of the propeller shaft and the rear axle housing are created

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1						2				3		1		1	1	1
CO2			2	3		1			1	3		2	1	1	1	2
CO3	3		2						1	2	3		2			2
CO4	2	3								1	3		2			1
CO5										1	3					1

Unit 1: Vehicle Frame and Suspension **9 Hours**

Study of loads - moments and stresses on frame members. Computer aided design of frame for passenger and commercial vehicle - Computer aided design of leaf springs - Coil springs and torsion bar springs.

Unit 2: Front Axle and Steering Systems **9 Hours**

Analysis of loads - moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of bearings. Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

Unit 3: Clutch **9 Hours**

Torque capacity of clutch. Computer aided design of clutch components, Design details of roller and sprag type of clutches

Unit 4: Gear Box **9 Hours**

Computer aided design of three speed and four speed gear boxes.

Unit 5: Drive Line and Read Axle **9 Hours**

Computer aided design of propeller shaft. Design details of final drive gearing. Design details of full floating. semi-floating and three quarter floating rear shafts and rear axle housings.

Text book(s):

1. Giancarlo Genta, L. Morello , “The Automobile Chassis: Volume 2", Springer, 2009.

Reference(s):

1. Heldt.P.M., “Automotive Chassis ", Chilton Co., New York, 2008.
2. Steeds.W., “Mechanics of Road vehicles ", llliffe Books Ltd., London, 2004.

AUT18R311 Theory and Design of Jigs and Fixtures	L	T	P	Credit
	3	0	0	3
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To impart the knowledge on Jigs and Fixtures
- To learn about design methodology of the jigs and fixtures

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the principles, functions and design practices of Jigs, Fixtures and dies for press working

CO2: To understand the Principles of jigs and fixtures design, locating principles, locating elements and clamping Devices.

CO3: To understand the loading and unloading problems in the jigs and fixtures.

CO4: To know about the various types of the bushes employed in design of the jigs and fixtures.

CO5: To study about the design principles of the jigs and the fixtures.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3				2				3	3			1	1	1	1
CO2				3						3				1		1
CO3		3		2	3								1	2		
CO4				2										1		
CO5	3				3					3			1		1	1

Unit 1: Introduction **9 Hours**

Definitions of Jigs and Fixtures - Principles of Jigs and Fixtures design - Preliminary analysis and planning of jigs and fixture parts and their materials - Basic steps in the design of jigs and fixtures - Advantages of Jigs & Fixtures.

Unit 2: Location and Clamping **9 Hours**

Degrees of freedom - 3-2-1 location principle - Radial location and diamond pin location - Principle of pin location - location from plane surfaces - location from a profile - location from a cylinder - Circular location - Jamming and remedies - V location - Adjustable locators - Redundant locators - Fool proofing – Adjustable supports and centralizers Strap clamp - cam clamps - screw clamping - latch clamps - wedge clamps – pivoted clamps - eccentric operator clamp - power clamps quick acting Clamps - Equalizers.

Unit 3: Loading and Unloading Problems **9 Hours**

Loading - Entering, locating and clamping symmetric consideration. Unloading - Bur clearance, ejectors, receivers, chip problems, relief and projection, shields and seals.

Unit 4: Cutter Guidance **9 Hours**

Various types of setting blocks - Press fit bushes - Renewable bushes - Slip bushes - Threaded bushes – Special bushes - Drills with attached bushing for small holes.

Unit 5: Design of Jigs and Fixtures **9 Hours**

Three construction principles - Builtup type, casting and weldment Practising the various types of jigs - Practising the various types of milling fixtures - broaching fixtures - function of broaching fixtures - Internal and external broaching fixtures.

Text book(s):

1. K.Venktaraman., " Design of jigs, fixtures and press tools", Wiley, 2015.

Reference(s):

1. P.H.Joshi., " Jigs and Fixtures Design Manual" Mc Graw Hill, 2003.
2. Dr. John G. Nee, "Fundamental of Tool design ", Society of Manufacturing Engineers, 2010.

AUT18R312 Noise, Vibration and Harshness	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

This course reviews the fundamental concepts of acoustics, noise propagation and vibrations. Focus is given to the theory and equipment pertaining to the measurement of automotive acoustics, sound quality and vibration.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand fundamental noise and vibration theory

CO2: Understand measurement instrumentation, techniques and metrics used f or Automotive NVH.

CO3: Perform noise measurements and analyze sound for automotive applications.

CO4: Explain fundamental principles of sound quality and vibration modal analysis.

CO5: Apply control system to reduce the noise, vibration and harshness.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	3							1		2		2		1	1
CO2	2	2		3				1					2	1	1	
CO3		3		2			1		1				1	1	1	
CO4		1		2				3	1				1	1	1	
CO5			2	3				1			2		1	1	1	1

Unit 1: Basics of Vibration Analysis **9 Hours**

Noise, Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles. Basic concepts, mathematical models, formulating the equations of motion - linear and torsion system characteristics and response – damped and undammed single & two degree of freedom system sunder harmonic force, coordinate coupling, generalized coordinates and modal analysis.

Unit 2: Vibration Control Techniques **9 Hours**

Vibration isolation, tuned absorbers, unturned viscous dampers, damping treatments, Applications: isolation of the engine from vehicle structure and control of torsional oscillation amplitudes in engine crankshaft.

Unit 3: Noise Fundamentals **9 Hours**

Fundamentals of acoustics – general sound propagation – structure borne sound & airborne sound, Plane wave propagation- wave equation, specific acoustic impedance, acoustic intensity, Spherical wave propagation– acoustic near and far fields, Reference quantities, The decibel scale, relationship among sound power, sound intensity and sound pressure level, summation of pure tones, Decibel addition, subtraction and averaging, Effects of reflecting surfaces on sound propagation, octave and analysis, Anatomy of Human Ear, Mechanism of hearing, loudness, weighting networks, equivalent sound level.

Unit 4: NVH Measurements **9 Hours**

Vibration and Noise Standards – Pass/Drive by noise, noise from stationary vehicles, interior noise in vehicles, NVH measurement tools and techniques, Modal parameter (natural frequency, mode shape and damping) estimation techniques, signal and system analysis.

Unit 5: Automotive Noise Sources and Control Techniques **9 Hours**

Methods for control of engine noise, Transmission Noise, Intake and Exhaust Noise, AerodynamicNoise,TyreNoise,Brakenoise.Noisecontrolstrategy,noise controlatsource–alongthepath–isolation,damping,balancing,resonators, absorption, barriers and enclosures.

Text book(s):

Matthew Harrison, "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier, 2004.

Reference(s):

1. Bell, L. H. and Bell, D. H., "Industrial Noise Control – Fundamentals and Applications", Marcel Dekker Inc, New York, 1994.
2. Xu Wang, "Vehicle Noise and Vibration Refinement", CRC Press, 2010
3. Ambekar, A. G., "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi, 2006.
4. Beranek, L. L. and Ver, I, L., "Noise and Vibration Control Engineering – Principles and Application", John Wiley & Sons, Inc, 1992.
5. Wilson, C. E., "Noise Control – Measurement, Analysis, and Control of Sound and Vibration", Harper & Row Publishers, New York, 1989.

6. Thomson, W. T., "Theory of Vibrations with Applications", CBS Publishers Delhi

AUT18R313 Vehicle Body Engineering	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Professional Elective **Course Type**: Theory			

Course Objective(s):
The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, panelling of passenger car body trim. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand various category of car frames
CO2: Understand various types of bus body frames and their construction
CO3: Understand the Vehicle ergonomics to provide at most comfortable position for driver and passenger in commercial vehicles
CO4: Explain the various aerodynamic effects of vehicle body under different loading conditions
CO5: Describe the various materials and methods used in body constructions and finishing

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	1	1				2	1		2	3	1	1	1
CO2	3		3	2			1	2		2		2	3	1	1	2
CO3	3						1			2		2	1		1	2

CO4	3	1		2					2	1	2	2	2	1	1	2
CO5	2								1		1		1		1	1

Unit 1: Car Body **9 Hours**

Passenger Cars – Types, basic dimensions - driver's seat, Visibility regulations - Driver's visibility, tests for visibility, Methods of improving visibility and space in cars - Safety: shape of the vehicle, safety design. Safety equipment for cars, Car body construction.

Unit 2: Bus Body **9 Hours**

Types: Mini bus, single decker, double decker, two level, split level and articulated bus. Bus body layout – Floor height - Engine location - Entrance and exit location - Seating dimensions. Constructional details: Frame construction, Double skin construction - Types of metal section used - Regulations - Conventional and integral type construction.

Unit 3: Commercial Vehicle **9 Hours**

Classification of commercial vehicle bodies.Construction of Tanker body and Tipper body. Dimensions of driver seat in relation to controls. Driver cabin design for compactness.

Unit 4: Vehicle Aerodynamics **9 Hours**

Objectives - Vehicle drag and types -various types of forces and moments - Effects of forces and moments - Side wind effects - Various body optimization techniques for minimum drag – Wind tunnel testing: Flow visualization techniques, Scale model testing, Component balance to measure forces and moments.

Unit 5: Body Materials, Trim and Mechanisms **9 Hours**

Steel sheet, timber, plastics, GRP, properties of materials – Corrosion – Anticorrosion methods – Selection of paint – Modern painting process in details – Body trim items – Body mechanisms.

Text book(s):

1. Powloski., " Vehicle Body Engineering ", Business Books Ltd., 1989.

Reference(s):

1. Giles. J. C. "Body construction and design ", lliffe Books Butterworth & Co., 1971.
2. John Fenton, "Vehicle Body layout and analysis ", Mechanical Engg Publication Ltd., London, 1982.
3. Braithwaite. J. B., "Vehicle Body building and drawing ", Heinemann Educational Books Ltd., London, 1977.

AUT18R207 Off Road Vehicles	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R274 - Automotive Engines	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

At the end of the course, the students will be able to understand the various Off road vehicle and their systems and features

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand Classification and requirements of off road vehicles

CO2: Describe the concepts of land clearing machinery.

CO3: Understand and apply the concept of various earth moving vehicle

CO4: Know the difference of operation of scrappers and graders.

CO5: Basic description about shovels and ditchers

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	3									2		2			1
CO2		3									2		1			1

CO3				3	3				2					3	1	
CO4		3		3							2		1	1		1
CO5					3									1		

Unit 1: Classification and Requirements of Off Road Vehicles **9 Hours**

Power plants, chassis and transmission, Tractors, Multi-axle vehicles.

Unit 2: Land Clearing Machines **9 Hours**

Bush cutter, stampers, Tree dozer, Rippers.

Unit 3: Earth Moving Machines **9 Hours**

Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, drag and self-powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.

Unit 4: Scrapers and Graders **9 Hours**

Scrapers, elevating graders, self-powered scrapers and graders.

Unit 5: Shovels and Ditchers **9 Hours**

Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.

Text book(s):

1. Wang.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York, 4th edition 2008.

Reference(s):

1. “Earthmoving Operations”, Department of the Army, Washington, DC 15 June 2000.
2. Abrosimov. K. Bran berg.A. and Katayer.K., " Road making Machinery ", MIR Publishers, Moscow, 1971.
3. Off the road wheeled and combined traction devices - Ashgate Publishing Co. Ltd. 1998.

AUT18R314 Two and Three wheeled Vehicles	L	T	P	Credit
	3	0	0	3
Pre-requisite: : AUT18R274 - Automotive Engines	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To develop the basic knowledge of the students in constructional details of two and three wheelers.
- To develop the skills of the students in the operating principles.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the working of two and four stroke engines.

CO2: Understand the functioning of clutch and gear box.

CO3: Know the wheels, tyres, suspensions and braking systems.

CO4: Familiarize the latest models of two wheelers.

CO5: Understand the operations of three wheelers and latest models of three wheelers.

Mapping of Course Outcome(s):

CO /	PO	PSO

PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1	3					2		2		2	1	1	1
CO2	2	1		3	1				2		2		1	1	1	1
CO3	1	3		1					3		2		2	1	1	1
CO4	1	2	2								3		2			1
CO5	2	3	1						2				2		1	1

Unit 1: The Power Unit **9 Hours**

Two stroke and four stroke SI engines, merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes – merits and demerits.Scavenging efficiency, scavenging pumps, rotary valve engine, fuel system, lubrication system. Magneto coil and battery coil spark ignition system, electronic ignition system, starting system- kick starting system

Unit 2: Chassis and Sub Systems **9 Hours**

Main frame – types. Chassis and shaft drive. Single, multiple plate and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems – shock absorbers. Panel meters and controls on handle bar

Unit 3: Brakes and Wheels **9 Hours**

Drum brakes, disc brakes, front and rear brake links layouts. Brake adjustment. Spoked wheel, cast wheel, disc wheel – disc types. Tyre and tube for two and three wheelers.

Unit 4: Two Wheelers **9 Hours**

Case study of major Indian models of scooters, motor cycles and mopeds like Bajaj, Honda, LML scooters, enfield, TVS, Suzuki, Hero, Yamaha. Servicing and maintenance

Unit 5: Three Wheelers **9 Hours**

Case study of Indian models. Front engine and rear engine auto rickshaws, pickup vans, delivery van and trailer.

Text book(s):

1. Irving. P. E., “Motor cycle engineering”, Clymer publications, London, 1973.

Reference(s):

1. The motor cycle manual, Temple press ltd., London, 1990
2. Marshall cavensih, Encyclopedia of motor cycling, 20 volumes, New York and London, 1989
3. Bryaut. R. V., Vespa Maintenance and Repair series

AUT18R315 Tractor and Farm Equipment	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To understand the trends in the tractors and farm equipments, their suspension, cooling system, lubrication system etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To gain knowledge on the tractor classification and its components

CO2: To acquire skills about the control of tractor and operation of its engine.

CO3: To know about the engine frame of tractor and the tractor mechanism

CO4: To understand about the cooling, lubrication and fuel system of a Tractor as well as farm equipment

CO5: To learn about the farm equipment construction and applications.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1		3							3				1		1	
CO2				3			2		2					1	1	
CO3			2	3	2				3		3	2	1	2	1	2
CO4							2		3	2	3	3		1	1	3
CO5		3								3	3	3	1			3

Unit 1: General Design of Tractors **9 Hours**

Classification of tractors - Main components of tractor - Safety rules.

Unit 2: Control of the Tractor and Fundamentals of Engine Operation 9 Hours

Tractor controls and the starting of the tractor engines - Basic notions and definition - Engine cycles – Operation of multicylinder engines - General engine design - Basic engine performance characteristics.

Unit 3: Engine Frame Work and Valve Mechanism Of Tractor **9 Hours**

Cylinder and pistons - Connecting rods and crankshafts - Engine balancing - Construction and operation of the valve mechanism - Valve mechanism components - Valve mechanism troubles.

Unit 4: Cooling System, Lubrication System and Fuel System of a Tractor 9 Hours

Cooling system - Classification - Liquid cooling system - Components, Lubricating system servicing and troubles - Air cleaner and turbo charger - Fuel tanks and filters - Fuel pumps.

Unit 5: Farm Equipments **9 Hours**

Working attachment of tractors - Farm equipment - Classification - Auxiliary equipment - Trailers and body tipping mechanism.

Text book(s):

1. Rodichev and G.Rodicheva, " Tractor and Automobiles ", MIR Publishers, 1984.

Reference(s):

1. Kolchin.A., and V.Demidov " Design of Automotive engines for tractor ", MIR Publishers, 1984.

AUT18R316 Automotive Safety	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

1. To broaden the understanding of role of safety systems in automobiles
2. To introduce vehicle structural crashworthiness and crash testing
3. To broaden the importance of ergonomics in automotive safety and human response to impact

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify different safety systems and its role in automobiles

CO2: Evaluate various errors and risks in crash testing

CO3: Determine vehicle structural crashworthiness

CO4: Determine injury thresholds and apply trauma for analysis of crash injuries

CO5: Understand the recent trends in automotive safety.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1					2	3	3	2	1					2	2	
CO2								2	3						2	
CO3				2	2	1	2	3						2	2	
CO4				1	2			2	2					1	2	
CO5				2	2				1					2	1	

Unit 1: Learning the Basics **9 Hours**

Understanding Regulatory and Warning Signs - Guide and International Signs - Understanding the Purpose of Pavement Markings - Responding to Traffic Control Signals -Building Math Skills - Basic Operating Procedures: Automatic Transmission - Basic Operating Procedures: Standard Transmission - Acceleration, Deceleration, and Speed - Learning How to Steer the Car, Building Map Skills.

Unit 2:Risk Evaluation **9 Hours**

Basic trilogy – Decision models -Balancing risks – Combining risks – Biological risk assessments –Human error analysis – Illustrative errors – Acceptable errors – Preventive measures.

Unit 3: Crash Testing **9 Hours**

Introduction – Volunteer testing – Cadaver testing – Dummies. Crashworthiness – Compliance testing – Component testing – Competitive race testing – Proving ground testing – In field testing.

Unit 4: Analysis and Reconstruction **9 Hours**

Vehicle Crush – Crash event sequence –Black box data – Momentum and energy – Injury Classifications – Isolation – Reputation - Bullet proof office on wheels – Pedestriants.

Unit 5: Future Vehicle Safety **9 Hours**

Human interaction – Distractions – Compensatory actions – Universal design – Precautionary principle – Dealer choice and restrictions –Local issues – Display integration – Adaptive head lights – Global warming and emissions –Design safety research

Text book(s):

1. “Automotive vehicle safety” By Barbara J. Peters, 2002, CRC Press, USA.

Reference(s):

1. Automotive safety” By Boy Scouts, USA, 1962
2. Bosch - “Automotive Handbook” - 5th edition - SAE publication - 2000.
3. Ronald.K.Jurgen - “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., - 1999.

AUT18R318 Vehicle Maintenance	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To make the student understand the need for vehicle maintenance and its importance
- To familiarize the maintenance procedure for various components of an automobile

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand about the records maintained in vehicles

CO2: To know about the auxiliary maintenance in automotive system

CO3: Understand about engine maintenance and management.

CO4: Apply the knowledge in chassis maintenance system

CO5: To know extensively about vehicle body maintenance and its importance

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2		2								2	1		
CO2	3		2		2				2		2		2	1	1	1
CO3		3				2							1	1		
CO4			2			1			2	3	3		1	1	1	2
CO5		3							2		3		1		1	1

Unit 1: Records and Schedule **9 Hours**

Maintenance Records and Schedule: Importance of maintenance, scheduled and unscheduled maintenance, preventive maintenance details, breakdown maintenance details vehicle log books, maintenance record forms, different service garages & its layout

Unit 2: Auxiliaries Maintenance **9 Hours**

Maintenance, Servicing of Auxiliaries: Cooling system service, radiator, water pump service aspect, anti corrosion additives, anti freezing solutions Petrol fuel and diesel fuel system maintenance, lubrication system service, engine oil change, engine oil topping up, oil filters maintenance, oil relief valve Chassis lubrication, lubrication charts, head light focusing and adjustment.

Unit 3: Engine Maintenance **9 Hours**

Maintenance, Repair and Overhauling of Engine: Dismantling of engine, cleaning, and checking of components visually and dimensionally, reconditioning methods of engine components, engine tune-ups, assembly of engine components, special tools used for maintenance, repair and overhauling of engine

Unit 4: Chassis Maintenance **9 Hours**

Maintenance, Repair and Overhauling of Chassis Drive-line Components: Servicing, repair & maintenance of clutch, maintenance, repair and servicing of gear box, servicing of propeller shaft, servicing and maintenance aspects of differential unit, servicing of front axle and rear axle, suspension system of both rigid and independent types, servicing of brake systems, hydraulic, air systems, brake bleeding and brakes adjustments, maintenance and servicing of steering system, wheel balancing, wheel alignment, maintenance of tyres, tyre rotation

Unit 5: Vehicle Body Maintenance **9 Hours**

Maintenance and Repair of Vehicle Body: Special tools used for body repair, minor body panel beating, tinkering of body works, polishing and painting of new and old vehicle body, servicing of door locks, passenger seat maintenance

Text book(s):

1. Knott and Phil Knott, "An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles", EMS publishing, 2010.

Reference(s):

1. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", 10th edition, 2007
2. 2.Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007
3. Jack Erjavec, "Automotive technology: A systems approach", 5th edition, 2009.

AUT18R318 Fleet Management	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To understand the vehicle management and its related activities

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the management training and operations involved in fleet

CO2: Apply the knowledge in maintenance of fleet

CO3: Understand about the spares, supply and budget allotment.

CO4: Create schedule and fare structure for the fleet

CO5: Study the motor vehicles act

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2		2								2	1		
CO2	3		2		2				2		2		2	1	1	1
CO3		3				2							1	1		
CO4			2			1			2	3	3		1	1	1	2
CO5		3							2		3		1		1	1

Unit 1: Management Training and Operations **9 Hours**

Basic principles of supervising. Organising time and people. Job instruction training - Training devices and techniques - Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations

Unit 2:Vehicle Maintenance **9 Hours**

Scheduled and unscheduled maintenance - Planning and scope - Evaluation of PMI programme – Work scheduling - Overtime - Breakdown analysis - Control of repair backlogs - Cost of options.

Unit 3: Vehicle Parts, Supply Management and Budget **9 Hours**

Cost of inventory - Balancing inventory cost against downtime - Parts control - Bin tag systems – Time management - Time record keeping - Budget activity - Capital expenditures - Classification of vehicle expenses - Fleet management and data processing - Data processing systems - Software. Model - Computer controlling of fleet activity - Energy management

Unit 4: Scheduling and Fare Structure **9 Hours**

Route planning - Scheduling of transport vehicles - Preparation of timetable, Costs, fare structure - Methods of fare collection - Preparation of fare table

Unit 5: Motor Vehicle Act **9 Hours**

Schedules and sections - Registration of motor vehicles - Licensing of drivers - Control of permits - Limits of speed - traffic signs - Constructional regulations - Description of goods carrier, delivery man, tanker, tipper, Municipal, fire fighting and break down service vehicle

Text book(s):

1. John Dolce, " Fleet management ", McGraw-Hill Co., 2011 (9th edition).

Reference(s):

1. Kadiyali.L.R., " Traffic engineering and Transport Planning " Khanna Publishers, 2011
2. Goverment Publication, "The Motor vehicle Act ", 1989.
3. Kitchin.L.D., " Bus operation ", llliffe and Sons Ltd., London, III Edition, 1992.

AUT18R319 Automotive Air-Conditioning	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To make the students understand the fundamentals of refrigeration systems.
- Familiarize the students with concept of psychometry and its application in air conditioning systems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To know the basics involved in automotive air conditioning system

CO2: To study about the heating system

CO3: Understand about the various refrigerants uses in air conditioning system.

CO4: Apply then knowledge in air routing and temperature control

CO5: Understand about the air condition servicing

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2		2								2	1		
CO2	3		2		2				2		2		2	1	1	1
CO3		3				2							1	1		
CO4			2			1			2	3	3		1	1	1	3
CO5		3							2		3		1		1	1

Unit 1: Air-conditioning Fundamentals **9 Hours**

Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports. Thermostatic expansion value - Expansion value calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator

Unit 2:Air Conditioner - Heating System **9 Hours**

Automotive heaters - Manually controlled air conditioner - Heater system - Ford automatically controlled air conditioner and heater systems - Automatic temperature control - Air conditioning protection – Engine protection.

Unit 3: Refrigerant **9 Hours**

Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis -Diagnostic procedure - Ambient conditions affecting system pressures

Unit 4: Air Routing & Temperature Control **9 Hours**

Objectives - Evaporator care air flow through the Dash recirculating unit - Automatic temperature control – Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems

Unit 5: Air Conditioning Service **9 Hours**

Air conditioner maintenance and service - Servicing heater system Removing and replacing components. Trouble shooting of air controlling system - Compressor service

Text book(s):

1. Mark Schnubel, "Automotive Heating and Air Conditioning", Today's Technician, 5th edition, 2013

Reference(s):

1. Steven Daly, “Automotive Air Conditioning and Climate Control Systems”, Butterworth-Heinemann; 1 edition (2006)
2. Norman C. Harris, “Modern Air-Conditioning Practice”, McGraw-Hill Education 1984
3. R.J. Dossat, “Principles of Refrigeration”, Prentice Hall, 5th ed, 2001.
4. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)

AUT18R320 Foundry Engineering	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To introduce foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces and foundry tools and their purposes.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Able to design and fabricate the pattern for automotive application.

CO2: Capable to perform the melting practice for ferrous and non-ferrous metal alloys.

CO3: Able to approach the casting techniques for particular applications.

CO4: To design gating system, types of risers, directional solidification and shrinkage.

CO5: To extrapolate casting defects, foundry layout, pollution control and safety in foundries.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2			1									1			
CO2		1											1			
CO3	2	3							1				2		1	
CO4					1		2				3			1		1
CO5		1	2										1			

Unit 1: Pattern Preparation and Moulding **9 Hours**

Introduction to foundry operations, patterns - functions, types, allowances, selection of pattern materials, colour codes, core boxes, moulding practice, ingredients of moulding sand and core sand, Testing of Moulding sands. Sand preparation, Sand moulding: green sand moulding, dry sand moulding, skin dry sand moulding, core sand moulding, loam moulding, fluid sand process, shell moulding, pit and floor moulding, carbon-di-oxide process.

Unit 2: Melting Practice **9 Hours**

Melting practice and special precautions for steels, alloy steels, cast irons, aluminium alloys, copper alloys and magnesium alloys, safety considerations, fluxing, degassing and inoculation

Unit 3: Casting Techniques **9 Hours**

Sand casting, permanent mould casting, die casting, centrifugal casting, plaster mould casting, investment casting, continuous casting, squeeze casting, full mould process.

Unit 4: Design of Castings and Foundry Metallurgy **9 Hours**

Elements of gating system, types, design of gating system with examples, functions of risers, types of risers, Chvorinov's rule, design and positioning of riser with examples, directional solidification, use of chills, exothermic compounds etc., riser efficiency, yield calculations. Concepts of pouring, solidification and shrinkage, inoculation and modification of cast irons and Al-Si systems

Unit 5: Fettling, Inspection and Automation **9 Hours**

Cleaning and repair of castings. Casting defects and remedies. Heat treatment of castings. Inspection of casting. Principles of mechanisation, automation and foundry layout. Pollution control and safety considerations in foundries. Functional design, simplification of foundry practices, metallurgical design

Text book(s):

1. Heine. R.W., Loper. C.R.,Rosenthal, P.C. “Principles of Metal Casting”, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1995.
2. Jain.P.L., “Principles of Foundry Technology”, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1995.

Reference(s):

1. Ramana Rao.T.V. “Metal Casting Principles and Practice”, New Age Pub. Co., New Delhi, 1996.
2. Beeley.P.R., “Foundry Technology”, Butterworths, London, 1982.
3. Srinivasan.N.K, “Foundry Engineering”, Khanna Tech Publications, New Delhi, 1994.
4. ASM Metals hand Book. Vol. 15. “Casting”, ASM International, 10th Edition, 1991

AUT18R321 Automotive Materials	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for Automobile engineering applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Gain basic knowledge in various fundamentals of alloy design with emphasis on Fe-C system

CO2: Acquire knowledge in heat treatment of engineering materials

CO3: Attain fundamental knowledge ferrous and nonferrous materials

CO4: Able to choose the required polymeric materials for automotive applications

CO5: Understand various type of foams, additives and coating techniques.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		3		2				1				2	1	1	
CO2		2		3	3		3			3			1	2	1	1
CO3	3	2		1	2				3	2			2	1	1	1
CO4	2			2	1		2				3		1	1	1	1
CO5	3		2	2					3				2	1	1	

Unit 1: Phase Diagrams **9 Hours**

Phase diagrams- Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Lever Rule, Iron–Iron carbide equilibrium diagram-Development of Micro structure in Iron–Carbon Alloys

Unit 2: Heat Treatment **9 Hours**

Annealing - types of annealing – full, process, isothermal, stress relief annealing-normalising, hardening and tempering of steel, quenching - quench medium - case hardening- carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

Unit 3: Ferrous & Non–Ferrous Materials **9 Hours**

Effects of alloy additions; Cast iron - Types of steel – plain carbon steels – low alloy steels - heat treatable steels - tool steels - die steels - stainless steels - special steels - Mechanical, thermal - electrical and physical properties of steels - Automotive applications. copper and its alloys– aluminium and its alloys - microstructure, properties and applications - magnesium and titanium base alloys.

Unit 4: Polymeric Materials **9 Hours**

Polymerization – Thermosets Vs Thermoplastics – Classes and types of polymers; Proper ties and limitations of plastic material species; Additives; Auto applications – exterior, interior, engine and fuel line, transmission systems, electrical and electronic components

Unit 5: Foams, Adhesives, Coatings and Paints **9 Hours**

PU & Latex foams - Adhesives - Condensation polymerization of products like – phenol formaldehyde (Phenolic resins), Amino resins, Polyester resins, Alkyl resins,

Epoxy resins, Polyurethane resins, Polyamide resins - Organic paints and coatings, metal coatings, ceramic coatings, Linings, primers, varnishes, enamels, galvanizing, anodizing - electro plating, CVD & PVD surface coatings

Text book(s):

1. Khanna.O.P., " Material Science and Metallurgy ", Dhanapal Rai & Sons, 2014

Reference(s):

1. William D. Callister, Jr., "Materials Science and Engineering an Introduction", John Wile y & Sons, 6th Edition, Inc., 2004.
2. Flinn, R.A. , and Trojan, P. K., "Engineering Materials and their Applications", Jai co , 4th Edition, 1999.
3. Avner, S. H., "Introduction to Physical Metallurgy", second edition, Mc Graw Hill, 1985.
4. 4. ASM Handbook, Vol. 2, "Properties and Selection - Nonferrous Alloys and Special-Purpose Materials"

AUT18R322 Composite Materials For Automotive Applications	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R325 - Automotive Materials	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To impart knowledge on the structure, properties, treatment, testing and applications of composite materials for automotive applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand various category fibers, matrices of composite materials.

CO2: Attain Knowledge on Polymer, Ceramics And Metal Matrix Composites

CO3: Know the different types of composite manufacturing process.

CO4: Apply the knowledge to fabricate the various automotive parts.

CO5: Recognize and recycle of composite based on its end of life.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		3		2				1				2	1	1	
CO2		2		3	1		3			3			1	1	1	1
CO3	3	2		1	3				3	2			2	1	1	1
CO4	2			2	2		2				3		1	1	1	1
CO5	3		2	2					3				2	1	1	

Unit 1: Introduction to Composite Materials **9 Hours**

Classification of Composites- categories of Composites- Fibers and whiskers – glass, aramid, metallic, graphite fibers – Matrices - Coupling Agents and Size Formulations - Temperature Sensitivity of Polymers- Mechanical Behavior of Composites Materials

Unit 2: Polymer, Ceramics and Metal Matrix Composites **9 Hours**

Characteristics of Natural Composites – Biocomposites - Carbon-Carbon Composites- Ceramic Matrix Composites- Metal Matrix Composites- Polymer Matrix Composites - Reinforcement materials - Types of PMC - wear & frictional property – material Selection criteria - Carbon/Carbon Composites - Advantages and limitations.

Unit 3: Composite Manufacturing Processes **9 Hours**

Open mold processes – Hand layup, Spray up, Vacuum bag, Pressure bag & autoclave, Centrifugal casting, Filament winding; Closed mold processes – Compression molding, Resin transfer molding (RTM),Injection molding, Pultrusion process.

Unit 4: Composites in Vehicle Manufacturing **9 Hours**

Structural and Semi-Structural Elements - Alternative Lightweight Materials - Composite Modular Front Ends - Front Fenders - Tail Doors - Side Doors - Seating - Chassis Components - Suspension Components

Unit 5: Methods of Recycle **9 Hours**

Recycling and Recovery from ELV - Mechanical Recycling - Chemical Recycling - Thermal Conversion Technologies - Energy Recovery - Automotive Shredder Residue - Commercial Composite Cost Analysis - Parts Integration and Modules

Text book(s):

1. Nick Tucker & Kevin Lindsey, “An Introduction to Automotive Composite”Rapra Technology Limited, 2002.

Reference(s):

1. Haslehurst.S.E., "Manufacturing Technology ", ELBS, London, 1990.
2. 2. Krishnan K. Chawle. “Composite Material: Science and Engineering” Second Edition, Springer, 1998
3. 3. T.W.Clyne, P. J. Wit hers, “An Introduction to metal matrix composites”, Cambridge University Press, 1993.
4. 4. F.C. Campbell “Structural Composite Materials”, Materials Par k, ASM International, 2010

AUT18R323 Metal Forming Processes	L	T	P	Credit
	3	0	0	3
Pre-requisite: AUT18R272-	**Course Category**: Professional Elective			

Manufacturing Processes and Machining	**Course Type**: Theory

Course Objective(s):

To impart in-depth knowledge in fundamental concepts related to metal forming and various metal forming process in detail

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain basic concepts related to deformation, structural changes during metal forming and its effects

CO2: Calculate rolling load and describe various types of roll mills and rolling processes

CO3: Classify choose and explain various forging processes and other processes related forging **CO4:** Describe various types of extrusion and drawing processes along with its classification

CO5: Choose a sheet metal operation based on the requirement to manufacture a component.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2				1							1	1	1		1
CO2	1	3			1			2				1	1	1	1	1
CO3	2	1			2	2		3				1	1	2	1	1
CO4					2	2						1		1		1
CO5		1			2							1	1	1		

Unit 1: Introduction to Metal Forming **9 Hours**

Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, effects of temperature, strain rate, microstructure and friction in metal forming-yield criteria and their significance, Classification of Metal Forming Processes, Advantages and Limitations, Stress strain relations in elastic and plastic deformation, concept of flow stresses, deformation mechanisms, Hot and Cold Working Processes and It's Effect on Mechanical Properties.

Unit 2: Rolling **9 Hours**

Introduction and Classification, Types of Rolling Mills, Forces and Geometrical Relationships in Rolling, Calculation of Rolling Load, Roll Pass Design, Defects in Rolled Products. Other Related Processes like Roll Piercing, Ring Rolling, Pipe and tube production by rolling processes.

Unit 3: Forging **9 Hours**

Introduction and Classification, operation and principle of Forging Processes and Equipments, Methods of forging, Open and Close Die Forging Processes, Defects, Structure and Properties of Forged Products. Force Analysis in forging. Other Related Processes like Cold Heading, Rotary Swaging, Sizing, Coining, Embossing and Roll Forging

Unit 4: Extrusion and Drawing **9 Hours**

Extrusion - Introduction and Classification, Extrusion Equipments, Forces in extrusion, Analysis of Extrusion Process, Extrusion of components including Seamless Pipes and Tubes. Extrusion of pipes by cold working, Other Related Processes like Impact Extrusion, Hydrostatic Extrusion, Piercing, Drawing, cupping and bending.

Drawing - Introduction and Classification, Wire Drawing, Rod Drawing, Tube Drawing, Deep Drawing, Analysis of Wire Drawing Process and Load Calculations.

Unit 5: Sheet Metal Forming **9 Hours**

Principle, process parameters, equipments and application of the following processes: spinning, stretch forming, plate, V and edge bending, Curling, Ironing, Roll Bending, Metal Spinning. Press brake forming, explosive forming, Hydro forming, electro hydraulic forming, and magnetic pulse forming. High Velocity forming of metals and High energy Rate forming

Text book(s):

1. B. L. Juneja, Fundametals of metal forming processes, New Age International, 2016

Reference(s):

1. Jain, R.K., Production Technology, Khanna Publishers, 2004.
2. HMT Production Technology, Tata Mc Graw-Hills Publishing Co. Ltd, 1994

AUT18R328	TRIBOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite: Nil	**Course Category**: Honors

Course Objective(s):

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To explain the components of tribology and their classification along with the materials and method to improve tribological properties

CO2: To classify lubrication regimes and apply the type of lubrication for various applications, also have the ability to choose the lubricants based on the application needed

CO3: To design various types of fluid film bearings.

CO4: To design the rolling element bearings

CO5: To explain various causes and effects of roller bearing failures

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		2										2			
CO2				2	2									2		
CO3				2	3						3			2		1
CO4	2				2						2		1	1		1
CO5	2				2						2		1	1		1

Unit 1: Tribology

Introduction, tribology in design, tribology in industry, tribological problems in design - economic consideration, laws of friction, kinds of friction, cause of friction, friction measurements, theory of friction, types of wear, various factors affecting wear, measurements of wear, wear between solid and liquids, theory of wear.

Unit 2: Lubricants and Lubrication

Lubrication properties - physical and chemical - lubrication - basic modes of lubrication - flow of viscous fluid through rectangular slots - seal - mechanical and dynamic seals - forging, wire drawing extrusion, rolling - lubrication used for wire ropes - design aspects of gear lubrication.

Unit 3: Elements of Contact Mechanics

Concentrated and distributed forces on plate surfaces - contact between two elastic bodies in the form of spheres - failures of contact surfaces - thermal effects in surface contact - contact between rough surfaces, representation of machine element contact.

Unit 4: Hydrostatic Bearings

Basic concepts, operations, advantages and limitations - hydrostatic conical and spherical bearings, load carrying and flow of lubricants - bearing power and film thickness, bearing temperature and power - compensator and their action - hydrostatic squeeze film, circular and rectangular plates, impact conditions between lubricated solids - application to journal bearing.

Unit 5: Hydrodynamic Bearing

Theory of hydrodynamic lubrication - mechanism of pressure development in oil film- two dimensional Reynolds equations - infinite tapered shoe slider bearings and infinite long journal bearing - short bearing theory applied to journal bearing - friction and power losses in journal

bearings, ratio of heat conducted, temperature rise approximate and rapid methods, design considerations - hydrodynamic thrust bearings - flat plate thrust bearing, pressure equation, load, centre of pressure -tapered land thrust bearing, step thrust bearing, tilting pad thrust bearing - friction in tilting pad thrust bearing.

Reference(s):

1. Willams, J.A., Engineering tribology, Oxford University Press, 1994.
2. Hailing J., Principles of tribology, MacMillan Press Ltd, 1978.
3. Neale M.J., Tribology hand book, Butterworth-Heinemann Ltd; 2 Rev.Ededition, 2004.
4. Bharat Bhushan, Modern Tribology Handbook, Vol. 1 and 2, CRC Publishers, 2000.

AUT18R329	COMBUSTION ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite: Nil	**Course Category**: Honors				

Course Objective(s):

- To present a problem oriented in depth knowledge of Combustion Engineering
- To address the underlying concepts and methods behind Combustion Engineering

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To explain the laws of thermodynamics applied to combustion in IC engine

CO2: To classify the combustion chambers and combustion process in CI engine

CO3: To explain the combustion kinematics and the reaction in combustion process

CO4: To Understand the combustion process using liquid fuel and detonation in gaseous mixture.

CO5: To understand the combustion process of solid fuels and pollution in combustion.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		2										1			
CO2				2	2									2		
CO3				2	3						3			2		1
CO4	2				2						2		1	1		1
CO5	2				2						2		1	1		1

Unit 1: COMBUSTION THERMODYNAMICS

Combustion thermodynamics; Stoichiometry; first and second laws of thermodynamics applied to combustion; Ignition and combustion in SI engine; Flame travel; turbulent flame propagation; flame stabilization; vaporization; Review of detonation and Diesel knock; effect of various factors;

Unit 2: COMBUSTION CHAMBERS

Combustion chambers for SI engines; Combustion in CI engine; Ignition delay and diesel knock; Excess air supply and air motion; Combustion chamber for CI engines Construction and Performance aspects; M-combustion chamber; latest combustion chamber and technology.

Unit 3: COMBUSTION KINETICS

Fundamentals of combustion kinetics' Combustion products in equilibrium; rate of reactions; chain reactions; opposing reactions; consecutive reactions,competitive reactions; Conservation equation for multi component reacting systems.

Unit 4: COMBUSTION OF LIQUID FUELS

Combustion of liquid fuel droplet; fuel atomization; types of injectors; spray formation and characteristics; Oil – fired furnace combustion; gas turbine spray combustion; direct injection engine combustion; detonation of liquid gaseous mixture.

Unit 5: COMBUSTION OF SOLID FUELS

Combustion of solid fuels; Coal combustion; combustion of pulverized coal; combustion of coal on bed in a fluidised bed and in a cyclone burners; stabilization of pulverized coal combustion; design consideration of coal burners; combustion generated pollution.

Textbook(s):

1. Applied Combustion, Second Edition by Eugene L. Keating, CRC PRESS, 2007.
2. Combustion Engineering – Gary L. Borman, Kenneth W. Ragland, McGraw Hill, 1998.

Reference(s):

1. Principles of Combustion – Kenneth K. Kuo, John Wiley & Sons, 2005.
2. Introduction to combustion phenomenon, Kanury murty, Mc-Ggraw hill, 1975.
3. Combustion, fundamentals, strehlow, Mc-Ggraw hill, 1984.

AUT18R330	Advanced Thermodynamics and Heat Transfer	L	T	P	C
		3	0	0	3
Pre-requisite: Nil		**Course Category**: Honors			

Course Objective(s):

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equation of state, methods used to describe and predict phase equilibrium
- To study heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To apply fundamental concepts of thermodynamics to engineering applications

CO2: To estimate thermodynamic properties of substances in gas and liquid states

CO3: Ability to understand and solve conduction, convection and radiation problems

CO4: Ability to design and analyse the performance of heat exchangers and evaporators

CO5: Ability to design and analyse reactor heating and cooling systems

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		2										2			
CO2				2	2									2		
CO3				3	3						3			2		1
CO4					2						2			1		1
CO5	2		2								2		2			1

Unit 1: CONCEPTS OF THERMODYNAMICS

Basic concepts of thermodynamics; irreversibility; Review of basic laws of thermodynamics and their consequences; Concept of Exergy and Entropy; Energy for closed system; Entropy generation; entropy balance for closed system; behavior of gases; Equations of state.

Unit 2: PHASE EQUILIBRIUM & APPLICATIONS

Phase equilibrium; phase rule without chemical reaction; chemical potential of ideal gases; T-ds equations for simple compressible systems; Helmholtz and Gibbs functions; Maxwell relations; generalized relations for changes in enthalpy; entropy and internal energy; equations for specific heats; Claudiuschaperon equation; Joule-Thomson and Joule coefficients; applications of thermodynamic relations.

Unit 3: CONDUCTION

Review of the basic laws of conduction; One dimensional steady state conduction with variable thermal conductivity and with internal distributed heat

source; Extended surfaces-review and design considerations; Two dimensional steady state conduction; Unsteady state conduction; solutions using Groeber'sand Heisler'scharts for plates,cylinders and spheres suddenly immersed in fluids.

Unit 4: CONVETION

Review of convection heat transfer laws, Natural and forced convection; Heat transfer in turbulent flow; eddy heat diffusivity; Reynold's analogy between skin friction and heat transfer; von Karman; turbulent flow through circular tubes;

Unit 5: RADIATION

Review of radiation heat transfer laws,Review of radiation principles; diffuse surfaces and the Lambert's Cosine law; Radiation through non-absorbing media; Hottel's methodof successive reflections.

Textbook(s):

1. Engineering Thermodynamics work and heat Transfer, Roger Gordon & Yon Mayhew, Addison-Wesley, 2001

Reference(s):

1. Fundamentals of Engineering Thermodynamics, Moran MJ & Shapiro HM, John Wiley, 2003.
2. Thermodynamics an Engineering Approach, Cengel Y.A. & Boles M.A., Tata McGraw-Hill, 2011.
3. Fundamentals of Classical Thermodynamics, Van Wylen GJ & S onntag RE, Wiley, 1994.
4. Thermodynamics, Wark K. Jr. & Donald E.R.,McGraw Hill (6th Edn.); 1999.
5. Convective Heat and Mass Transfer, Kays, W.M. and Crawford, McGraw Hill (2005).
6. Thermal Radiative Transfer and Properties, Brewster, M.Q., John Wiley (2006).
7. Heat Transfer, Holman, J.P., McGraw Hill (2007).

AUT18R331	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite: Nil		**Course Category**: Honors			

Course Objective(s):

- To understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
- To gain exposure to energy auditing, to identify energy conservation opportunities in various industrial processes and to evaluate the performance of boilers, furnaces and other energy intensive equipment/processes.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Correlate the energy crisis and environmental concerns with the energy efficiency, conservation and management

CO2: Apply techniques and skills for the energy conservation and management in the thermal and electrical energy systems

CO3: Apply tools associated with energy monitoring and auditing, and on the energy management systems

CO4: Apply skills acquired in energy planning and management software for data analysis and interpretation

CO5: Knowledge of various tools and components in maintaining economy in energy management

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		2										1			
CO2				2	2									1		
CO3				2	3						3			2		1
CO4	2				2						2		1	1		1
CO5	2				2						2		1	1		1

Unit 1: INTRODUCTION

Energy scenario, Principles of energy Conservation, Energy consumptionpattern, Resource availability.

Unit 2: THERMAL PERFORMANCE

Evaluation of thermal performance, calculation of heat loss – heat gain,estimation of annual heating & cooling load factors that influence thermalperformance, analysis of existing buildings.

Unit 3: ENERGY CONSERVATION

Organizing for energy conservation programme, the energy audit andenergy information system, technology for energy conservation, co-generation ofprocess, steam & electricity, computer controlled energy management,commercial options in

waste heat recovery equipment, cases of energy studies,energy conservation opportunity, energy conservation in I. C. Engine.

Unit 4: ENERGY MANAGEMENT

Strategies for electricity and management, setting up an energy management programme, electricity saving technique by category of end use, Electrical end use in industries, energy & power management in industry, energy management strategies for industry, demand management.

Unit 5: ENERGY ECONOMY

Importance and role of energy management, Energy economics, Payback period, internal rate of return, life cycle costing.

Reference(s):

1. Practical guide to energy conservation – a ready reckoner on energy conservation measures; Petroleum Conservation Research Association (2009).
2. Indian Energy Board-2012; World Energy Council
3. Energy Management Principles, C.B.Smith, Pergamon Press, New York, 1981.
4. Energy Management, W.C. Turner, Hand Book.
5. Hamies, Energy Auditing and Conservation, Methods, Measurements, Management and Case Study, Hemisphere, Washington, 1980.
6. Trivedi, P.R, Jolka K.R., Energy Management, Commonwealth Publication, New Delhi, 1997.
7. Witte, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washinton, 1988.

AUT18R332	Automotive Control Systems	L	T	P	C
		3	0	0	3

Course Objective(s):

- To understand the advancement in electronic control systems in field automobile engineering

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the working and calibration procedure of tool used to diagnose the repair in various automotive electrical system.

CO2: Understand the maintenance schedule of various automotive components.

CO3: Identify and solve the fault identified electrical system.

CO4: Understand the reconditioning procedure of engine components

CO5: Diagnose and repair the failure in automotive air conditioning system

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1					2				1	1	1		1	1
CO2			1		1							1		1		1
CO3	1		2		1								1	1		
CO4	2			2			1				2	1	1	1		1
CO5		2			1							2	1	1		1

Unit 1: Embedded Control Systems

Introduction to Embedded control systems, Microcontroller and processors used in Automotive systems, need for electronics in automobiles, Engine control unit, Electronic– Input devices, Sensors- wheel speed sensor, Crash sensor etc.

Unit 2: Electronic Fuel Injection & Ignition System

Introduction, feedback carburettor system, throttle body injection, advanced GDI and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

Unit 3: Braking and Electronic Stability Control

Vehicle motion control, collision avoidance control – cruise control, Adaptive cruise control, Electronic transmission control. Vehicle stabilization system -Antilock braking system, Traction control system, Anti slip regulation, Electronic stability program. On-board diagnosis system.

Unit 4: Passive Safety Systems

Air bags and seat belt pre-tensioner systems: Sensor functions, Distributed front air bag sensing system, Single-point sensing systems, Side-impact sensing – driver monitoring systems.

Unit 5: Infotainment Systems

Global positioning systems, geographical information systems, navigation systems, Voice Command Systems, automotive vision system, lane departure warning system, driver assistance systems such as power seats, Power windows, and Remote keyless entry systems.

Reference(s):

1. Allan W. M. Bonnick, "Automotive Computer Controlled Systems Diagnostic tools and techniques", Butterworth-Heinemann Linacre House, Jordan Hill, Oxford, 2001.
2. Ronald K. Jurgen, "Electronic Engine Control Technologies 2nd Edition", SAE International, 2004.
3. Ljubo Vlacic, Michel Parent, Furnio Harshima, "Intelligent Vehicle Technologies:
   Theory and Applications", Butterworth-Heinemann publications, 2001.
4. Denton, "Automotive Electrical and Electronic Systems", Routledge Publishers, 2013.

AUT18R401 Hydrogen and Fuel Cells	L	T	P	Credit
	3	0	0	3
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To impart knowledge to the students about the hydrogen fuel and the fuel cell vehicles as well as the handling of the hydrogen fuel

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn about the production of the hydrogen through electrolysis process.

CO2: To gain knowledge about the conversion of the hydrogen from gas to liquid and its storage techniques.

CO3: To know about the fuel cells and their working

CO4: To understand about the different types of fuel cells and their function in the vehicles

CO5: To know about the different fuel system in different vehicles.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1				1			2	1	3					1	1	2
CO2	2			3									1	1		
CO3		2									1		1			1
CO4							2								1	
CO5											3	3				2

Unit 1: Production of Hydrogen **9 Hours**

Steam reforming – partial oxidation – water electrolysis: reverse fuel cell operation – Gasification and woody biomass conversion – Biological hydrogen production – Photo dissociation – Direct thermal or catalytic splitting of water.

Unit 2:Hydrogen Conversion and Storage **9 Hours**

Uses as an energy carrier – energy storage medium – Combustion uses – Stationary fuel cell – Compressed gas storage – Liquid hydrogen storage - Hybrid storage – Cryo absorbed gas storage in carbon materials – Other Chemical storage options – Comparison

Unit 3: Introduction to Fuel Cells **9 Hours**

Electrochemistry and thermodynamics of fuel cells – Modelling aspects – Quantum chemistry approaches – Application to water splitting – Flow and diffusion modelling – temperature factor

Unit 4: Fuel Cells **9 Hours**

Molten carbonate cells – Solid oxide cells – Acid and alkaline cells – Proton \exchange membrane cells – Biofuel cells – Problems.

Unit 5: Systems **9 Hours**

Passenger cars – Bus, lorry – Ships, trains and airplanes – Power plants including stand –alone systems – Building integrated systems- Portable and other small – scale systems – Problems

Text book(s):

1. "Hydrogen and Fuel cells "Bent Sorensen, Elsevier Academic Press, 2000.

Reference(s):

1. Hydrogen--hot stuff, cool science By Rex A. Ewing
2. Larminie, James (1 May 2003). Fuel Cell Systems Explained, Second Edition. SAE International. ISBN 0768012597.
3. Production of hydrogen for fuel cells by steam reforming of ethanol, DK Liguras, DI Kondarides, XE Verykios - Applied Catalysis B, Environmental, 2003 – Elsevier

AUT18R402 Heat Transfer and Combustion	L	T	P	Credit
	3	0	0	3
Pre-requisite: AUT18R201 – Applied Thermodynamics	**Course Category:** Professional Elective **Course Type**: Theory			

Course Objective(s):

To provide a comprehensive knowledge of combustion processes in IC engines and heat transfer during the process.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding of thermodynamics and kinetics of combustion
CO2: Ability to characterize the fuels and its properties in combustion
CO3: Understanding and identifying the basic heat transfer modes
CO4: Ability to apply the concepts of conduction heat transfer
CO5: Analyse the convective and radiation heat transfer situations

Mapping of Course Outcome(s):

CO	PO												PSO			
/ PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1							1		2						1	
CO2		2							1				1		1	
CO3			2		3								1	1		
CO4	3			2			2					1	1	1	1	1
CO5	3			2						1			1	1		1

Unit 1: Combustion **9 Hours**

Combustion phenomena of S.I. and C.I. engines, Stages of combustion- Photographic studies of combustion process- p-q diagrams in S.I. and CI engines. Abnormal combustion-Effect of engine variables on knock-Factors controlling combustion chamber design. Combustion chambers: Diesel engine combustion chambers open, Divided, Swirl, Turbulent and Ricardo's Combustion chambers.

Unit 2: Measurements Flow Meters **9 Hours**

Volumetric type, gravimetric type-fuel consumption measurement in vehicles-Air consumption: Air box method, viscous air flow meter; flame temperature measurement and pressure measurement

Unit 3: Introduction to Heat Transfer **9 Hours**

Temperature, Heat and thermal equilibrium, Modes of basic laws of heat transfer i.e. conduction, Convection and Radiations; Fourier equation and Thermal Conductivity, Derivation of the general form of heat conduction equation in Cartesian, Cylindrical Spherical Coordinates

Unit 4: Conduction Heat Transfer **9 Hours**

Steady State Conduction, Heat conduction through plane wall, Composite wall, cylindrical wall, Multi layer cylindrical wall, and through spheres; effect of variable conductivity, Critical thickness of Insulation; conduction with heat generation, plane wall with uniform heat generation, Dielectric heating, Cylinder with uniform heat generation, Heat transfer through Piston crown. Heat transfer from extended surface, steady flow of heat along a rod, Governing differential equation and its solution, Heat dissipation from and infinitely long fin, Fin performance

Unit 5:Convection and Radiation **9 Hours**

Free and forced convection, Laminar and Turbulent flow, Newton- Rekhman Law: Convection rate equation, Nusselt Number; radiation heat exchanger; salient features and characteristics of radiation, Absorptive, reflectivity and transmittance; spectral and spatial energy distribution, wavelength distribution of black body radiation, Plank's law; total emissive power: Stefan Boltzman law, Wien's displacement law, Kirchoffs Law, gray body and selective emitters

Text book(s):

1. Arora and Domkundwar, Heat and Mass Transfer, Dhanpat Rai & Co (P) Ltd. Delhi, Edition 2005
2. Ganesan.V., " Internal Combustion Engines ", Tata-McGraw Hill Publishing Co.,New Delhi 2012

Reference(s):

1. D.S. Kumar, Heat and Mass Transfer, S.K. Kataria & Sons, 2012
2. Frank Kreith, Principles of Heat Transfer. 8th Edition, Cengage learning
3. E.R.G. Eckert and E.M.Drake Jr., Analysis of Heat and Mass Transfer, McGraw-Hill, Tokyo.
4. Kothandaraman, Heat Transfer Data Handbook.

AUT18R403 Vehicle Dynamics	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Theory			

Course Objective(s):
This course aims to give general knowledge about the concept of mechanical vibrations in various components of a vehicle. In detail the suspension and tyre related vibrations are studied. The various topics covered in this course are the stability of the vehicles in normal, curve and slope areas, load distribution under all conditions.

Course Outcome(s):
After completing this course, the student will be able to:
CO1: Understand the basic of mechanical vibration under free, forced and damped conditions
CO2: Estimate the multi degree of freedom systems for reducing vibration in vehicles
CO3: Identify, check and test the suspension and tyre characteristics
CO4: Apply the concept of vehicle handling system
CO5: Explain the concepts of load distribution in vehicles and stability of the vehicles

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1			3	1						2		1	2		1
CO2	3	3		1	2								2	1		
CO3		2			3				1	2	1		1	1	1	1
CO4		3		1	2					1			1	1		1
CO5	3			2					1	1	1		1	1	1	1

Unit 1: Introduction **9 Hour**
Fundamental of vibration, Mechanical vibrating systems. Modelling and Simulation - Model of an automobile - Single, two, multi degrees of freedom systems - Free, forced and damped vibrations. Magnification factor - Transmissibility - Vibration absorber.

Unit 2: Multi Degree of Freedom Systems **9 Hours**
Closed coupled system - Eigen valve problems - Far coupled Systems - Orthogonality of mode shapes – Modal analysis - Forced vibration by matrix inversion. Approximate methods for fundamental frequency - Dunkerley's lower bound - Rayleigh's upper bound - Hozler method for close coupled systems and branched systems.

Unit 3: Suspension and Tyres **9 Hours**

Requirements.Sprung mass frequency. Wheel hop, wheel wobble, wheel shimmy. Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and apt directions. Ride characteristics of tyre - Effect of driving and braking torque - Gough's tyre characteristics.

Unit 4: Vehicle Handling **9 Hours**

Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.

Unit 5: Stability of Vehicles **9 Hours**

Load distribution. Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road.

Text book(s):

1. Rao V. Dukkipati, Jian Pang, “Road Vehicle Dynamics problems and solution”,SAE,2010

Reference(s):

1. Karl Popp, Werner O. Schiehlen, “Ground Vehicle Dynamics”, Springer, 2010.
2. Rajesh Rajamani, “Vehicle Dynamics and Control”, Springer, 2012.
3. Georg Rill, “Road Vehicle Dynamics: Fundamentals and Modeling”, CRCPress, 2012.
4. Ellis.J.R., " Vehicle Dynamics ", Business Books Ltd., London, 1991.
5. Giles.J.G. Steering, " Suspension and Tyres ", llliffe Books Ltd, London, 1998.
6. Giri.N.K., " Automobile Mechanics ", Khanna Publishers. New Delhi, 1986.
7. Rao.J.S. & Gupta.K., " Theory and Practice of Mechanical Vibrations ", Wiley Eastern Ltd., New Delhi, 1999.

AUT18R404 Experimental Method In Fluids	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: -	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

The objective of the course is to enable the student to understand the situation of flow problem and suggest the possible solution for the measurement

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Able to understand the measurement method and technique and apply for the situation.

CO2: Applying the concepts of wind tunnel balance and measurements in subsonic flow problems.

CO3: Applying the proper flow visualization technique related the situation of flow to capture the flow physics.

CO4: Applying the acquired knowledge of measurement of temperature, pressure and velocity for the flow situation

CO5: Ability to choose the proper data acquisition and processing tools for post processing of signals acquired and preparing uncertainty report

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2			2	3								1	2		
CO2	3	2		3				1					2	1	1	
CO3		2	2	3	2		2		3				2	2	1	
CO4	2		2	2					3				1	1	1	
CO5	2			2					3	2	1	3	1	1	1	2

Unit 1: Basic Measurements in Fluid Mechanics **9 Hours**

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods - Components of measuring systems – Importance of model studies

Unit 2:Wind Tunnel Measurements **9 Hours**

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence- Wind tunnel balance – Principle and application and uses – Balance calibration.

Unit 3: Flow Visualization Methods **9 Hours**

Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Shadowgraph - Schlieren system – Background Oriented Schliren (BOS) System.

Unit 4: Pressure, Velocity and Temperature Measurements **9 Hours**

Pitot-Static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Hot-film anemometry – Laser Doppler Velocimetry (LDV) – Particle Image Velocimetry (PIV) – Pressure Sensitive Paints - Pressure measurement techniques - Pressure transducers – Temperature measurements

Unit 5: Data Acquisition Systems and Uncertainty Analysis **9 Hours**

Data acquisition and processing – Signal conditioning - Estimation of measurement errors – Uncertainty calculation - Uses of uncertainty analysis

Text book(s):

1. Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press – Taylor & Francis, 2007.

Reference(s):

1. Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press, Taylor & Francis, 2006.

AUT18R405 Computer Simulation of IC Engines Process	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: AUT18R201	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

- To introduce new combustion model, replacing the existing one used in the initial program.
- To provide knowledge in simulation techniques to estimate the performance and emission characteristics of IC engines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Able to describe all kind of thermodynamic combustion changes in an engine.

CO2: To simulate SI engine with adiabatic combustion, fuel vaporization and full throttle operations.

CO3: To distinguish progressive combustion with gas exchange process and validate pressure crank angle diagram.

CO4: To analyze compression of simulated valves and heat transfer process.

CO5: To calculate simulation of CI engine performance and pollution estimation.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2												1			
CO2		3		2	2				3				1	2	1	
CO3									2		2				1	1
CO4		2		2						2			1	1		1
CO5										3						1

Unit 1: Introduction **9 Hours**

Introduction - Heat of reaction - Measurement of URP - Measurement of HRP - Adiabatic flame temperature: Complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature - Isentropic changes of state.

Unit 2:SI Engine Simulation With Air as Working Medium **9 Hours**

Deviation between actual and ideal cycle - Problems, SI engine simulation with adiabatic combustion, temperature drop due to fuel vapourisation, full throttle operation - efficiency calculation, part-throttle operation, super charged operation.

Unit 3: Progressive Combustion **9 Hours**

SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.

Unit 4: Diesel Engine Simulation **9 Hours**

Multi zone model for combustion, different heat transfer models, equilibrium calculations, simulation of engine performance, and simulation for pollution estimation.

Unit 5: Finite Element Analysis in the Design Process **9 Hours**

Defeaturing, Idealization, Clean up, Common meshing problems, Mesh Adequacy, FEA Projects- Major steps in a FEA project, FEA report, Importance of documentation and backup, Common errors in FEA management.

Text book(s):

1. Ganesan.V. “Computer Simulation of spark ignition engine process ", Universities Press (I) Ltd, Hyderbad, 1996.

Reference(s):

1. Ramoss.A.L., " Modelling of Internal Combustion Engines Processes ", McGraw Hill Publishing Co., 1992.
2. Ashley Campbel, “Thermodynamic analysis of combustion engines ", John Wiley & Sons, New York, 1986.
3. Benson.R.S., whitehouse.N.D., " Internal Combustion Engines ", Pergamon Press, oxford, 1979.

AUT18R406 Terotechnology	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: MAT18R203	**Course Category**: Professional Elective **Course Type**: Theory			

Course Objective(s):

To study about reliability, maintenance and monitoring of production system

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To know the basic concepts of probability and reliability

CO2: Understand about the reliability models

CO3: To apply the knowledge in reliability functions

CO4: To know the importance of maintenance

CO5: Understand the concepts of monitoring and related activities

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO6	3		2		2								2	1		
CO7	3		2		2				2		2		2	1	1	1
CO8		3				2							1	1		
CO9			2			1			2	3	3		1	1	1	2
CO1(		3							2		3		1		1	1

Unit 1: Introduction **9 Hours**

Probability concepts – Probability distributions – density and distribution functions for uniform, exponential, razeligh, weibull, normal distribution - Non-maintained systems – Reliability definition and its important – method of improving reliability redundancy techniques – failure data analysis

Unit 2:Reliability Model **9 Hours**

Reliability models- Hazard models – constant, linearly increasing and Weibull models estimating of reliability, failure density and MTTF for hazard models.

Unit 3: Maintenance and Reliability **9 Hours**

Maintenances systems and economics of reliability - Maintainability and availability concepts, MTBF, MTTR, MTBM & MDT repair hazard rate, maintainability and availability functions and their mathematical expressions

Unit 4: Maintenance Management **9 Hours**

Maintenance and spares management - preventive replacement- individual breakdown replacement policy - individual preventive replacement policy – preventive group replacement

Unit 5: Condition Monitoring **9 Hours**

Condition based maintenance - advantages and disadvantages - vibration monitoring - vibration parameters - vibration instruments

Text book(s):

1. Patrick D. T. O' Connor, “Practical Reliability Engineering “ Wiley; Fourth edition (2008)

Reference(s):

1. Anand Tembulkar and S.P. Meher, “Reliability and Maintenance Engineering”, Anand Tembulkar and S.P. MeherS K KATARIA and SONS (2014).
2. Collact, "Mechanical Fault Diagnosis & condition monitoring",1977.
3. Balagurusamy.E., "Reliability Engineering", Tata Mcgraw Hill Publishing Company, New Delhi,1984.

AUT18R407	ADVANCED VIBRATION ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite: Nil		**Course Category**: Honors			

Course Objective(s):

- Develop an ability to apply advanced analysis techniques to mechanical vibration systems
- Develop an ability analyse continuous vibrational systems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Have an in-depth understanding of the principles of vibrations;

CO2: Understand the concepts of vibration modes and natural frequencies and their measurement and estimation for multi-degree-of-freedom systems;

CO3: Have an in-depth understanding of System Modelling via use of Energy Analysis and its application to complex vibrating systems;

CO4: Be familiar with the use of different numerical techniques and its application to vibration design

CO5: Understand the fundamentals of flow-induced vibrations

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2			2				2		1			1	1	1	1
CO2	2	2										1	2			1
CO3	1			2				2		1		1	1	1	1	1
CO4	1		1					2		1		1	1	1	1	1
CO5			1					1					1	1	1	

Unit 1: SINGLE AND TWO DEGREES OF FREEDOM SYSTEM

Introduction to free, forced, transient and damped vibrations, terminology and applications. Discrete systems – single degree and two degree systems, response to

free forced motions (steady state and transient) applications to vibration isolation and absorption.

Unit 2: SEVERAL DEGREES OF FREEDOM

Multi degree systems – techniques of analysis such as Dunkerley, Rayleigh, Holzer, Matrix iteration, Transfer matrices and modal analysis.

Unit 3: CONTINUOUS AND TORSIONAL VIBRATION

Continuous systems Free and forced vibrations of bars for longitudinal, shear, torsional and transverse vibrations, Beams with attached masses rotor dynamics and FEM applications.

Unit 4: NON-LINEAR VIBRATIONS

Non-linear vibrations, jump phenomenon and stability. Applications including self-excited and parameter excited vibrations.

Unit 5: RANDOM VIBRATIONS

Random vibrations – stationary and non-stationary, ergodic systems, response of single degree systems to random excitation.

Textbook(s):

1. W. T. Thomson, “Theory of Vibration” Kluwer Academic Pub; 4th edition, 1999. 2. TSE, Morse and Hinkel, “Mechanical Vibrations”, Chapman and Hall, 1991.

Reference(s):

1. Den Hartong, “Mechanical Vibrations”, McGraw Hill, 1986.
2. V.P.Singh, Dhanput Rai & Co., “Mechanical vibrations”. 1988
3. S.Timoshenko, D.H.Young , “Vibrations Problems in Engineering”, D.Van Hostrand Company, Inc, Afiliated east-west press Pvt. Ltd.,1991

AUT18R408	Autotronics and Vehicle Intelligence	L	T	P	C
		3	0	0	3

Course Objective(s):

- To understand the automotive electronics in terms of sensor and governing systems in fuel supply and ignition system
- To broaden the importance of hybrid cars and vehicle intelligence system

Course Outcome(s):

After completing this course, the student will be able to:

CO1:explain the working various systems such as ABS, drive line, charging and ignition system in an automobile

CO2: Describe the sensor classification and sensor product selection guide and the measurements of automotive sensors.

CO3: Analyse various electronics systems like fuel injection system, ECU

CO4: Understand the concept of electric and hybrid vehicle

CO5: Design of intelligence vehicle systems

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		3			2						3	2	1		1
CO2	1	2				2						2	1	1		1
CO3	1	2	1			1						1	2	1		1
CO4		2	1									2	1			1
CO5			1			2						2	1	1		1

Unit 1: Automotive Fundamentals

The engine-components-Drive train -Starting &charging systems operation- Ignition system- Suspension systems-brakes -ABS - Steering system

Unit 2: Automotive Sensors

Temperature sensor-gas sensor-knock sensor-pressure sensor - flow sensor-torque sensor-crash sensor-Speed sensor and acceleration sensor-micro sensor-smart sensor-operation, types, characteristics, advantages and their applications.

Unit 3: Fuel Injection and Ignition System

Introduction -fuel system components-electronic fuel system-fuel injection-types-throttle body versus port injection-electronic control fuel injection-operation-different types-fuel injectors-idle speed control-continuous injection system-high pressure diesel fuel injection -MPFI system -Electronic ignition system-operation-types, Electronic spark timing control

Unit 4: Electric Vehicles and Hybrid Vehicles

Introduction-Electric Vehicle development- system layout- basic system components-Electric battery-solar cells-rapid charging system-motor drive system-fuelcell Electric vehicle-hybrid vehicle-series Hybrid Vehicle - parallel Hybrid Vehicle-CNG Electric hybrid vehicle.

Unit 5: Vehicle Intelligence

Introduction -basic structure-vision based autonomous road vehicles-architecture for dynamic vision system - features-applications- A visual control system using image processing and fuzzy theory-An application of mobile robot vision to a vehicle information system.-object detection, collision warning and Avoidance systemlow tire pressure warning system.

Reference(s):

1. 1.Willium B. Ribbens,Understanding Automotive Electronics -Sixth edition Elsevier Science 2003
2. Ronald K.Jurgen, Sensors and Transducers - SAE 2003
3. Jack Erjavec, Robert Scharff, Automotive Technology - Delmar Publications Inc 1992
4. Ronald K.Jurgen, Electric and Hybrid-electric vehicles - SAE 2002
5. Ichiro Masaki, Vision-based Vehicle Guidance - Springer Verlag, Newyork 1992
6. Jay Webster, Class Room Manual for Automotive Service And System - Delmer Publications Inc 1995.
7. Ron Hodkinson, John Fenton, Light Weight Electric/Hybrid Vehicle Design - Read Educational and Professional Publications Ltd. 2001

AUT18R409	Computational Fluid Dynamics and Applications	L	T	P	C
		3	0	0	3

Course Objective(s):

The course introduces the various methods to solve the complex fluid and heat flow problems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the theory of computational fluid dynamics which portray different types of flow, boundary conditions and governing equation.

CO2: Analyze the importance of finite difference method and application of finite difference methods in real time applications.

CO3: Able to synthesize the diverse approaches of finite volume methods and its applications

CO4: Ability to recognize and articulate the interplay between finite element, finite volume and finite difference methods

CO5: To gain experience in the application of CFD analysis to real engineering designs and to build up the skills in the actual implementation of CFD methods in using commercial CFD 8codes

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2			3						3	2	1		1
CO2	3		2	1		2		2				2	2	1	2	1
CO3	1			1				1				2	1	1	1	1
CO4						1		1						1	1	
CO5	3		3	2		1						3	2	1		1

Unit 1: Governing Equations

Introduction, Finite control volume, Infinitesimal Fluid Element, Continuity Equation, Momentum Equation, Energy Equation, Navier-Stokes Equations, and Euler Equations.

Unit 2: Partial Differential Equations

Introduction, Classification of PDE, Eigenvalue method, Hyperbolic Equations, Parabolic Equations, Elliptic Equations.

Unit 3: Discretization Techniques

Introduction, Domain, Grid Points, Grids- Structured and Unstructured, Finite Difference, Finite Volume, Finite Element, Explicit and Implicit Approaches.

Unit 4: CFD Solution Procedure

Introduction, Pre-process – Creation of geometry, Mesh generation, Selection of physics and fluid properties, Specification of boundary conditions, CFD Solver – Initialization and solution control, Monitoring Convergence, Post Process – XY plots, Vector plots, Contour Plots, Data report, Animation.

Unit 5: Applications

Introduction, Indoor Airflow Distribution, Flow over a Vehicle, Design of a room ventilation system, Gas particle flow in a 90^{o} bend etc.

Text Book(s):

1. John D Anderson JR, Computational Fluid Dynamics, McGraw Hill, 2014.

Reference(s):

1. Dennis G. Zill and Michael R. Cullen, Advanced Engineering Mathematics, Narosa Publishing house, 2009.
2. JiyuanTu, Guan HengYeoh and Chaoqun Liu, Computational Fluid Dynamics, Elsevier, 2008.
3. J. Blazek, Computational Fluid Dynamics: Principles and Applications, Elsevier, 2001.

AUT18R410	Finite Element Analysis for Engineers	L	T	P	C
		3	0	0	3

Course Objective(s):

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the concept of numerical methods to find the approximate solution for partial differential equation.

CO2: Evaluate the significance of coordinate measurement system for the one dimensional finite element problems.

CO3: Develop the finite element formulation to solve structural application problems such as bar, trusses and beam

CO4: Perform analysis of 2D structures using plane stress and plane strain condition.

CO5: Analyze the dynamic characteristics of structural members using FEM.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2		2										1			
CO2				2	2									1		
CO3				3	3						3			2		1
CO4					2						2			1		1
CO5	2		2								2		2			1

Unit 1: Introduction

Introduction, shape functions, Degrees of freedom, Element order, Artificial constraints, choices of discretization, Types of finite elements- Element dimensionality, analysis dimensionality, Element shape, Element order and type, Element modelling capabilities.

Unit 2: Finite Element Mesh

Meshing Techniques- Manual meshing, semi-automatic meshing, automatic meshing, Mesh compatibility – Compatible, incompatible, forced compatible elements, Common meshing problems – Element distortion, Incorrect mapping to geometry, Incorrect conversion to shell model.

Unit 3: Modeling Process

Modeling steps- Definition of the objective of analysis, selection of the units of measurement, Geometry creation, Defining material properties, Defining boundary conditions.

Unit 4: Types of Finite Element Analysis

Thermal analysis, Nonlinear analysis, Modal analysis, Buckling analysis, Dynamic Analysis.

Unit 5: Finite Element Analysis in the Design Process

Defeaturing, Idealization, Clean up, Common meshing problems, Mesh Adequacy, FEA Projects- Major steps in a FEA project, FEA report, Importance of documentation and backup, Common errors in FEA management.

Text Book:

1. Paul M. Kurowski, Finite Element Analysis For Design Engineers, SAE International, 2004.

Reference(s):

1. Logan, D.L., A First course in the Finite Element Method, Thomson Learning, Third Edition, 2002.
2. Robert D Cook., David.S, Malkucs Michael E Plesha, Concepts and Applications of Finite Element Analysis, Wiley, 4th Edition, 2003.
3. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Elements in Engineering, Pearson Education, New Delhi, 3rd Edition, 2002.
4. David V Hutton, Fundamentals of Finite Element Analysis, McGraw-Hill Int. Ed., 2004.
5. Tarek I.Zohdi, A Finite Element primer for Beginners, Springer, 2015.
6. P.Seshu, Textbook of Finite Element Analysis, PHI learning Pvt Ltd, 2012.

AUT18R411	Automotive Component Reconditioning	L	T	P	C
		3	0	0	3

Course Objective(s):

- To acquire hands on experience of maintenance and repairs of various component parts of a vehicle.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the working and calibration procedure of tool used to diagnose the repair in various automotive electrical system.

CO2: Understand the maintenance schedule of various automotive components.

CO3: Identify and solve the fault identified electrical system.

CO4: Understand the reconditioning procedure of engine components

CO5: Diagnose and repair the failure in automotive air conditioning system

Mapping of Course Outcome(s):

CO / PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO6	M		M									
CO7				M	M							
CO8				S	S						S	
CO9					M						M	
CO10	M		M								M	

Unit 1: Equipment's for Testing Electrical Accessories

Specifications and range; Electric test bench; growler; coil tester; distributor test bench; ignition timing light; digital multi-meter; wiring harness tester; hydrometer; battery ampere hour tester; cam dwell angle tester; feeler gauge; ohmmeter; ammeter; voltmeter and connecting wires.

Unit 2: Maintenance Schedule

Batteries-Charging; Faults; Care and Maintenance; Starter motor; dynamo; ignition system; wiper motor; electrical fuel pump; alternator; horn; flasher unit; Diagnosis chart: Ignition system; cranking system; charging system; power door lock control system; headlight; turn signal light; brake light; fuel meter and fuel gauge unit; engine coolant meter and sensor; oil pressure light; wind shield wiper and washer; interior light and horn.

Unit 3: Overhaul and Testing of Electrical system:

Starter Motor; Dynamo; alternator; ignition system; wiper motor; electrical solenoid switch; fuel pump; horn; flashing unit; wiring harness; distributor condenser; H.T coil; Spark plug; power door lock control system; electrical power steering; Air Bag Circuit.

Unit 4: Diesel Components Overhaul and Testing:

Grinding and lapping of injector; needle Valves; Troubles and diagnosis; multi cylinder inline and rotary fuel injection pump; single cylinder F.I Pump; hoses and pipe lines; jerk pumps; priming unit and tanks; fuel injector spray tests and pressure testing; Calibration and phasing of in-line and rotary fuel injection pumps on test m/c; trouble and diagnosis chart for injectors; F.I Pumps; CRDI Engine: troubles; diagnosis and testing : fuel system; injectors; particulate filters and sensors.

Unit 5: Automobile Air Conditioning System and Repair

Specifications; Functions and General layout of the components : Evaporator; compressor; thermostatic expansion valve; low and high pressure; condenser; dehydrator receiver and sight glass; Possible troubles and remedies; Procedure for discharging and recharging the Auto A/c System; Use of vacuum pump; Function and inspection of compressor relay; A/c relay; dual pressure switch vacuum switch; magnetic clutch; thermostat; H.P switch; cooling fan relay; A/c relay; Troubles and Diagnosis of A/c system

Reference(s):

1. Kohli, P. L., “Automotive Electrical Equipment”, Tata McGraw-Hill, 1983.
2. Maruti, Suzuki., “Service Training Handbook”, Maruti Udyog Ltd;
3. Lindley R. Higgins, R. Keith Mobley, “Maintenance Engineering Handbook”, McGraw-Hill Professional; 6th edition, 2001.

UT18R412	Modern Automobile Accessories	L	T	P	C
		3	0	0	3

ENGINE MANAGEMENT SYSTEMS

Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed loop ignition system. Catalytic converters and particulate traps.

CHASSIS

Active suspension control, Pneumatic suspensions, Power train monitoring, safety views-Modern development in Chassis management of vehicles.

HEATING AND AIR CONDITIONING

Principles of vehicle air conditioning and heating-Automatic climate control system-Modern trends in thermal management of vehicles-Influence of Electronics in thermal management of vehicles.

COMFORT AND CONVENIENCE

Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering.

SAFETY AND SECURITY SYSTEMS

Airbags, seat belt tightening system, collapsible and tilt-able steering column, Anti-theft system, anti-lock braking system, electronic stability control system/traction control system, roll overprotection system.

Theory: 45

References:

1. Tom Denton - Automobile Electrical and Electronic Systems - Edward Arnold, London - 1995.
2. Eric Chowanietz - Automotive Electronics- SAE International USA - 1995.
Other references:
1. Bosch Automotive Hand Book - 5th Edition - SAE Publication, USA - 2000.

IV –OPEN ELECTIVES

OEE18R008	**Photonics and Optoelectronic Devices**	**L**	**T**	**P**	**C**

		3	**0**	**0**	**3**

Course Outcomes:

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

CO-1: Know the fundamentals of fibre based optical devices

CO-2: Understand the basic of integrated optical devices

CO-3: Learn about the opto-electronic devices

CO-4: Understanding of nanostructured materials

CO-5: Understanding of quantum devices with applications

Unit – I: Optical Fibre based Devices

Introduction to optical Fibre; Fused single mode fibre directional coupler, Polished single mode fibre directional coupler; Fibrepolariser; Wavelength multiplexer and demultiplexer; Optical fibre switches and intensity modulators; Optical fibre phase modulator; Optical fibre frequency modulator; Optical fibre amplifiers

Unit – II: Integrated Optics based Devices

Optical directional coupler: directional coupler wavelength filter, polarisation splitting directional coupler; Polarisers: leaky mode polariser, metal clad polariser; Phase modulator; Optical switch; Acousto-optic devices : mode converter , tunable wavelength filter, Bragg type modulator , Bragg type deflector; Magneto-optic devices : TE-TM mode converter, modulators and switches, Ti / $LiNbO_3$ based optical devices.

Unit – III: Optoelectronic Devices

Semiconductor Lasers: homojunction, heterojunction and surface emitting lasers, quantum well lasers; Modulation of lasers; Photodetectors: PIN, Avalanche photodiodes; Optoelectronic modulation and switching devices; Electro-optic Devices; Optoelectronic Integrated circuits; SiO_2 / Si based optoelectronic devices.

Unit – IV: Nanophotonics

Nanocomposites: Nanocomposite Waveguides, Random Lasers, Nanocomposites for optoelectronics-Basics of nano-photonics-Introduction to MEMS and NEMS-Working principles: as micro sensors-biosensors, chemical sensors and optical sensors. MEMS/NEMS applications: Applications in automotive industry-health care-aerospace-industrial product-consumer products.

Unit – V: Quantum Devices

Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots; Density of states in low-dimensional structures; Resonant tunneling phenomena and

applications in diodes and transistors; Applications of quantum devices: quantum well and quantum dot lasers, ultra-fast switching devices, high density memories, dc and rf squids, multi-state logic circuits, long wavelength detectors ; Quantum Computing (Qualitative)

Reference Books:

1. Joachim Piprek, Semiconductor optoelectronic devices, Academic press Hardbound, 2003

2. A.K. Ganguly, Optoelectronic devices and circuits, Narosa publication, 2007

3. Shun Lien Chuang, Physics of Optoelectronic Devices, Wiley-Interscience; 1st ed.,1995

4. Goure and I Verrier, Optical Fibre Devices, Taylor& Francis; 1st ed., 2001

5. Ray Tricker,Optoelectronics and Fiber Optic Technology,Newnes, 2002

6. K Krishna Reddy M Balakrishna Rao, Nanostructures & Quantum Devices, Campus Books International, 2007

7. RahmanFaiz, Nanostructures in Electronics and Photonics, Pan Stallion press (Year)

8. Guozhong Cao, Nano structures &nanomaterials: synthesis, properties & applications, Imperial College Press, 2004

9. Todd D. Steiner, Semiconductor nanostructures for optoelectronic application, Artech House, INC., 2004

10. Jia- Ming Liu, Photonic Devices, Cambrige University Press, 2005

OEE18R009	LASER TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

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

CO-1: An ability to enhance the modern technological aspects in laser

CO-2: To correlate the basic concept of theoretical principles in laser

CO-3: An ability to improve the knowledge of various types of laser

CO-4: Enormous interest to study the various properties of laser.

CO-5: Knowledge of laser applications in various engineering fields

Unit - I: Absorption and Emission of Radiation

Concept of coherence – spatial and temporal - Conditions for Producing Laser - spontaneous and stimulated emission - Population Inversion-different methods-Einstein coefficients – negative absorption – Gain and Gain saturation - Saturation intensity - shape and width of spectral lines.

Unit - II: Threshold Condition and Resonators

Rate equations – optical excitation in three and four level lasers – standing waves in laser – cavity theory – dichroic filter – modes, diffraction theory of the Fabry – Perot interferometer – Types of resonators – stability diagram

Unit - III: Types of Lasers

Principle, construction, working-Gas lasers:He-Ne laser, , CO_2 laser- Liquid lasers: dye lasers, solid state laser: Ruby laser, Nd-YAG laser-applications.

Unit - IV: Ultrafast Photonics and Laser Q Switching

Introduction to ultrashort pulse lasers and amplifiers – wavelength conversion – time-resolved experiments – applications of ultrashort pulses – Mode locking – second harmonic generation – theory and experiment – materials for optical second harmonic generation

Unit - V: Applications

Measurement of distance, velocity, rotation with lasers – laser in communications and computer technology– holography – industrial applications – cutting, drilling & welding – lasers in medicine – laser in research and development

Text Books:

1. Simon Hooker & Colin Webb “Laser Physics” Oxford Press, 2010.

2. William T. Silfvast “Laser Fundamentals” Cambridge University Press, Second Edition, 2008.

3. William S. C. Chang “Principles of Lasers and Optics” Cambridge University Press, 2007.

4.Yehoshua Y. Kalisky “The Physics and Engineering of Solid State Lasers” SPIE Press, 2006.

5. Mark Csele“ Fundamentals of light sources and lasers” John Wiley and sons, New jersey 2004

OEE18R006	Industrial Chemistry for Engineers	L	T	P	C
		3	0	0	3

Course Outcome(s)

CO1 To apply the knowledge of electrochemistry to understand the working mechanism of batteries and sensors.

CO2 To understand the process involved in refining of petroleum, cracking of crude oil and manufacturing of fuel gases and to analyze the flue gas.

CO3 To understand the process of adsorption and colloidal state of materials.

CO4 To understand the formulation of protective coatings and to know the process of manufacturing and cleansing action of soaps.

CO5 To know the constituents, composition and manufacturing process of cement, glass and ceramics.

Unit - I: Energy Storage Devices and Sensors

Batteries - primary and secondary cells. Primary cell - Dry cell, Mercury cell. Secondary cell - Lead acid battery, Lithium battery. Solar cells & fuel cells (H_2-O_2, PEFC and SOFC) - principle, construction, working and application. Electrochemical sensors - working, application and merits.

Unit - II: Fuels and Combustion

Petroleum: Origin, refining, cracking - thermal and catalytic, reforming – thermal and catalytic, knocking and octane number, synthetic petrol - Fischer-Tropsch and Bergius method.

*Fuel Gases***:** Large scale production, storage, hazards and uses of LPG, coal gas, water gas, producer gas, and oil gas. Combustion (Problems). Mass analysis from volume analysis and vice versa. Analysis of flue gas (Orsat's apparatus).

Unit- III: Applications of Adsorption and Colloidal State

Adsorption: Classification of Adsorption – Adsorption of Gases on Solids – Adsorption from Solutions – Applications of Adsorption.

Colloidal state: Types of colloidal solution –Preparation and purification of colloidal solutions – Characteristics of colloidal solution –Coagulation of sols – Origin of charge on colloids – Stability of colloids – Applications of Colloids – Protective colloids – Emulsions – Gels – Micelles.

Unit - IV: Organic Protective Coatings and Soaps

*Paints & Varnishes***:** Requirements of a good paint. Primary constituents of paints, dispersion medium (solvent), binder, pigments, formulation of paints and varnishes.

Soaps: Classification of soap, manufacture of soaps by hot and cold process, cleansing action of soap and classification of detergents (anionic and cationic).

Unit - V: Siliceous Materials

Cement: Manufacture - Wet Process and Dry process, types, analysis of major constituents, setting of cement, reinforced concrete.

Glass: Composition and manufacture of glass .Types of glasses- optical glass, coloured glasses and lead glass.

Ceramics: Types- raw materials - white wares, manufacture and uses.

Reference Books:

1) Jain and Jain, *Engineering Chemistry*, 15th Edition, .Dhanpat Rai Publishing Company, New Delhi, 2005.
2) B.N. Chakrabarty, *Industrial Chemistry*, Oxford & IBH Publishing Co, New Delhi, 1981.
3) B.K. Sharma, *Industrial Chemistry*, 11th Edition, Goel Publishing House, Meerut, 2000.
4) P.P. Singh, T.M. Joesph, R.G. Dhavale, *College Industrial Chemistry*, 4th Edition, Himalaya Publishing House, Bombay, 1983.

OEE18R005	COMBINATORICS	L	T	P	C
		3	1	0	3

Course Objectives:

To enable the students to understand the concepts of permutation, combination and inclusion and exclusion principle.

Course outcomes:

Upon successful completion of this course, students will be able to

CO1. understand the rules of sum and product of permutations and combinations.

CO2. analyze the concepts of pigeonhole principle and its applications.

CO3. identify solutions by the technique of generating functions

CO4. understand the concepts of Pascal's triangle, the binomial Theorem and unimodality of binomial Coefficients.

CO5. understand the concepts of the principle of inclusion-exclusion and their applications.

Unit I - Permutations and Combinations

Four Basic Counting Principles, Permutations of sets, Combinations (Subsets) of Sets, Permutations of Multi-sets, Combinations of Multi-sets.

Unit II - The Pigeonhole Principle:
Pigeonhole Principle: Simple Form, Pigeonhole Principle: Strong Form, A Theorem of Ramsey.

Unit III - Generating Permutations and Combinations:
Generating Permutations, Inversions in Permutations, Generating Combinations, Generating r-Subsets**.**

Unit IV - The Binomial Coefficients:

Pascal's Triangle, The Binomial Theorem, Unimodality of Binomial Coefficients, The Multinomial Theorem, Newton's Binomial Theorem.

Unit V - The Inclusion-Exclusion Principle and Applications:

The Inclusion-Exclusion Principle, Combinations with Repetition, Derangements, Permutations with Forbidden Positions, Another Forbidden Position Problem.

Text Book :

1. Richard A. Brualdi, Introductory Combinatorics, Pearson Education, Inc, China machine press, Fifth Edition, 2009

References :

1. Miklos Bona, A walk through Combinatorics, (Second Edition), *World Scientific Publ. Co.,* 2008.
2. C. L. Liu, Introduction to Combinatorial Mathematics*, Mc Graw Hill Book Company, New York,* 1968.

OEE18R003	Mathematical Biology	L	T	P	C
		3	1	0	3

Course Objective:

To enable the students to understand the concepts of models for single species, interacting populations and dynamics of marital interaction.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Learn continuous population models for single species

CO2. Learn discrete population models for a single species

CO3. Understand models for interacting populations

CO4. Analyze the various competitive models..

CO5. Model the dynamics of marital interaction.

Unit-I: Continuous Population Models for Single Species

Continuous Growth Models, Insect Outbreak Model: Spruce Budworm, Delay Models. Linear Analysis of Delay Population Models: Periodic Solutions, Real Life Problems related to Growth Model.

Unit-II: Discrete Population Models for a Single Species

Introduction: Simple Models, Cob webbing: A Graphical Procedure of Solution, Discrete Logistic-Type Model: Chaos, Stability, Periodic Solutions. Discrete Delay Models, Tumor Cell Growth.

Unit-III: Models for Interacting Populations

Predator-Prey Models: Lotka-Volterra Systems, Complexity and Stability, Realistic Predator-Prey Models, Analysis of Predator-Prey Model with Limit Cycle, Periodic Behavior: Parameter Domains of Stability.

Unit-IV: Competitive Models

Competition Models: Competitive Exclusion Principle, Mutualism or Symbiosis, General Models and Cautionary Remarks, Threshold Phenomena, Discrete Growth Models for Interacting Populations, Predator- Prey Models : Detailed Analysis.

Unit-V: Modelling the Dynamics of Marital Interaction: Divorce Prediction and Marriage Repair

Psychological Background and Data: Gottman and Levenson Methodology, Maital Typology and Modelling Motivation, Modelling Strategy and the Model Equations, Steady States and Stability.

Text Book:

1. J. D. Murray, Mathematical Biology: I. An Introduction, Third Edition, *Springer-verlag Berlin Heidelberg,* 2002.

REFERENCE BOOKS:

1. R.M. Anderson and R. M. May, editors, Infectious Disease of Humans : Dynamics and Control. *Oxford University Press, Oxford*, 1991..
2. O. Diekmann and J. A. P. Heesterbeek. Mathematical Epidemiology of Infectious Diseases: Model Building, *Analysis and Interpretation. John Weily, New York*, 2000.

OEE18R004	MATHEMATICAL MODELLING	L	T	P	C
		3	1	0	3

Course Objective:

To make the students to be capable of doing simple mathematical modelling using differential equations and difference equations.

Course Outcomes:

Upon successful completion of this course**,** Students will be able to

CO1: Understand the mathematical modelling of ordinary differential equation of first order.

CO2: Know about the concepts of mathematical modelling in difference equations and Linear difference equations.

CO3: Know mathematical modelling through partial differential equation and study about the mass-balance equations.

CO4: Know the first and second methods of obtaining partial differential equation models.

CO5: Study about the mathematical modelling through delay differential and functional equations.

Unit I:

Review of ODE and System of First Order ODE - Mathematical modelling in population dynamics-Epidemics through systems of ODE of first order - Mathematical modelling through systems of ordinary differential equations of the first order.

Unit II:

Difference Equation and its solution - Mathematical modelling through difference equations - The need for mathematical modeling through difference equations some simple models-Basic theory of linear difference equations with constant coefficients.

Unit III:

Review of PDE and solution of simple linear PDEs, Mathematical modelling through Partial differential equation -situation giving rise to Partial differential equation models-Mass-balance equations.

Unit IV:

First method of getting Partial differential equation models-Momentum balance equations the second method of obtaining PDE models.

Unit V:

Integral Equations - Solution of Simple Integral Equations - Mathematical modelling through functional Integral , delay differential and differential difference equations.

Text Book:

1. J.N. Kapur, Mathematical modelling, *New age international publishers,* 2005 (Reprint).

Reference Book:

1. Frank R. Giordano, William P. Fox, Steven B. Horton , A First Course in Mathematical Modelling , *Cengage Learning Publishers, 5th Edition*, 2013.

V –HUMANITIES ELECTIVES

HSS18R001Management Concepts and Techniques	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course addresses the definition of management, its characteristics, evolution and importance as well as the functions performed by manages-planning, organizing, directing and controlling. The course also intends to show students the applications of management functions in various enterprises such as marketing, finance, personnel, production, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Explain the historical backdrop and fundamentals of Management thoughts vital for understanding the conceptual frame work of Management as a discipline.

CO2: To Discuss about the various concepts of planning, Decision making and controlling to help solving managerial problems

CO3: To Understanding concepts of Ethics, Delegation, Coordination and Team work

CO4: To Study and understand the management concepts and styles in Global context

CO5: To develop an understanding about emerging concepts in management thought and philosophy

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						M						L			
CO2							M	M	L	L					
CO3						L		H	H	M					
CO4						H	M			L					
CO5							H					H			

Course Topics:

Unit 1: Development of Management Thoughts **9 Hours**

Scientific Management Movement - Administrative Movement - Human Relations Movement -Decision Movement - Behavioural Science Movement - Systems Movement - Contingency Movement.

Unit 2:Essentials of Planning **9 Hours**

Planning Objectives – Goals - Programmed Decisions and Unprogrammed Decisions; Decision – Making - Creativity in Decision - Making, Forecasting and Strategy to Formulation

Unit 3: Effective Organising **9 Hours**

Span of Control – Departmentation - Authority; Responsibility - Bureaucracy and Adhocracy; Group Dynamics

Unit 4: Staffing and Directing **9 Hours**

Staffing: Manpower Planning – Recruitment Sources – Selection Procedure – Training Methods – Performance Evaluation Methods – Executive Development Programs -

Directing: Communication Process and Barriers – Motivation Techniques – Financial and Non – Financial Motivation- Leadership Qualities and Styles

Unit 5: Controlling and Recent Concepts **9 Hours**

Controlling: Meaning and Process - Requisites of Effective Control - Control Techniques. Emerging Issues in Management: Japanese and American Management – Management by Objectives – Knowledge Management – Technology Management – Business Process Outsourcing- Social Responsibility and Business Ethics

Text Book(s):

1. Harold Koontz, Heinz Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10th Edition, McGraw Hill, 2016
2. Stephen P. Robbins, Mary A. Coulter, Management, 13th Edition, Pearson Education Limited, New Delhi, 2016

Reference(s):

1. C.B.Gupta, Management Theory and Practice, 19th Revised Edition, Sultan Chand and Sons.2017.
2. L.M.Prasad, Principles and Practices of Management, 9th Edition, Sultan Chand and Sons, 2015.
3. K.Aswathappa, Essentials of Business Environment: Text Cases and Exercises 12th, edition, Himalaya Publishing House, Mumbai, 2014.
4. Tripathi, Reddy, Principles of Management, 5th Edition, McGraw Hill, 2012

HSS18R002 Marketing Management	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course develops students understanding of how organizations match the requirements of consumers in competitive environments, and develop strategies to create the competitive edge. It covers areas such as analysis, planning, implementation, and control, as well as the marketing mix, exportation, and the social aspects of marketing.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To develop understanding of marketing concepts, philosophies and historical background.

CO2: To develop understanding of marketing operations and complexities for students to apply in practical business situations.

CO3: To understand concepts related to Segmentation, Targeting and Positioning, product attributes, and pricing strategies prevalent in domestic and international scenario.

CO4: To Study various tools and techniques of promoting the products in ethical manner.

CO5: To Understand emerging concepts of marketing in the emerging global markets

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						M	L					L			
CO2							M	M	L	L					
CO3						L		H							
CO4						H	M	H	L	L					
CO5							H					H			

Course Topics:

Unit 1: Marketing **9 Hours**

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process –Marketing mix – Marketing department

Unit 2: Product **9 Hours**

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix - branding. Packing, labelling

Unit 3: Pricing **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4: Distribution **9 Hours**

Nature of Marketing channels - Types of Channel flows – Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping

Unit 5: Promotion **9 Hours**

Promotion Mix - Advertisement - Message - copy writing – Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling steps, publicity and direct marketing

Text Book(s):

1. Philip.T. Khotler, Kevin Lane Keller, Marketing Management, 15th Edition, Pearson Education, New Delhi, 2016.
2. Ramaswamy.VS, Namakumari. S, Marketing Management – Global Perspective, Indian Context, McGraw Hill, 2013

Reference(s):

1. Rajan Saxena, Dorector, Jain S.P., Marketing Management, McGraw Hill, 2006.
2. K.S. Chandrasekar, Marketing Management, Text and Cases, McGraw hill 2013.
3. Tapan K. Panda, Marketing Management Text and Cases, 2nd Edition, Excel Books.2008

HSS18R003 Organisational Psychology	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course aims to clarify the principles and basic concepts of organizational psychology. Including organizations and understanding its business design based on efficiency and quality of employee life. It also aims at enhancing the quality of life of employees. When organization's aspects are gauged in terms of psychological assessment, personnel decisions in line with training and development, organizational change and organizational health in specific the intrinsic problems are understood paving way towards standards that are high.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts of industrial and organisational psychology

CO2: To illustrate different ways of achieving organisational effectiveness through individual behaviour.

CO3: To learn the concepts relating to individual behaviour to achieve group target and achieve leadership position in organisation.

CO4: To understand the organisational changes and means to evaluate based on nature of organisations.

CO5: To learn implications of changes aligning the interest of individual, group and organisation.

Mapping of Course Outcome(s):

CO /	PO												PSO		
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						M		L	M						
CO2						L		L	M	M					
CO3						L		L	M	H					
CO4						L	L	L	L	L					
CO5						L	L	L				L			

Unit 1: Focus and Purpose **9 Hours**

Organisational Behaviour - Need and importance, nature and scope, framework

Unit 2: Individual Behaviour **9 Hours**

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics –components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception

Unit 3: Group Behaviour **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4: Leadership **9 Hours**

Leadership styles – theories – Qualities - leaders Vs managers – sources of power – power centres – power and Organisational Politics- Motivation

Unit 5: Organisational Development **9 Hours**

Organizational development - Importance, characteristics, objectives, stability Vs change, proactive vs reaction change, the change process, resistance to change, managing change, team building - Organizational effectiveness, perspective, effectiveness Vs efficiency, approaches, the time dimension, achieving organizational effectiveness

Text Book(s):

1. Stephen Probing and Timothy A. Judge, Organisational Behavior, Peason Education, 17th edition, 2017.
2. Fred Luthans, Organisational Behavior, McGraw Education, 12th Edition, 2010

Reference(s):

1. Aswathappa, Organisational Behavior, Himalaya Publishing House, 12th edition, 2016.
2. P.Subba Rao, Management and Organisational behavior: Text, Cases and Games, Himalaya Publishing House, 1st edition, 2010.
3. Mullins, Organisational Behavior, Pearson Education Limited, 9th edition, 2010.
4. L.M.Prasad, Organisational Behavior, 5th edition, Sultan Chand and Sons, New Delhi, 2014

HSS18R004 Project Management	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course describes concepts relating to project management and enable students to evolve project objectives appropriately with relevance to business proposals. It covers the required dimensions relating to evaluation of project by testing the technical feasibility, financial viability, market acceptability and social desirability of projects. It gives an account on risk and profitability analysis that facilitates the making of the effective project proposal and guides learners in project planning, implementation and control. It also emancipates the scope of project management in undertaking foreign collaboration projects.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Familiarizes the concept of project and steps in project management.
CO2: Understand the basics stages involved in preparing business proposals.
CO3: Evaluate the technical feasibility, financial viability, market acceptability and social desirability of projects.
CO4: Enabled to analyse the Risk and profitability of the project proposals
CO5: Act effectively as project managers and as part of project teams

Mapping of Course Outcome(s):

CO /	PO												PSO		
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							L		L	M	H	L			
CO2						L		L	H	H	L				
CO3						H		L	L	L	H				
CO4						L	L	L	L	L	H	L			
CO5						L		L	H	L	L	L			

Course Topics:

Unit 1: Introduction to Project Management **9 Hours**

Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting

Unit 2: Stages of Project Management **9 Hours**

Opportunity studies - prefeasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal: Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment

Unit 3: Appraisal Process **9 Hours**

Concepts.Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice

Unit 4: Risk and Profitability Analysis **9 Hours**

Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Means of financing, Term Loans, Financial Institutions. Cost of capital. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections

Unit 5: Project Planning, Implementation And Control **9 Hours**

Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network. Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects

Text Book(s):

1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, 8th Edition, McGraw Hill, 2014.
2. M.R. Gopalan, Project Management Core Textbook, 2nd edition, Wiley India, 2015

Reference(s):

1. Harold Kerzne, Project Management - Best Practices: Achieving Global Excellence, 3edition, Wiley Publications, 2013
2. George Ritz, Sidney Levy, Project Management in Construction, Sixth Edition, Mc. Graw Hill Education, 2011.
3. Gary Heerkens, Project Management, 2ndEdition, Mc. Graw Hill, 2013
4. P.Gopalakrishnan and V.E.Rama Moorthy Text Book of Project Management,1st Edition, Macmillan India Ltd., New Delhi, 2014.
5. John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, 5th Edition, Routledge, 2016

HSS18R005 Stress Management and Coping Strategies	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

Stress has become an integral part of every professional's life. Approaching the stress in the right manner has become imperative as it has become an unavoidable one. The stress and its effect over performance has also become notable in today's organization. To cope well and to sustain in market, for that the skills are required to understand and to overcome the same. This course helps in understanding the intricacies of stress and overcoming the stress through appropriate approaches.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: The students understand the responsibility of tackling stress

CO2: The students identify and modify the approaches of stress accordingly while dealing with team in workplace.

CO3: Those students who are prone to face high- pressure working conditions will be able to tackle stress appropriately without ignoring.

CO4: The students will implement a stress -free work environment.

CO5: The students will enrich their way of behaviour and personality and ensure professional working condition and balanced quality of life.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							L		L	M		L			
CO2						L		M	H	H					
CO3						M		L	L						
CO4						L	L	L	L	L		L			
CO5						L		L	H	L		L			

Unit 1: Understanding Stress **9 Hours**

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing Stress – Burnout

Unit 2: Common Stress Factors Time **9 Hours**

Common Sources of Stress Biological, Personality and Environmental – Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area - Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'

Unit 3: Crisis Management **9 Hours**

Implications – People issues – Structure issues, environmental issues, psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment

Unit 4: Work Place Humour **9 Hours**

Developing a sense of Humour – Learning to laugh, role of group cohesion and team spirit, using humour at work, reducing conflicts with humour. Coping Styles Defensive Behaviours and Problem-Solving

Unit 5: Self Development **9 Hours**

Improving Personality – Leading with Integrity, enhancing creativity – Effective Decision Making – Sensible Communication – The Listening Game – Managing Self - Meditation for Peace – Yoga for Life

Text Book(s):

1. D. Gordano and G. Everly., "Controlling Stress and Tension", 9th Edition, Prentice-Hall, 2013.
2. Greenberg Jerrold S., Comprehensive Stress Management, 14th Edition, McGraw Hill Education, 2017.

Reference(s):

1. Dr. P.K.Dutta, “Stress Management” Himalaya Publishing House, First Edition 2010.
2. Schafer, Stress Management, 4th Edition, Cengage Learning, Delhi, 2008
3. Wolfgang Linden, Stress Management, Sage Publication, 1st Edition 2005.
4. Daniel Girdano, Dorothy Dusek and George S. Everly, Controlling Stress and Tension, 8th Edition, Pearson Education, 2009.
5. Brian Luke Seaward, Essentials of managing Stress, 1st edition, Jones & Bartlett Publishers, 2013

HSS18R006 Economics for Engineers	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course introduces a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics - the analysis of choices made by individual decision-making units (households and firms) - and macroeconomics - the analysis of the economy. Demand and market structure will be analysed at the firm level. Macroeconomic issues regarding National Income, Inflation, labour and money at an aggregate level will be modelled. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and learn economic concepts into market economies.

CO2: Understand the pricing methods, interpret the market factors to determine the price for products or services and to making decisions based on demand factors.

CO3: Understand the major characteristics of different market structures and the implications for the behaviour of the firm.

CO4: Measure living standards, inflation, and unemployment for use as economic indicators.

CO5: Understand the role of international trade,

CO6: Analyse the determinants of the relative strengths of monetary policy for sustainable growth of our nation and International Trade.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1											H				
CO2						L		L			M				
CO3						L	L		M	L	L				
CO4	H	H									L				
CO5	L							L	L						
CO6								L			M				

Unit 1: Definition and Scope of Economics **9 Hours**

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing StressDefinitions by A. Smith, A. Marshal and L. Robbins, P.Samuels on and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics

Unit 2: Pricing and Law of Demand **9 Hours**

Demand, Factors influencing demand, Elasticity of demand - price, income and cross, concepts and measurement - Break Even Analysis – Law of Demand - Price, income and substitution effects - Giffen goods- Pricing Methods.

Unit 3: Market Structure **9 Hours**

Definition of market.Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules.Price determination under perfect competition in long and short run.Price determination under monopoly. Discriminating monopoly

Unit 4: Macro Economics **9 Hours**

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

Unit 5: Commercial and Central Banks **9 Hours**

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

Text Book(s):

1. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 2nd Edition, 2009.
2. Ruddar Datt and K.P.M. Sundharam, Indian Economy, 70th Edition, S. Chand & Company Ltd., New Delhi, 2013.

Reference(s):

1. D.N. Dewedi, Managerial Economics, 8th Edition, S. Chand & Company Ltd., New Delhi, 2005.
2. Gupta, G.S. Macroeconomics, Theory and Applications, 2nd edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2004.
3. Macroeconomic –Theory and policy, 3rd Edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2010.
4. Micro Economics, Mas Colell, 1st edition, Oxford Press, Delhi, 2012

HSS18R007 Human Resource Management and Labour Law	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course aims at exploring key issues related to the management, performance, and development of human resources in the workplace. It places special emphasis on making decisions and developing plans that will enable managers to make the best possible use of their human resources, and covers areas such as: manpower planning, analysis and evaluation, recruitment and selection, wages and salaries, training and management development, performance appraisal, and industrial relations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To provide the basic knowledge on developing the employment relations and knowledge to resolve the issues.

CO2: To design an appropriate and suitable role of HR specialist for implementing Human Resource Management policies.

CO3: To Manage the manpower to motivate and attract them to retain in the organization.

CO4: To Develop the responsibility of employer and legal system to manage the employment relations

CO5: To Provide more insights on the applicability of business law on various functional domains this in turn enhances a strong human relation

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							L	L	M						
CO2									M	M					
CO3									H	H					
CO4						L		L	L						
CO5						L	L	L	H						

Course Topics:

Unit 1: Fundamentals of HRM **9 Hours**

Human Resource Development Systems-HR environment in India-Functions and Operations of a Personnel Office - Emerging HR Trends - HR information system

Unit 2: HRM Functions **9 Hours**

Job analysis and job design - HR planning – Recruitment - selection and induction-Staff Training and Development-Career planning and Development- Job Evaluation-Performance Appraisal and Potential Evaluation-Wage determination; salary structure-Wage policies and Regulations-Employee benefits and services.

Unit 3: Motivating Human Resources **9 Hours**

Team and Team work - Collective Bargaining Employee Morale – Participative Management – Quality Circle – Empowerment –counselling and mentoring

Unit 4: Maintenance of Workers **9 Hours**

Compensation Management- Reward system – Labour relations –Employee Welfare, Safety and Health – Employee benefits and services – Promotion, Transfers and separation – Ethical issues in HR Management and International Human Resource Management - Legal Aspect of Labour

Unit 5: Business Law **9 Hours**

Factories Act, 1948 - Industrial Dispute Act, 1947 – Industrial employment – Standing Orders Act, 1946 – Trade Union Act, 1926 - Workmen Compensation Act, 1923, Employees State Insurance Act, 1948, Employees Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act, 1972. Payment of Wages Act 1936, Minimum wages Act, 1948– Payment of Bonus Act, 1965.Tamil Nadu Shops and Establishments Act.

Text Book(s):

1. Decenzo and Robbins, Human Resource Management, Wiley, 12th edition, 2015.
2. Prasad L.M., Human Resource Management, Sultan Chand, 2014.

Reference(s):

1. Biswajeet Pattanayak, Human Resource Management, 3rd edition, Eastern Economy Edition, New Delhi, 2010.
2. C.B. Gupta, Human Resource Management, 13th Edition, Sultan Chand
3. V.S.P. Rao, Human Resource Management, 3rd edition, Excel Books.
4. Frank B. Cross and Roger LeRoy Miller, The Legal Environment of Business Text and cases, 9th Edition, Cengage Learning, 2015.

HSS18R008 Entrepreneurship Development	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course focuses on the entrepreneurial process and the different kinds of entrepreneurial outcomes. Topics covered include opportunity identification through analysis of industry niches, skills needed to turn an opportunity into reality, business plans, launch decisions, and obtaining risk capital. This course deals with the problems and challenges facing the management of businesses in raising funds, marketing products and services, improving effectiveness and flexibility, and achieving growth.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: It provides more insights into the concept of entrepreneurship and which in turn leads to think creatively for new business opportunities to sustain individual as well as social goals.

CO2: It provides and promotes entrepreneurial spirit and provides a framework of successful business world with relation to agencies to promote employment opportunities.

CO3: It focuses on women entrepreneurship and promotes a successful business models and explains operational implementations for investment details.

CO4: It provides the role of government in promoting the entrepreneurship among the individuals and organizations as a whole

CO5: To Understand emerging concepts of marketing in the emerging global markets and provide more insights into project management and venture promotion

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						H	L	L	M	L		L			
CO2						L		L	L						
CO3						M		M	M						
CO4								L	H	L					
CO5							H				L	H			

Unit 1: Basics **9 Hours**

Concepts of entrepreneur, entrepreneurship and entrepreneur - Characteristics and competencies of a successful entrepreneur - General functions of an entrepreneur - Type of entrepreneurs - Role of entrepreneur in economic development - Distinction between an entrepreneur and a manager - Entrepreneur and Intrapreneur

Unit 2: Growth of Entrepreneurship **9 Hours**

Emergence of entrepreneurship - Economic and non-economic factors for stimulating entrepreneurship development - Obstacles to entrepreneurship development in India - Growth of entrepreneurship in India.

Unit 3: Women and Entrepreneurship **9 Hours**

Concept of women entrepreneurship - Reasons for growth of woman entrepreneurship - Problems faced by them and remedial measures

Unit 4: Role of the Government in Entrepreneurship Development 9 Hours

Concept and meaning of entrepreneurship development - Need for entrepreneurship development programmes (EDPs) - Objectives of EDPs - Organizations for EDPs in India; NIESBUD, SISI – their roles and activities.

Unit 5: Venture Promotion and Project Formulation 9 Hours

Concept of projects classification of projects and project report - Project identification and selection - Constraints in project identification - Techniques of Project Identification, Significance – contents - formulation of project report - Need for Project Formulation - Elements of project Formulation

Text Book(s):

1. Michael H Morris, Corporate Entrepreneurship and Innovation in Corporations, 7th Edition, CENGAGE Learning, Delhi, 2010
2. Jerry Katz, Entrepreneurship Small Business, 5th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007

Reference(s):

1. Khanka S.S., Entrepreneurial Development, 1st edition, S. Chand and Company Limited, New Delhi, 2013.
2. Prasama Chandra, Projects: Planning, Analysis, Selection, Implementation and Reviews, 2nd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Robert D. Hisrich, Entrepreneurship, 10th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

HSS18R009 Cost Analysis and Control	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course in meant to exhibit the concepts on costing by describing its elements, types and cost sheet preparation. It also encompasses the analytical framework that can be applied in cost analysis like Marginal costing, CVP analysis, break even analysis, etc. enabling the students to make decisions on cost parameters. Students are enabled to apply techniques like standard costing, activity based costing, etc. to manage and control cost effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the basics of Costing and preparation of Cost sheet.

CO2: Analyse the cost by applying tools like Marginal costing, CVP analysis and other applications.

CO3: Enabled to use Budgets for controlling cost in Manufacturing or Production Centres.

CO4: Defining cost standards and critically examining the application of Standard costing in a Production Centre.

CO5: Understanding the application of various strategic cost alternatives including Activity based costing.

Mapping of Course Outcome(s):

CO /	PO												PSO		
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1											H	L			
CO2											H	L			
CO3	L			L							M				
CO4									L		M				
CO5											M				

Course Topics:

Unit 1: Basics of Costing **9 Hours**

Costing, Elements of costing, Types of cost, Preparation of cost sheet

Unit 2: Cost Analysis **9 Hours**

Marginal costing, Cost - volume – Profit analysis, Break-Even- Analysis, Break –Even - Chart, Applications.

Unit 3: Control Techniques **9 Hours**

Budgeting and Budgetary control, Types of Budgets, Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, zero based Budgeting

Unit 4:Standard Costing **9 Hours**

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing –Control through variances.

Unit 5: Activity Based Costing **9 Hours**

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory)

Text Book(s):

1. K.Saxena & C.D. Vashist, Advanced Cost Accounting and Cost Systems, 2nd Edition, V.Sultan Chand & Sons Publishers. 2014
2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers, 1st Edition, 2017

Reference(s):

1. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2008
2. Don R. Hansen, Maryanne M. Mowen, Cornerstones of Cost Management, 6th Edition, Cengage Learning, 2015
3. Roger Hussey, Audra Ong, Strategic Cost Analysis, Business Expert Press, 2012.

HSS18R010 Product Design and Development	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course aims to clarify the principles and basic concepts of Product Design and Development. Including organizations and understanding of its products. It also aims at enhancing the quality of products. Product Design means recognition of a new product need, information gathering and requirements setting up, unambitious-clear and complete specification list, study on the product's mechanical architecture, selection of materials and production processes and engineering the various components necessary to make the product work. Product Development means identification of market opportunity, creation of product to appeal to the identified market, and finally, testing, modifying and optimizing the product until it is ready for production.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts related to design and development of New product

CO2: To understand the structured approach towards incorporating quality, safety, and reliability into design.

CO3: To learn the concepts relating to simulating product performance and manufacturing processes.

CO4: To understand the technologies related to computer aided group technology

CO5: To learn implications of changes related to Economic analysis.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				L		L	M					L			
CO2				L		L	M					L			
CO3							M					L			
CO4							L	L				L			
CO5				L				M		L	L	L			

Course Topics:

Unit 1: New Product Idea **9 Hours**

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flowcharting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification

Unit 2: New Product Design **9 Hours**

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits. The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance.

Unit 3: Role of Technology in Designing **9 Hours**

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product

Unit 4: Methods and Principles of Designing **9 Hours**

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules - Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimising part variations – Design of parts to be multifunctional, multi-use, ease of fabrication – Pooka Yoka principles.

Unit 5: Feasibility Analysis **9 Hours**

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights.

Text Book(s):

1. Karl. T.Ulrich, Steven D., Product Design and Development, McGraw Hill International, 6th Edition, 2016.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 3rd edition, Prentice Hall of India Private Limited, New Delhi, 2005

Reference(s):

1. Richard Crowson, Product Design and Factory Development, 2nd Edition, CRC Press, 2005.
2. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case 9-600-143, June 22, 2000.
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill Higher Education, 4th Edition, 2012.
4. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education

HSS18R011 Business Process Reengineering	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course aims to clarify the principles and basic concepts of Business Process Engineering. This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The main objective of the course is to prepare the student to play a significant role in the management of a world class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn the basic concepts related to Business Process Reengineering.

CO2: To understand the methodologies and tools used for Business Process Reengineering.

CO3: To learn the concepts relating to benefit/cost analysis and its impact on the business organizations.

CO4: To understand the need for assessment of business re-engineering and the factors contributing to its success.

CO5: To learn the best practices used in Business Process Reengineering with illustrations from corporate world.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						L	L	M	L						
CO2						L	L	H	L						
CO3						L		L	L	L	M	L			
CO4	L						L	L							
CO5							M					H			

Course Topics:

Unit 1: Basic Concepts **9 Hours**

Introduction to BPR Definition; the paradigm shifts in production; the positioning concept; the re-engineering visions; the benefits of business re-engineering

Unit 2: Methodologies for BPR **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process.

Unit 3: Modelling the Business **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process

Unit 4: Change Management **9 Hours**

Change Management, Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering.

Unit 5: Best Practices in BPR **9 Hours**

Best Practices in BPR, Case studies: Bell Atlantic, Nissan, Chrysler, Xerox, and Hewlett Packard etc.

Text Book(s):

1. Ali K. Kamrani, Maryam Azimi (2011). New Methods in Product Design: New Strategies in Reengineering (Engineering and Management Innovation). CRC Press. 1st ed.
2. Bassam Hussein (2008). PRISM: Process Reengineering Integrated Spiral Model. VDM Verlag Dr. Mueller e.K

Reference(s):

1. Harmon, P. (2007), Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals, Elsevier/Morgan Kaufmann Publishers.
2. R. Anupindi et al. (2006), Managing Business Process Flows: Principles of Operations Management, Pearson

HSS18R012 Political Economy	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This course introduces the political economy of India. It examines the interplay of politics and economics. Some of the key themes to be explored are globalization, economic reform, poverty, redistribution, federalism, political protest, public goods delivery, gender, and ethnic politics. Although this class focuses specifically on India, many the themes discussed in this course are functions of institutions, rights, Party Systems and challenges.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the key concepts of political economy analyse the significant developments in the political ideologies.

CO2: Describe the salient features of the constitution of India and its functions and interpret, integrate and critically analyse the fundamental rights duties and responsibilities.

CO3: Understand the Political party system their evolution and role in the economy

CO4: Understand the various ideological of Indian Political Thoughts

CO5: Have a deep understanding and appreciation of India undergoing major economic and social transformation

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						L		H				L			
CO2						L		M	L	L	L				
CO3											L				
CO4	L						L								
CO5							L					L			

Unit 1: Basics of Political Economy **9 Hours**

Political Economy as a Method, perspectives, Politics as Reproduction of Social Relations, State and Social Opportunity, Politics of Rent Seeking -Evolution of State in India: Historical Roots of planning, Redistribution

Unit 2: Indian Constitution **9 Hours**

The Pre-amble- Fundamental rights and duties, Directive Principles- Offices of the President, Prime Minister, Cabinet Government, Chief Election Commissioner, and Governor – Parliamentary system and Procedures - The Judiciary system.

Unit 3: Party System **9 Hours**

National and regional political parties, ideological and social bases of parties; patterns of coalition politics; Pressure groups, trends in electoral behaviour; changing socio-economic profile of Legislators.

Unit 4: Indian Political Thought **9 Hours**

Political Ideologies: Liberalism, Socialism, Marxism, Fascism, Gandhism and Feminism - Dharamshastra, Arthashastra and Buddhist traditions; Sir Syed Ahmed Khan, Sri Aurobindo, M.K. Gandhi, B.R. Ambedkar, M.N. Roy.

Unit 5: Challenges to Indian Democracy **9 Hours**

Uneven Development of Regions in India – Communalism – Regionalism – Violence – Corruption – environmental degradation- illiteracy –**p**opulation

Text Book(s):

1. Charles Sackrey, Geoffrey Schneider, Janet Knoedler, Introduction to Political Economy, Dollars & Sense, 8th Edition, 2016.
2. Robert.S.Dimand, Review of Political Economy: An Introductory Text, 1st Edition, Routledge, 2008.

Reference(s):

1. Barry R. weingast and Donald A.Wittman, Handbook of Political Economy, 1st Edition, Oxford University Press, New York, 2006.
2. Ed. Sanjay Ruparelia; Sanjay Reddy; John Harriss & Stuart Corbridge, Understanding India's New Political Economy: A Great Transformation, Routledge 1st Edition 2011.
3. M.Laxmikanth, Indian Polity, 4th Edition, McGraw Hill Education, New Delhi,2017.
4. Niraja Gopal Jayal, Pratap Bhanu Mehra, The Oxford Companion to Politics in India: Student Edition, Oxford Press, 2011

HSS18R013 Professional Ethics	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This subject will provide students with ability to understand and analyse managerial problems in industry so that they can use resources (capitals, materials, staffing, and machines) more effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify the multiple ethical interests at stake in a real-world situation or practice

CO2: Assess their own ethical values and the social context of problems

CO3: Develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change

CO4: demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work

CO5: Manage differing opinions on complex ethical scenarios. It's important for those confronted with ethical challenges to be able to hold multiple conflicting points of view, without necessarily adhering to any of them.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						L		H	L	L					
CO2						H	L	H	L	L					
CO3				L			M					L			
CO4						M	M		M	M		L			
CO5								M		L					

Unit 1: Engineering Ethics **9 Hours**

Functions of Being a Manager – Stock holder and stakeholder management – Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

Unit 2: Engineering as Social Experimentation **9 Hours**

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories.

Unit 3: Engineer Responsibility for Safety **9 Hours**

Corporate social responsibility - Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

Unit 4: Responsibility And Rights **9 Hours**

Moral imagination, stake holder theory and systems thinking - One approach to management decision – making Leadership.

Unit 5: Global Issues **9 Hours**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct

Text Book(s):

1. Mike Martin and Roland Schinzinger, Introduction to Engineering Ethics, 2nd Edition, McGraw Hill, 2010.
2. Charles D Fledderman, Engineering Ethics, Pearson, 2011.

Reference(s):

1. R.S.Nagarajan, Text book on Professional Ethics and Human Values, New Age International, 2007.
2. Gail Baura, Engineering Ethics- An Industrial Perspective, 1st Edition, Academic Press, 2006.
3. Charles e. Harris, Michael s. Pritchard and Michael J. Rabins Texas, Engineering Ethics- Conecpts and Cases, 4th Edition, Cengage Learning, 2009.
4. Charles Byms Fleddermann, Engineering Ethics, Pearson, 2008.
5. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2013.
6. Dr.V.Jeyakumar, Professional Ethics in Engineering, Lakshmi Publication, Chennai, 2014

HSS18R014 Operations Research	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

It is essential for professionals in any field to understand the ethical problems and principles in their field. The general principles of professional ethics will be examined, as well as the distinctive problems. This course is presented in three parts: theory; case studies; and research and presentation. Theory includes ethics and philosophy of engineering.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and develop operational research models from the verbal description of the real System.

CO2: Build and solve Transportation Models and Assignment Models

CO3: Use mathematical software to solve the proposed models.

CO4: Develop a report that describes the model and the solving technique, analyse theresults and propose recommendations in language understandable to the decision-making processes in Management Engineering.

CO5: Design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			L					L							
CO2			M									L			
CO3			L							L					
CO4			L							L					
CO5			M				L			L	M	L			

Unit 1: Linear Programming Basics **9 Hours**

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method

Unit 2: Transportation Models and Assignment Models **9 Hours**

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy - Transhipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

Unit 3: Integer Linear Programming and Game Theory **9 Hours**

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two Person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

Unit 4:Replacement Models and Decision Theory 9 Hours

Replacement Models-Individuals Replacement Models (With and without time value of money) – Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty.

Unit 5: Project Management Method and Simulation 9 Hours

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource levelling techniques - Application of simulation techniques for decision making

Text Book(s):

1. Kalavathy S, Operations Research, Vikas Publishing House, 4TH Edition, 2013.
2. Paneerselvam R., Operations Research, Prentice Hall of India, 2ND Edition, 2006.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

Reference(s):

1. D.S.Hira, Problems in Operations Research, Kindle Edition, S.Chand, 2010.
2. Prem Kumar Gupta and D.S. Hira, Operations Research,S.Chand, 2016.
3. R.C.Mishra,Principles of Operations Research, 1st Edition, New Age International 2011.
4. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, 15th Edition, Sultan Chand and Sons 2010

HSS18R015 Total Quality Management	L	T	P	Credits
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Humanities Elective **Course Type:** Theory			

Course Objective(s):

This subject provides students with the knowledge to understand the philosophy and core values of Total Quality Management (TQM). It helps to determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality. Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the role and nature of quality in evolving international economic conditions

CO2: Apply the Principles of Quality Management for real time problems.

CO3: the quality encounter process, including supporting facilities and customer requirements/characteristics

CO4: Classify quality measurement methods and continuous improvement process

CO5: Frame Management strategy methods, including identification, development, implementation and feedback processes

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1								L			M				
CO2						M	L					L			
CO3						L				L	L				
CO4										L					
CO5							L			M		M			

Unit 1: Introduction to Quality Management **9 Hours**

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

Unit 2: Principles and Philosophies of Quality Management **9 Hours**

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit 3: Statistical Process Control and Process Capability **9 Hours**

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts –

definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit 4: Tools and Techniques for Quality Management **9 Hours**

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process.Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation.

Unit 5: Taguchi Techniques **9 Hours**

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

Text Book(s):

1. Poornima M.Charantimath., Total quality management, Pearson Education, 2nd Edition, 2011.
2. Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).

Reference(s):

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition, 2002.
2. Jams R. Evans, Total Quality: Management, Organisation and strategy, 4th Edition, South- Western College, 2004.
3. Vincent K.Omachonu, Joel E.Ross, Principles of Total Quality, 3rd Edition, CRC Press, 2004.
4. S.Rajaram, M. Sivakumar, Total Quality Management, Wiley Publishers, 1st Edition, 2008