REGULATION 2015

M. TECH – AUTOMOBILE ENGINEERING

CURICULUM AND SYLLABUS

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MMA101	Advanced Mathematics for Automobile Engineers	3	1	0	4
2	MAM 101	Thermal Engineering	3	1	0	4
3	MAM 102	Automotive Engines and Subsystems	3	0	0	3
4	MAM103	Automotive Chassis	3	1	0	4
5	MAM 104	Automotive Transmission	3	1	0	4
PRACTICAL						
6	MAM 1L1	Automotive Engines Lab	0	0	4	2
		TOTAL	15	4	4	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MAM 201	Automotive Electrical and Electronics	3	0	0	3
2	MAM 202	Vehicle Body Engineering	3	0	0	3
3	MAM 203	Vehicle Dynamics	3	1	0	4
4	MAM 204	Engine Management Systems	3	0	0	3
5	MAM 205	Advanced Materials for Automotive Engineers	3	1	0	4
PRACTICAL						
6	MAM 2L1	Automotive Electrical and Electronics Laboratory	0	0	4	2
		TOTAL	15	2	4	**19**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MAM 3E1	Elective-I	3	0	0	3
2	MAM 3E2	Elective-II	3	0	0	3
3	MAM 3E3	Elective – III	3	0	0	3
PRACTICAL						
5	MAM3P1	Project Work – Phase I	0	0	18	6
		TOTAL	9	0	22	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MAM4P1	Project Work - Phase II (Continuation of Phase I)	0	0	35	12
		TOTAL	0	0	35	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 67

LIST OF ELECTIVES					
MAM001	Rubber Technology for Automobiles	3	0	0	3
MAM002	Noise vibration and Harshness	3	0	0	3
MAM003	Transport management and Motor Industry	3	0	0	3
MAM004	Quality Control and Reliability Engineering	3	0	0	3
MAM005	Advanced Manufacturing Processes	3	0	0	3
MAM006	Automotive Air-conditioning systems	3	0	0	3
MAM007	Automotive Aerodynamics	3	0	0	3
MAM008	Tyre Technology	3	0	0	3
MAM009	Simulation of Vehicle Systems	3	0	0	3
MAM010	Alternative Fuels and Propulsion Systems	3	0	0	3
MAM011	Instrumentation and Experimental Techniques	3	0	0	3
MAM012	Computer Aided Design (CAD)	3	0	0	3
MAM013	Automotive Safety	3	0	0	3
MAM014	Electric and Hybrid Vehicles	3	0	0	3
MAM015	Special Types of Vehicles	3	0	0	3
MAM016	Vehicle Maintenance	3	0	0	3
	Research Methodology	3	0	0	3

MMA 101 ADVANCED MATHEMATICS FOR AUTOMOBILE ENGINEERS **L T P C**
3 1 0 4

Course Objectives:

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

Learning Outcomes:

At the end of the course the students will be able to

1. Compute Eigen values and Eigen vectors by different methods.
2. Solve different non-linear ordinary and Partial differential equations, and problems of variation applicable in Automobile engineering.
3. Find numerical solution for advanced problems in interpolation and integration
4. Solve LPP by different algorithms.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		M	S		M
CO3		M		S	
CO4	S		M		
CO5		M	S		M

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I MATRIX THEORY **12**

Eigen values using QR transformations – generalized eigen vectors – canonical forms – singular value decomposition and applications –pseudo inverse – least square approximations.

UNIT II DIFFERENTIAL EQUATIONS – NONLINEAR ODE & PDE **12**

Introduction – Equations with separable variables – Equations reducible to linear form – Bernoulli's equation – Riccati's equation – Special forms of Riccati's equation – Laplace transform methods for one dimensional wave equation – Displacement in a long string – Longitudinal vibration of an elastic bar.

UNIT III CALCULUS OF VARIATION **12**

Introduction – Euler's equation – several dependent variables Lagrange's equations of Dynamics – Integrals involving derivatives higher than the first – Problems with constraints – Direct methods and Eigen value problems.

UNIT IV INTERPOLATION AND INTEGRATION **12**

Hermite's Interpolation – Cubic Spline Interpolation – Gaussian Quadrature – Cubature.

UNIT V LINEAR PROGRAMMING PROBLEM **12**

Simplex algorithm – Two-phase and Big-M Techniques – Duality theory – Dual simplex method – Integer programming - Gomory's cutting plane method.

TOTAL NUMBER OF PERIODS: 60

REFERENCES

1. Stephenson, G, Radmore, P.M., "Advanced Mathematical Methods for Engineering and Science Students", Cambridge University Press 1999.
2. Richard Bronson, "Matrix Operations", Schaum's Outline Series, 2nd Edn. McGraw Hill, NewYork, 1989.
3. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley, 8th Edition, 2004.
4. Sastry.S.S, "Introductory Methods of Numerical Analysis", 5th Edn. PHI, New Delhi. 2008
5. Gupta, A.S. "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi,1997
6. Sankara Rao.K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
7. Hamdy A.Taha. "Operations Research-An Introduction". 8th Edn. PHI, New Delhi. 2007.

MAM 101 **THERMAL ENGINEERING** **L T P C**
3 1 0 4

OBJECTIVE:

- To integrate the concepts, laws and methodologies from the first course in thermo dynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Réfrigération and Air conditioning systems

Course Outcomes

CO01 - To learn the detailed study of thermo dynamics of combustion
CO02 - To learn the detailed study of chemical kinetics of combustion
CO03 - To learn the detailed study of steam nozzles and turbines
CO04 – To learn the study of air compressor, Classification and working principle of various types of compressors
CO05 - To learn the detailed study of refrigeration and air-conditioning

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CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	W	
CO5		W	S		M

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I THERMODYNAMICS OF COMBUSTION 12

Premixed and diffusion combustion process in IC engines and gas turbines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and droplet combustion.

UNIT II CHEMICAL KINETICS OF COMBUSTION 12

Fundamentals of combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion.

UNIT III STEAM NOZZLES AND TURBINES 12

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocitydiagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV AIR COMPRESSOR 12

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT V REFRIGERATION AND AIR CONDITIONING 12

Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems (Description only) - Alternate refrigerants – Comparison between vapour compression and absorption systems - Air conditioning system: Types, Working Principles - Psychrometry, Psychrometric chart - Cooling Load calculations - Concept of RSHF, GSHF, ESHF -(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and refrigerant property tables are permitted in the examination)

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007.
2. Kothandaraman.C.P., Domkundwar.S,Domkundwar. A.V., "A course in thermal Engineering,"Dhanpat Rai &sons, Fifth edition, 2002.

REFERENCES:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers , 2000
2. Arora.C.P,"Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994
3. Ganesan V. ." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003

MAM 102 **AUTOMOTIVE ENGINES AND SUBSYSTEMS** **L T P C**
3 0 0 3

AIM:

To impart the knowledge on basic concepts on Automotive Engines and its various sub components along with its functions.

OBJECTIVE:

The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

Course Outcomes

CO01 - To learn the detailed study of engine basic theory

CO02 - To learn the detailed study of fuel supply, ignition system

CO03 - To learn the study of cooling and lubricating system

CO04 – To learn the study of air motion, combustion and combustion chambers

CO05 - To learn the detailed study of new engine technology , lubrication system.

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CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	W	
CO5		M	S		M

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I ENGINE BASIC THEORY **9**

Engine types - operating cycles of SI and CI Engines - Engine design and operating parameters - Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine - performance and emissions from SI and CI engines- Standards for Bharath stages and other Standards.

UNIT II FUEL SUPPLY, IGNITION SYSTEM 9

Theory of carburetion and carburetors — Design aspects — Petrol Injection and diesel fuel injection - pumps and injectors, gasoline direct injection system - conventional and electronic ignition systems for SI engine.

UNIT III COOLING AND LUBRICATING SYSTEM 9

Air cooling and water cooling – thermosympon cooling, forced cooling systems. Fins and radiator - design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 9

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion — combustion in SI and CI engines. - Cylinder pressure data and heat release analysis. Optimized design of combustion chambers.

UNIT V NEW ENGINE TECHNOLOGY 9

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogenous charge compression ignition in diesel engines – variable valve timing - electronic engine management.

TOTAL: 45 PERIODS

TEXTBOOK

1. J.B.Heywood, ‘Internal combustion engine Fundamentals’, McGraw Hill Book Co, 1989.
2. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.

REFERENCES:

1. Edward F.Obert, ‘Internal combustion engines and air pollution’ Harber and Row Publishers, 1973.
2. M.Khovakh, ’Motor Vehicle Engines’, Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, ‘Automotive Emission control’, McGraw Hill Book Co, 1995.
4. G.S.Springer and A.J.Patterson, ’Engine emissions and pollutant formation’, plenum press, Newyork, 1985.

MAM 103 **AUTOMOTIVE CHASSIS** **L T P C**
3 1 0 4

OBJECTIVE:

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

Course Outcomes

CO01 - To learn the detailed study of introduction constructional details
CO02 - To learn the detailed study of front axle steering system
CO03 - To learn the detailed study of drive line study
CO04 – To learn the detailed study of braking system
CO05 - To learn the detailed study of suspension systems

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		S	S		M
CO3		M		S	
CO4	S		M		M
CO5	S		M		M

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I INTRODUCTION **10**

Layout with reference to power plant, steering location and drive, frames, constructional details, materials, testing of frames, integral body construction.

UNIT II FRONT AXLE STEERING SYSTEM **12**

Front axle type, rigid axle and split axle, Constructional Details, Materials, Front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out. Condition for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkages layout for conventional and independent suspensions. Turning radius, instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering

UNIT III DRIVE LINE STUDY 12

Effect of driving thrust and torque –reaction .Hotchkiss drives. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drive- different types. Two speed rear axle. Rear axle construction-full floating, three quarter floating and semi-floating arrangements. Differential-conventional type, Non-slip type, Differential locks and differential housing.

UNIT IV BRAKING SYSTEM 12

Type of brakes, Principles of shoe brakes. Constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Exhaust brakes, power and power assisted brakes. Testing of brakes.

UNIT V SUSPENSION SYSTEMS 14

Types of suspension, Factors influencing ride comfort, Types of suspension springs-independent suspension- front and rear. Rubber, pneumatic, hydro- elastic suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, tubeless tyres and aspect ratio of tube tyres.

TOTAL NUMBER OF PERIODS: 60

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.
2. P.M.Heldt, “Automotive Chassis”, Chilton Co., New York, 1982.
3. W.Steed, “Mechanics of Road Vehicles”, Illiffe Books Ltd., London. 1992.

REFERENCES:

1. Harban Singh Rayat, “The Automobile”, S. Chand & Co. Ltd, New Delhi, 2000.
2. G.J.Giles, “Steering Suspension and Tyres”, Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, “Automobile Engineering”, Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang, “Automobile Engineering”, Khanna Publishers, Twelfth reprint New Delhi, 2005.
5. R.P.Sharma, “Automobile Engineering”, Dhanpat Rai & Sons, New Delhi, 20

MAM 104 **AUTOMOTIVE TRANSMISSION** **L T P C**
3 1 0 4

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

Course Outcomes

CO01 - To learn the detailed study of clutch and gear box
CO02 - To learn the detailed study of hydrodynamic drives
CO03 - To learn the detailed study of automatic transmission
CO04 – To learn the detailed study of hydrostatic drive and electric drive
CO05 - To learn the detailed study of automatic transmission applications

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	W	
CO5		M		S	

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I CLUTCH AND GEAR BOX **15**

Requirement of Transmission system. Different types of clutches: Principle, construction and operation of friction clutches. Objective of the gear box. Problems on performance of

automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications. Different types of gear boxes.

UNIT II HYDRODYNAMIC DRIVES 13

Principles, performance and limitations of fluid coupling Constructional details of a typical fluid coupling. Reduction of drag torque, Principle, construction and advantages of hydrodynamic torque converters. Performance characteristics, converter couplings. Multi-stage Torque converter and poly phase torque converter.

UNIT III AUTOMATIC TRANSMISSION 11

Ford – T model gear box, Wilson gear box- Cotal electric transmission– Hydraulic control systems of automatic transmission.

UNIT IV HYDROSTATIC DRIVE AND ELECTRIC DRIVE 9

Principle of hydrostatic drive systems. Construction and working of typical drives. Advantages and limitations. Control of hydrostatic transmissions, Principle of electric drive. Early and modified Ward Leonard control systems.

UNIT V AUTOMATIC TRANSMISSION APPLICATIONS 12

Chevrolet “Turbo glide” transmission. Toyota’s Automatic transmission with Electronic control system. Continuously Variable Transmission (CVT) – types – Operations.

TOTAL NUMBER OF PERIODS: 60

TEXTBOOK:

1. Heldt P.M, Torque Converters, Chilton Book Co., 1992.
2. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India, 2004.

REFERENCES:

1. Heinz Heisler, “Advanced Vehicle Technology”, second edition, Butterworth – Heinemann, New York, 2002
2. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005

MAM 1L1 **AUTOMOTIVE ENGINES LAB** **L T P C**
0 0 4 2

AIM:

To familiarize and train the students on the constructional arrangements of different engine and chassis system with performance study of SI and CI engines.

OBJECTIVE:

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles with performance study of SI and CI engines.

Course Outcomes

CO01 – Performance Test of SI Engine, CI Engine pressure crank angle diagram in IC Engines.

CO02 – Heat balance test on IC engines

CO03 – Assembling and dismantling Fiat engine. Constant mesh, Sliding mesh gear box

CO04 – Programming exercise of Performance test on variable compression ratio multi fuel diesel engine

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	W	

Course Assessment Methods:

Direct		**Indirect**	
1	Lab Observation Book	1	Students Exit Survey
2	Lab Record Book	2	Faculty Survey
3	Viva Voce	3	Industry
4	Model Examination	4	Alumni
5	End Semester Examinations		

LIST OF EXPERIMENTS

1. Performance Test of SI Engine.
2. Performance Test of CI Engine.
3. Determination of pressure crank angle diagram in IC Engines.
4. Heat balance test on IC engines
5. Performance test on variable compression ratio multi fuel diesel engine.
6. Assembling and dismantling of the following
   (i) Fiat engine.
   (ii) CI-Ashok Leyland engine
   (iii) Single plate, Diaphragm Clutch.
   (iv) Constant mesh, Sliding mesh gear box
   (v) Transfer case
   (vi) Differential
   (vii) Front axle, Rear axle
   (viii) Brakes system
   (ix) Steering system

MAM 201 AUTOMOTIVE ELECTRICAL AND ELECTRONICS **L T P C**
3 0 0 3

AIM:

The student will have to know about all theoretical information and about electrical components used in a vehicle.

OBJECTIVE:

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

Course Outcomes

CO01 - To learn the detailed study of batteries and starting system
CO02 - To learn the detailed study of charging system, lighting system and accessories
CO03 - To learn the detailed study of electronic ignition and injection systems
CO04 – To learn the detailed study of sensors in automobiles
CO05 - To learn the detailed study of microprocessor in automobiles

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I BATTERIES AND STARTING SYSTEM 9

Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

UNIT II CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES 9

D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS 9

Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

UNIT IV SENSORS IN AUTOMOBILES 9

Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, altitude sensor, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

UNIT V MICROPROCESSOR IN AUTOMOBILES 9

Microprocessor And Microcomputer controlled devices in automobiles such as instrument cluster, Voice warning system, Travel information system, Keyless entry system, Automatic Transmission. Environmental requirements (vibration, Temperature and EMI).

TOTAL: 45 PERIODS

TEXTBOOK:

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chamman & Hall, London, 1992.
2. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, 1998
3. Young. A.P. & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.

REFERENCES:

1. Vinal. G.W., Storage Batteries, John Wiley & Sons inc., New York, 1985.
2. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980.
3. Spreadbury.F.G. Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.
4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
5. Kohli P L., "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004

MAM 202 **VEHICLE BODY ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, paneling 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 Outcomes

CO01 - To learn the detailed study of car body details
CO02 - To learn the detailed study of bus body details
CO03 - To learn the detailed study of car aerodynamics
CO04 – To learn the detailed study of commercial vehicle details
CO05 - To learn the detailed study of commercial vehicle aerodynamics

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				

CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I CAR BODY DETAILS 9

Types of car bodies - visibility: regulation, driver's visibility, methods of improving visibility- safety: safety design, safety aspects. Constructional details of a passenger car.

UNIT II BUS BODY DETAILS 9

Classification of bus bodies – based on distance traveled, based on capacity of the bus and based on style & shape. Types of metal section used in the construction. Construction of Conventional and integral type bus.

UNIT III CAR AERODYNAMICS 9

Objects — Vehicle types of drag. Various types of forces and moments. Effects of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Test with scale models.

UNIT IV COMMERCIAL VEHICLE DETAILS 9

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of drivers seat in relation to controls. Driver’s cab design. Compactness of Driver’s cab. Segmental construction of driver’s cab.

UNIT V COMMERCIAL VEHICLE AERODYNAMICS 9

Effects of rounding sharp front body edges. Effects of different cab to trailer body Fore body pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicle drag reducing devices. Modern painting process of a commercial vehicle.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Powloski, J., 'Vehicle Body Engineering', Business Books Ltd, 1970
2. J.G. Giles, 'Body Construction and Design', Butterworth and Co., 1975

REFERENCES:

1. John Fenton 'Vehicle Body layout and analysis', Mechanical Engineering Publication Ltd., 1984
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002

MAM 203 **VEHICLE DYNAMICS** **L T P C**
3 1 0 4

OBJECTIVE:

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

Course Outcomes

CO01 - To learn the detailed study of basic of vibration
CO02 - To learn the detailed study of tyres
CO03 - To learn the detailed study of performance characteristics of vehicle
CO04 – To learn the detailed study of handling characteristics of vehicles
CO05 - To learn the detailed study of dynamics of suspension system

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey

3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I BASIC OF VIBRATION 12

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system. modal analysis.

UNIT II TYRES 12

Tire forces and moments, rolling resistance of tires, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

UNIT III PERFORMANCE CHARACTERISTICS OF VEHICLE 12

Equation of motion and maximum tractive effort. Aerodynamics forces and moments. Power plant and transmission characteristics. Prediction of vehicle performance. Braking performance.

UNIT IV HANDLING CHARACTERISTICS OF VEHICLES 12

Steering geometry. Steady state handling characteristics. Steady state response to steering input. Transient response characteristics. Directional stability of vehicle.

UNIT V DYNAMICS OF SUSPENSION SYSTEM 12

Requirements of suspension system. Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft, Hydraulic dampers and choice of damping characteristics. Compensated suspension systems. Human response to vibration, vehicle ride model. Load distribution. Stability on a curved track, banked road and on a slope.

TOTAL: 60 PERIODS

TEXTBOOK:

1. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., 2002.
2. J.Y.Wong,’ Theory of ground vehicles’, John Wiley and Sons Inc., Newyork, 1978
3. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005

REFERENCES:

1. Groover, “Mechanical Vibration”, 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.
2. W.Steeds, ‘Mechanics of road vehicle’ Illiffe Books Ltd, London 1992
3. JG.Giles, ‘Steering, Suspension tyres’, Illife Books Lid London 1975
4. P.M.Heldt, ‘Automotive chassis’, Chilton Co ., Newyork, 1982

5. J. R. Ellis, 'Vehicle Dynamics', Business Books, London, 1969.

MAM 204 **ENGINE MANAGEMENT SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVE:

To explain the principle of engines electronic management system and different sensors used in the systems.

Course Outcomes

CO01 - To learn the detailed study of fundamentals of automotive electronics
CO02 - To learn the detailed study of sensors and actuators
CO03 - To learn the detailed study of SI engine management
CO04 – To learn the detailed study of CI engine management
CO05 - To learn the detailed study of SI engine management

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines.

UNIT II SENSORS AND ACTUATORS 9

Inductive, Hall Effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, c Engine and vehicle design data rash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors.

UNIT III SI ENGINE MANAGEMENT 9

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch Monojetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control.

UNIT IV CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

UNIT V DIGITAL ENGINE CONTROL SYSTEM 9

Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control – Integrated engine control system, Exhaust emission control engineering, and Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis system.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE

REFERENCES:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004.

MAM 205 **ADVANCED MATERIALS FOR AUTOMOTIVE ENGINEERS** **L T P C**
3 1 0 4

OBJECTIVE:

The main objective of this course is to impart knowledge General properties and characteristics Automotive applications Reinforcement materials Auto applications Fracture mechanics Composite for automotive applications CMC & PMC Characteristics, Various Polymerization transmission systems, electrical and electronic components. Injection molding, selection criteria for auto applications, economics PU & Latex foams Adhesive Protective coatings and Paints automotive engine components, will be taught to the students.

Course Outcomes

CO01 - To learn the detailed study of fibre reinforced plastics (frp
CO02 - To learn the detailed study of engineering ceramics and metal matrix composites
CO03 - To learn the detailed study of ceramic & polymer metal composites
CO04 – To learn the detailed study of manufacturing processes automotive elastomers and plastics polymeric materials
CO05 - To learn the detailed study of foams, adhesives, coatings and paints

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	W	
CO5	S		M	S	

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I FIBRE REINFORCED PLASTICS (FRP) 12

Definition; Types; General properties and characteristics; Reinforcing materials – particles, fibers, whiskers; Properties of reinforcing materials; Matrix materials; Additives; Properties of FRP materials; Automotive applications

UNIT II ENGINEERING CERAMICS AND METAL MATRIX COMPOSITES 12

Reinforcement materials; Matrix; Characteristics and specialized properties like – weibull modulus, high temperature strengths, wear & frictional property improvements; Selection criteria; Advantages and limitations in use of ceramics & MMCs; Fracture mechanics; Auto applications.

UNIT III CERAMIC & POLYMER METAL COMPOSITES 12

CMC & PMC Characteristics, Various types, Advantages & Limitations, Applications. Role of Mixtures- Reinforcement – Particles – Fibres. Carbon/Carbon Composites- Advantages, Limitations- Sol-Gel techniques – Chemical Vapor Deposits. Composite for automotive applications**.**

UNIT IV POLYMERIC MATERIALS AND MANUFACTURING PROCESS 12

Polymerization – Thermosets Vs Thermoplastics – Classes and types of polymers; Properties and limitations of plastic material species; Additives; Auto applications – exterior, interior, engine and fuel line, transmission systems, electrical and electronic components.

Injection molding, Reaction injection molding (RIM), Transfer molding, Extrusion, compression molding, blow molding, scopes and limitations of various manufacturing processes, mold making, safety in handling of materials, hands on training on processes, selection criteria for auto applications, economics

UNIT V FOAMS, ADHESIVES, COATINGS AND PAINTS 12

PU & Latex foams - Formulations and manufacturing Control of various foam properties – density, modulus of elasticity, compression set, dynamic properties, etc.

Adhesives - Condensation polymerization of products like – phenol formaldehyde (Phenolic resins), Amino resins, Polyester resins, Alkyl resins, Epoxy resins, Polyurethane resins, Polyamide resins; Additional polymerization products like – Vinyl resins, Vinyl alcohol resins, vinylidine resins, Styrene resins and Acrylic resins.

Protective coatings and Paints - Organic paints and coatings, metal coatings, ceramic coatings, Linings, primers, varnishes, enamels, galvanizing, anodizing, blackodizing, electro plating, CVD & PVD surface coatings

Other Materials - Seals and Gaskets, Automotive glasses, Refractory materials

TOTAL: 60 period

TEXT BOOK

1. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.
2. Krishnan K. Chawle. “Composite Material: Science and Engineering” Second Edition, Springer, 1998
3. T.W.Clyne, P.J. Withers, “An Introduction to metal matrix composites”, Cambridge University Press, 1993.

4. F.C. Campbell “Structural Composite Materials”, Materials Park,ASM International,2010

REFERENCE BOOKS

1. Derek Hull, *“An Introduction to composite Materials”*, Cambridge University Press, 1988.

2. B.T.Astrom, “ Manufacturing of polymer composites”, Champman & Hall,1997 S.C.Sharma, “ Composite Materials”, Narosa Publishing House,2000

3. Berins, ISBN 0442010699, “Design with Plastics and Plastic Engineering”, Wiley & Sons Inc., 1995.

4. D. Huda, M.A. E1 Baradie and M.S.J. Hashmi, “Metal-matrix composites: Materials aspects- Part II”, Journal of Materials Processing Technology, 37 (1993) 521-541

5. ASM Metals Hand Book, Vol.21, “Composites”, ASM International, 2001

6. Kalyan Sehanobish, “Engineering Plastics and Plastic Composites in Automotive Applications”, SAE International, April 2009.

7. Francis Gardiner and Eleanor Garmson “Plastics and the Environment” Smithers Rapra, 2010.

8. Mahendra D Baijal “Plastic Polymer Science and Technology”, John Wiley&Sons,1982.

MAM 2L1 AUTOMOTIVE ELECTRICAL & ELECTRONICS LAB L T P C
0 0 4 2

OBJECTIVE:

To provide hands on training on automotive electrical and electronic systems and to provide knowledge on interfacing of different sensors and actuators used in the automobile systems.

Course Outcomes

CO01 – Verification of truth table of Logic Gates,
CO02 – Characteristics of rectifiers – Half wave & Full wave
CO03 – Characteristics of SCR.
CO04 – Assembly language programming exercise

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M

CO3		M		S	
CO4	S		M	W	

Course Assessment Methods:

Direct		Indirect	
1	Lab Observation Book	1	Students Exit Survey
2	Lab Record Book	2	Faculty Survey
3	Viva Voce	3	Industry
4	Model Examination	4	Alumni
5	End Semester Examinations		

LIST OF EXPERIMENTS:

Study of electrical systems such as

1. Battery
2. Lighting system
3. Electric horn system
4. Windscreen wiper system
5. Starting motor and drive system
6. Charging system
7. Ignition system
8.

Experiments on

1. Basic Digital circuits
2. Timer
3. Seven segment displays
4. Characteristics of load cells

5. Characteristics of thermocouples
6. Characteristics of resistance thermometers
7. Characteristics of piezoelectric pressure transducers
8. Characteristics of LVDT
9. Characteristics of Strain gauges
10. Programming of microprocessor.
11. Programming of microcontroller.
12. Interfacing of microprocessors,
13. Interfacing of micro controllers.
14. Mini project

ELECTIVES

MAM001 **RUBBER TECHNOLOGY FOR AUTOMOBILES** **L T P C**
3 0 0 3

OBJECTIVE:

At the end, the student will have good exposure to role of various Rubber components in Automobiles.

Course Outcomes

CO01 - To learn the detailed study of fundamentals of automotive electronics
CO02 - To learn the detailed study of sensors and actuators
CO03 - To learn the detailed study of SI engine management
CO04 – To learn the detailed study of CI engine management
CO05 - To learn the detailed study of SI engine management

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I INTRODUCTION **6**

Identification of plastics / rubber components in automobiles – function – selection criteria.

UNIT II STRUCTURE-PROPERTY RELATIONSHIP OF RUBBER **10**

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behavior in dynamic applications.

UNIT III VIBRATION AND RUBBER SPRING 10

Principle of vibration isolation – rubber mounts – spring design – comparison with metallic springs – shape factor and its effect – forced and free vibrations with damping – typical mounts, compounding and manufacture.

UNIT IV FLUID SEALINGS AND FLEXIBLE COUPLINGS AND HOSES 10

Seals for static and dynamic applications – effect of heat / oil ageing – frictional behavior – fundamental of seal ability.

UNIT V COMPOUNDING AND MANUFACTURE 9

Types of couplings – specification and selection – torque vs. deflection relationships – brake fluid / hydraulic hoses, materials and manufacture.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Freakley, P.K., and Payne, A.R., Theory and Practice of Engineering with Rubber, Applied Science Publishers Ltd.

REFERENCES:

1. Hobel, E.F., Rubber Springs Design.
2. Blow, C.M. and Hepburn, C., Rubber Technology and Manufacture.

MAM 002 NOISE VIBRATION AND HARSHNESS

L	T	P	C
3	0	0	3

OBJECTIVE:

The main objective of this course is to impart knowledge in 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 torsional system will be taught to the students.

Course Outcomes

CO01 - To learn the study of Basic concepts, mathematical models, formulating the equations of motion linear

CO02 - To learn the detailed study of vibration control techniques

CO03 - To learn the study of Fundamentals of acoustics – general sound propagation structure borne sound & air borne sound, Plane wave propagation

CO04 – To learn the detailed study of natural frequency, mode shape and damping

CO05 - To learn the detailed study of noise sources and control techniques

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5							
CO1	S											
CO2		W	S		M							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

INTRODUCTION TO NVH

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.

UNIT I - BASICS OF VIBRATION ANALYSIS **9**

Basic concepts, mathematical models, formulating the equations of motion linear and torsional system characteristics and response – damped and undamped single & two degree of freedom systems under harmonic force, coordinate coupling, generalized coordinates and modal analysis.

UNIT II - VIBRATION CONTROL TECHNIQUES **9**

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

UNIT III - NOISE FUNDAMENTALS **9**

Fundamentals of acoustics – general sound propagation – structure borne sound & air borne 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 band analysis, Anatomy of Human Ear, Mechanism of hearing, loudness, weighting networks, equivalent sound level.

UNIT IV - NVH MEASUREMENTS **9**

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 V-AUTOMOTIVE NOISE SOURCES AND CONTROL TECHNIQUES 9

Methods for control of engine noise, Transmission Noise, Intake and Exhaust Noise, Aerodynamic Noise, Tyre Noise, Brake noise. Noise control strategy, noise control at source – along the path – isolation, damping, balancing, resonators, absorption, barriers and enclosures.

TOTAL NO OF PERIODS: 45

TEXT BOOK:

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

REFERENCES:

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, 1 992.
5. Wilson, C. E., "Noise Control – Measurement, Analysis, and Control of Sound and Vibration" Harper & Row Publishers, New York, 1989.

MAM 003 TRANSPORT MANAGEMENT AND MOTOR INDUSTRY **L T P C**

3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge in transport management and road safety measures play a major role in automotive Industry. The chapter gives a broad description on Safety rules and regulations adopted in transport and motor industry.

Course Outcomes

CO01 - To learn the study of Elements of Mass Transportation, History of transport, modes of transport, types of transport systems

CO02 - To learn the detailed study of Transport organization structure, operations, General set up, transport industry, government / (STU) State Government Theory of fares and cost of services, fare charging, costing and statistics of operating cost

CO03 - To learn the study of planning for new transport organization

CO04 – To learn the detailed study Acts & definitions, Licensing of drivers and conductors , registration of vehicles, control of transport, Service Life of vehicles. Toll tax-reasons & operational management. Build Operate Transfer arrangement.

CO05 - To learn the detailed study of accident & prevention

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5							
CO1	S											
CO2		W	S		M							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I INTRODUCTION ON TRANSPORTATION MODES 6

Elements of Mass Transportation, History of transport, modes of transport, types of transport systems

UNIT II TRANSPORT ORGANIZATION AND DEVELOPMENT 9

Transport organization structure, operations, General set up, transport industry, government /(STU) State Government Undertakings and private Bus transport organizations. Bus depot organization structure. Truck fleet operators organization. Economics of Road Transport: Theory of fares and cost of services, fare charging, costing and statistics of operating cost

UNIT III PLANNING FOR NEW TRANSPORT ORGANIZATION 9

Geographical considerations, economic factors, vehicles used, planning of trips. Concept of BRTS operations. Organization of Transport Services: Records and fleet management, vehicles schedule, booking and reservation, statistical records and shipment center, recording of goods transport

UNIT IV MOTOR VEHICLE ACT 9

Acts & definitions, Licensing of drivers and conductors , registration of vehicles, control of transport, RTO and other regulations , offences, penalties and procedures, types of form and procedures, licensing of taxies and buses, rules and regulations, testing and passing of vehicles. Taxation: Structure, method of laying taxation, goods vehicle taxation, passenger vehicle taxation, mode of payment, tax exemption, one / life time taxation. Service Life of vehicles. Toll tax- reasons & operational management. Build Operate Transfer arrangement.

UNIT V ACCIDENT & PREVENTION 9

Vehicle accident, laws, injury, safety precautions, road transport regulations. Insurance & Finance Classes/types of insurance, accident claims and settlements, duty of driver in case of accident, hire purchase.

TOTAL NO OF PERIODS: 42

TEXT BOOK:

1. Motor Vehicles Acts, Law Publishers
2. Myer Kutz, "Handbook of Transportation Engineering", Volume 1: Systems and Operations, Second Edition, Tata McGraw Hill Edition, 2011.
3. Coleman O'Flaherty, "Transport Planning and Traffic Engineering", 4th Edition, Butterworth Heinemann Publications, 2010.
4. Roger P. Roess and Elena S. Prassas, "Traffic Engineering", 4th Edition.

REFERENCES:

1. Schumer, Economics of transport, TMH
2. Fair and Williams, “Economics of transportation”, East West Press.
3. Hudson, “Motor transportation”, TMH.
4. M.V. Act 1988-RTO rules and regulation manual
5. Fuel Economy of Motor Vehicle, Allied Publishers

MAM 004 QUALITY CONTROL AND RELIABILITY 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge statistical quality control, acceptance sampling, reliability engineering , failure data analysis, reliability prediction and management will be taught to the students.

Course Outcomes

CO01 - To learn the study of Methods and Philosophy of Statistical Process Control Capability Analysis Six sigma concept.

CO02 - To learn the detailed study of Acceptance Sampling Problem ,Military standards ,Random sampling.

CO03 - To learn the study of failure data analysis

CO04 – To learn the detailed study Statistical failures of components distribution Gamma distribution -Weibull distribution Life distribution

CO05 - To learn the detailed study of Failure rate estimates Reliability prediction and management FMEA and Fault tree analysis, Risk assessment

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5							
CO1	S											
CO2		W	S		M							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I - STATISTICAL QUALITY CONTROL **9**

Methods and Philosophy of Statistical Process Control - Control Charts for Variables and Attributes –Cumulative sum and Exponentially weighted moving average control charts - Other SPC Techniques – Process - Capability Analysis Six sigma concept.

UNIT II - ACCEPTANCE SAMPLING **9**

Acceptance Sampling Problem - Single sampling plans for attributes – double sampling - multiple sampling - sequential sampling - Military standards - The Dodge Roming sampling plans – Random sampling.

UNIT III - RELIABILITY ENGINEERING **9**

Definition of reliability – Performance and reliability - Reliability requirements – System life cycle – Mean time between failures – Mean time to failure - Mortality Curve -Availability – Maintainability.

UNIT IV - FAILURE DATA ANALYSIS **9**

Statistical failures of components – failure distributions – Bath tub curve – Negative exponential distribution – Normal distribution - log normal distribution – Gamma distribution - Weibull distribution Life distribution measurements – Accelerated life tests -Data requirements for reliability.

UNIT V - RELIABILITY PREDICTION AND MANAGEMENT **9**

Failure rate estimates - Effect of environment and stress - Series and Parallel systems -RDB analysis – Standby Systems - Complex Systems - Reliability demonstration testing- Reliability growth testing - Duane curve - Risk assessment – FMEA and Fault tree analysis.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Khanna O.P, “Statistical Quality Control”, Dhanpat Rai Publications (P) Ltd., 2001.

2. Lewis E.E, “Introduction to Reliability Engineering”, John Wiley and Sons, 1987.

REFERENCES:

1. Mohamed Zairi, “Total Quality Management for Engineers”, Woodhead Publishing Limited 1991.

2. Harvid Noori and Russel, “Production and Operations Management - Total Quality and Responsiveness”, McGraw-Hill Inc, 1995.

3. Douglus C. Montgomery, “Introduction to Statistical Quality Control”, 2nd Edition, John Wiley and Sons, 1991.

MAM 005 **ADVANCED MANUFACTURING PROCESS** **L T P C**

3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledgead vances inadvances in casting, Advanced forming and powder metallurgy processes, Fabrication of micro electronic devices,manufacturing of composites,rapid prototyping will be taught to the students.

Course Outcomes

CO01 - To learn the study of Rapid solidification for amorphous alloys Casting techniques for single crystal components.

CO02 - To learn the detailed study of High speed forging machines Design consideration for Powder Metallurgy forming Production of metal powders

Secondary and finishing operations.

CO03 - To learn the study of fabrication of micro electronic devices

CO04 – To learn the detailed study manufacturing of composites

CO05 - To learn the detailed study of Rapid prototypingfused deposition modeling, Solid groundcuring, 3D ink jet printing

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**						
CO1	S										
CO2		M	S		S						
CO3		M		S							
CO4	S		M	M							
CO5		S	S		M						

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I - ADVANCES IN CASTING **9**

Newer casting techniques - Expendable pattern casting - Plaster mold and ceramic mold casting – Vacuum casting - Squeeze casting - Rapid solidification for amorphous alloys – Casting techniques for single crystal components.

UNIT II -ADVANCED FORMING AND POWDER METALLURGY PROCESSES 9

High speed forging machines - Die materials - semisolid metal forming- Peen forming of sheet metals - Super plastic forming – Forming and shaping glass. Design consideration for Powder Metallurgy forming - Production of metal powders – Compaction – Sintering – Finishing of sintered parts – Secondary and finishing operations.

UNIT III - FABRICATION OF MICRO ELECTRONIC DEVICES **9**

Semiconductors and silicon - Crystal growing and wafer preparation - Film deposition, Oxidation, Lithography, Etching, Diffusion and ion implantation, Metallization and testing - Bonding and packing.

UNIT IV - MANUFACTURING OF COMPOSITES **9**

Introduction- Fibre reinforced, Metal matrix, Ceramics matrix composites, Nanocomposites - structure, Properties, manufacturing processes and applications.

UNIT V - RAPID PROTOTYPING **9**

Rapid prototyping- overview, Techniques-Stereo lithography, Laminated object manufacturing, Selective laser sintering, fused deposition modeling, solid ground curing, 3D ink jet printing-Applications of rapid prototyping-Rapid tooling-Rapid manufacturing-Future development-Virtual prototyping.

TOTAL NO OF PERIODS: 45

TEXT BOOKS

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", 3rd Edition, Addison-Wesley Publishing Co., Boston, 2009.
2. Madou M. J, "Fundamentals of micro fabrication and nanotechnology", 3rd edition, CRC Press, USA, 2011.

REFERENCES

1. Amstead B. H, Ostwald Phillips and Bageman R.L, "Manufacturing Processes", John Wiley & Sons, New York, 1987.
2. Jaeger R.C, "Introduction to microelectronic Fabrication", Addision Wesley, Boston, 1988.
3. Chua C. K, "Rapid Prototyping - Principles and Applications", World Scientific Publishing Company, 2010.
4. Hilton P. D and "Marcel Dekker", Rapid Tooling, New York, 2000.

MAM 006 **AUTOMOTIVE AIR-CONDITIONING SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge advances in automotive air-conditioning fundamentals, Refrigerant, Air conditioner – heating system, Air routing & temperature control, Heater – air conditioner trouble shooting & service will be taught to the students.

Course Outcomes

CO01 - To learn the study Basic air conditioning system Evaporator temperature Controls for TXV & CCOT systems

CO02 - To learn the detailed study of Refrigeration system ambient conditions affecting system pressures requirements for refrigerants

CO03 - To learn the study of air conditioner – heating system

CO04 – To learn the detailed study Objectives Evaporator case air flow through the

Dash recirculating unit Automatic temperature

CO05 - To learn the detailed study of heater air conditioner trouble shooting & Service

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S				
CO2		M	S		S
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT – I AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS 10

Basic air conditioning system – Components – types of Compressor, Condenser, Expansion devices and Evaporators. Location of air conditioning components in a car – Schematic layout of a air conditioning system. Compressor components – Thermostatic expansion valve & orifice tube – Expansion valve calibration – Evaporator temperature controls for TXV & CCOT systems.

UNIT – II REFRIGERANT 9

Requirements for refrigerants – Classification of refrigerants- Refrigerant selection-Storage of refrigerants – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT – III AIR CONDITIONER – HEATING SYSTEM 10

Manually controlled air conditioner – Heater system – Ford automatically controlled air conditioner – heater systems – Chrysler automatically controlled air conditioner – Heater system, General Motors automatically controlled air conditioner – Heater system – Flushing & Evacuating.

UNIT – IV AIR ROUTING & TEMPERATURE CONTROL 10

Objectives – Evaporator case air flow through the Dash recirculating unit – Automatic temperature control – Ducting system in Passenger car and Bus– Controlling flow – Vacuum reserve – Testing the air control and handling systems- Load calculations - Psychrometry

UNIT – V HEATER – AIR CONDITIONER TROUBLE SHOOTING & SERVICE 6

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

TOTAL : 45 PERIODS

TEXT BOOK:

1. William H Crouse and Donald L Anglin, Automotive Air conditioning, McGraw Hill Inc., 1990.

REFERENCES:

1. Paul Weisler, Automotive Air Conditioing, Reston Publishing Co. Inc., 1990.
2. McDonald,K.L., Automotive Air Conditioning, Theodore Audel series, 1978.
3. Goings,L.F., Automotive Air Conditioning, American Technical services, 1974.

MAM007 AUTOMOTIVE AERODYNAMICS 3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge advances in aerodynamic, shape optimization of cabs drag of cabs will be taught to the students.

Course Outcomes

CO01 - To learn the study of Scope historical development trends Fundamentals of fluid mechanics

CO02 - To learn the detailed study of aerodynamic drag of cabs

CO03 - To learn the study of shape optimization of cabs

CO04 – To learn the detailed study The origin of force and moments on a vehicle Characteristics of forces and moments

CO05 - To learn the detailed study of wind tunnels for automotive aerodynamics

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				

CO2		M	S		S
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT – I INTRODUCTION 10

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT – II AERODYNAMIC DRAG OF CABS 8

Car 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 – III SHAPE OPTIMIZATION OF CABS 7

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

UNIT – IV VEHICLE HANDLING 10

The origin of force 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 – V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 10

Introduction – Principles 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.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

REFERENCES:

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Houghton, Aerodynamics

MAM 008 **TYRE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledgead vances – calendaring, Thread extrusion and bead construction,Tyre building ,Green tyre preparation & curing ,fabric preparation will be taught to the students.

Course Outcomes

CO01 - To learn the study Fabrics of the Tyre IndustryWet & dry bonding systems dip and hot stretch process for Nylon. REL-VP latex systems

CO02 - To learn the detailed study of Calendering process: 3 and 4 roll calenders. Skimming & frictioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calenders.

CO03 - To learn the study of Basic concepts of Extrusion. Die swell & shrinkage phenomenon effect of compounding parameters on these phenomenon

CO04 – To learn the detailed study of tyre building

CO05 - To learn the detailed study of Hot and cold process retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5							
CO1	S											
CO2		M	S		S							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

INTRODUCTION TO BASICS OF TYRES 5

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres - Major departments of a Tyre Industry – An explanation of their function and relation to other departments. Factors influencing the performance of tyre: Compound design, degree of mixing: (open mill & internal mixing), parameters (temperature, time, speed), degree of vulcanization - Testing and dispatch of mixes, Basic quality control and mill room control Laboratory.

UNIT I - FABRIC PREPARATION 8

Fabrics of the Tyre Industry: Cotton, Rayon, Nylon & steel cords – manufacture, construction – styles and presentations. Bonding methods – Fabric bonding necessities of stronger fabrics leading to bonding methods developments. Wet & dry bonding systems – dip and hot stretch process for Nylon. REL-VP latex systems – and parameters for dip & hot stretch process for Nylon. Modified surface treatment needed for polyesters & glass fabric - Metal coating for steel cord. Recent developments in Radical Tyre fabrics – Aromatic Nylon (Kevlar) and other special fabric reinforcement systems and their use - Testing of dipped fabrics ‘U’, ‘H’ and other tests. Dip pick up and the relation to adhesion etc.

UNIT II - CALENDERING 8

Calendering process: 3 and 4 roll calenders. Skimming & frictioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calenders. Topping process on calendar - Limitation of 3 roll calenders and advantages of 4 roll calenders-process control aspects – economics - Relation between ends per inch and calendering process. Inner, outer and breaker fabrics. Compound fabric ratios and compound design consideration for different styles of fabrics - Defects of calendered fabrics and their remedies. Parameters for scrap control in fabric processes in the tyre industry requirement of total quality control involving fabric supplier’s dipping, calendering and bias cutting operations. Economics of fabric usage.

UNIT III - THREAD EXTRUSION AND BEAD CONSTRUCTION 8

Basic concepts of Extrusion. Die swell & shrinkage phenomenon – effect of compounding parameters on these phenomenon. Die design and theoretical calculation of tread weight. Effect of viscosity & temperature on extrusion. Dimensions and weight control extusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile – critical dimensions. Duel extruder – Cap & base concept relation to tyre wear parameters like tread wear heat buildup etc. Cross head extruder wire

coating process - Bias cutting and pocket making: Bias angle specification and the significance Horizontal and vertical laying of coated wore. Apex preparation on extruder and profile calender Bead wrapping and flipping operations. Single and double bead concept and preliminary calculation of bead safety factors. Width and angle adjustments splicing and identification. Bias plies pocket 3-3-2 4-4-2 ply constructions Defects of pockets wrong identification over splicing wrinkles, parallel plies etc.

UNIT IV - TYRE BUILDING **8**

Tyre building inputs: Inner liners, plies, beads, tread, side wall and gum strips – their inspection Drum inspection for drumset, drum circumference Significance of parameters for tyre building. Size making on finished tyre and the relation to building specifications. Tyre building specifications sequence of building. Intermitant consolidation use of various cements and gum strips. Importance of the state of the Art Technology. Appraisal of Tyre building as most crucial operation correlation of some of the cured tyre & service returned tyres to the lack of building skill. Green tyre inspection procedures weight tolerance techno-commercial importance of green tyre weight. Green tyre storage considerations.

UNIT V - GREEN TYRE PREPARATION & CURING **8**

Internal and External painting – Awling – Bagging in case of Air bag cure Bag-omatic and Air bag curing – mold lubrication- Bladder assembly bead curing rings – Dimension criticality Services to the Bag-o-matic presses Curing cycle – shaping – HPS, and hot water circulation. Dome steam cold water & vacuum cycles. Determination of optimum cure of tyres by thermocouple built tyres. Economics of curing post cure inflation of Nylon tyres cured tyre inspection. Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fastwear, poor retreading Bead/casing failures. Hot and cold process retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

TOTAL NO OF PERIODS: 45

TEXT BOOK:

1. Tom French, Tyre technology, The University of Michigan, 1989.

REFERENCES:

1. Blow. C. M, Rubber Technology and Manufacture, Butterworth- Heinemann, London, 1982.
2. Maurice Morton, “Rubber Technology”, Springer, 3rd edition, 1987.
3. Claude Hepburn, “Rubber Technology and Manufacture”, Third Edition, 2005.
4. Kovac. F. J, “Tyre Technology”, Good Year Tire & Rubber Company, 1973.
5. Different tyre manufacturer’s websites.

MAM009 **SIMULATION OF VEHICLE SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVE:

The objective of this course is to introduce the essential principles of simulation of various vehicle systems like longitudinal, lateral dynamics, modeling of suspension and tire system etc.

Course Outcomes

CO01 - To learn the detailed study of longitudinal dynamics and control lateral dynamics and electronic stability control

CO02 - To learn the detailed study of Modeling of passive automotive suspensions

CO03 - To learn the detailed study of Modeling of semiactive and active automotive

CO04 – To learn the detailed study of Suspensions

CO05 - To learn the detailed study of Lateral and longitudinal tire forces

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**						
CO1	S										
CO2		W	S		M						
CO3		M		S							
CO4	S		M	M							
CO5		S	S		M						

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic drag force - Longitudinal tire force - Rolling resistance - Calculation of normal tire forces - Calculation of effective tire radius - Driveline Dynamics - Torque converter - Transmission dynamics - Engine dynamics - Wheel dynamics - Cruise Control - Anti-Lock Brake Systems - Automated Highway Systems - Longitudinal Control Architecture.

UNIT II LATERAL DYNAMICS AND ELECTRONIC STABILITY CONTROL 9

Lateral Systems - Kinematic Model - Bicycle Model. Motion of Particle Relative to a rotating Frame. Dynamic Model in Terms of Error with Respect to Road, Yaw Rate and Slip Angle. Road Model. Differential Braking Systems - Steer-By-Wire Systems - Independent All Wheel Drive Torque Distribution

UNIT III MODELING OF PASSIVE AUTOMOTIVE SUSPENSIONS 9

Introduction - Modal Decoupling - Performance Variables - Natural Frequencies and Mode Shapes - Approximate Transfer Functions - Analysis of Vibrations in the Sprung Mass Mode and Unsprung Mass Mode - Verification Using Quarter Model. Half-Car and Full-Car Suspension Models.

UNIT IV MODELING OF SEMIACTIVE AND ACTIVE AUTOMOTIVE SUSPENSIONS 9

Semi-Active Suspension Model - Optimal Semi-Active Control Law - Calculation of Transfer Function Plots - Performance of Semi-Active Suspension Systems. Active Automotive Suspensions - Trade-offs and Limitations - Invariant Points and Their Influence - Hydraulic Actuators for Active Suspensions

UNIT V LATERAL AND LONGITUDINAL TIRE FORCES 9

Tire Forces - Tire Structure - Longitudinal Tire Force at Small Slip Ratios - Lateral Tire Force at Small Slip Angles - Magic Formula Tire Model - Dugoff's Tire Model - Dynamic Tire Model - Development of Lateral Tire Model for Uniform Normal Force Distribution and Parabolic Normal Pressure Distribution - Combined Lateral and Longitudinal Tire Force Generation.

TOTAL: 45 PERIODS

TEXT BOOK

1) Rajesh Rajamani, “Vehicle Dynamics and Control”, Springer, 2006.

MAM 010 ALTERNATE FUELS AND PROPULSION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE:

The main objective of this course is to impart knowledge advances introduction Properties as engine fuels, alcohols and gasoline blends Availability of cng, properties, modification required to use in engines Various vegetable oils for engines Layout of an electric vehicle will be taught to the students.

Course Outcomes

CO01 - To learn the study of Estimation of petroleum reserve "World Energy Scenerio, Energy Survey of India"
CO02 - To learn the detailed study of alcohols

CO03 - To learn the study ofnatural gas, lpg, hydrogen and biogas

CO04 – To learn the detailed study vegetable oils

CO05 - To learn the detailed study of electric and solar powered vehicles

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5						
CO1	S										
CO2		M	S		S						
CO3		M		S							
CO4	S		M	M							
CO5		S	S		M						

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT – I INTRODUCTION 6

Estimation of petroleum reserve “World Energy Scenerio, Energy Survey of India” – Need for alternate fuel – Availability of alternate fuels- Other alternate energy sources

UNIT – II ALCOHOLS 9

Properties as engine fuels, alcohols and gasoline blends, Performance in SI engine. Methanol and gasoline blends - Performance combustion and emission characteristics.

UNIT – III NATURAL GAS, LPG, HYDROGEN AND BIOGAS 9

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

UNIT – IV VEGETABLE OILS 10

Various vegetable oils for engines – Transesterification – Performance in engines – Performance and emission characteristics.

UNIT – V ELECTRIC AND SOLAR POWERED VEHICLES 11

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

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.
2. Bechtold,R.L., Alternative Fuels Guide Book, SAE, 1997.

REFERENCES:

1. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
2. Alcohols and motor fuels progress in technology, Series No.19, SAE Publication USA 1980.

MAM 011	**INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES**	**L T P C** **3 0 0 3**

OBJECTIVE:

The main objective of this course is to impart knowledgead vances in measurement systems, transducers, modifiers and terminating devices, mechanical measurement engine experimental techniques ,vehicle experimental techniques will be taught to the students.

Course Outcomes

CO01 - To learn the study of measurement systems

CO02 - To learn the detailed study of transducers, modifiers and terminating devices

CO03 - To learn the study of mechanical measurement

CO04 – To learn the detailed study engine experimental techniques

CO05 - To learn the detailed study of vehicle experimental techniques

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**							
CO1	S											
CO2		M	S		S							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT – I MEASUREMENT SYSTEMS 6

Static and Dynamic Measurement systems- Requirement and characterisitics- Analysis of experimental detail, Error analysis.

UNIT – II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8

Transducers for Automotive Applications- Amplifiers- Filters- Data Acquisition- Indicators, Printers and Displays- Signal Analyzing.

UNIT – III MECHANICAL MEASUREMENT 10

Instrumentation for Measuring weight, Force, Torque, Pressure Power, Temperature, Fluid flow, Vibration, Rotational speed, Velocity, Acceleration and Angular motion.

UNIT – IV ENGINE EXPERIMENTAL TECHNIQUES 12

I S Code for Engine testing- Instrumentation for Performance testing of engine- Instrumentation for Research and Development, Instrumentation for noise, vibration, in cylinder gas flow, Flame temperature dynamic cylinder pressure measurements.

UNIT – V VEHICLE EXPERIMENTAL TECHNIQUES 9

Laboratory tests- Tests tracks-Endurance tests-Crash tests- Wind tunnel tests-Brake tests.

TOTAL: 45 PERIODS

TEXTBOOK:

1. J.G. Giles, "Engine and Vehicle Testing", Illiffe books Ltd., London,1968.

2. T.G. Beckwith and Buck, "Mechanical Measurements", Oxford and IBH Publishing House, New Delhi,1995

REFERENCE:

1. A.W. Judge, "Engineering Precision Measurement", Chapman and Hall Ltd, Essex Street W.C., 1951.

2. D.Patambis. "Principle of Industrial Instrumentation", Tata McGraw Hill Publishing Company, New Delhi, 1990.

3. Rangan, Sharma and Mani, "Instrumentation Devices and Systems ", Tata McGraw Hill Publishing Company, New Delhi, 1990.

MAM012 **COMPUTER AIDED DESIGN (CAD)** **L T P C**
3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledgead vances in Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of

integrated CAD/CAM, Necessity & its importance, Engineering Applications Graphics standards Curves representation Polygon surfaces Finite Element Method will be taught to the students.

Course Outcomes

CO01 - To learn the study of Introduction, Hard copy printers and plotters Graphics Input devices cursor control ,Computer graphics-i .

CO02 - To learn the detailed study of computer graphics-ii Geometric transformations,2 D Geometric transformationsTranslation,3 D transformations, multiple transformation

CO03 - To learn the study of curves

CO04 – To learn the detailed study 3d graphics

CO05 - To learn the detailed study of numerical methods.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5						
CO1	S										
CO2		M	S		S						
CO3		M		S							
CO4	S		M	M							
CO5		S	S		M						

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT-I

Introduction

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I

CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display

devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II

Computer Graphics-II

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations:

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation.

UNIT-III

Curves:

Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics:

Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD & ProE software

UNIT-V

Numerical Methods:

Introduction, Errors in numbers, Binary representation of numbers, Root finding- Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

MAM013 **AUTOMOTIVE SAFETY** **L T P C**

3 0 0 3

OBJECTIVE:

At the end, the student will have good exposure to Automotive safety aspects including safety equipments.

Course Outcomes

CO01 - To learn the Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment

CO02 - To learn the deformation behaviour of vehicle body, and speed and acceleration characteristics of passenger compartment on impact. Safety concepts

CO03 - To learn the study of automatic seat belt tightener system collapsible steering column speed control devices

CO04 – To learn the detailed study of collision warning and avoidance

CO05 - To learn the detailed study of comfort and convenience system

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	S				
CO2		W	S		M
CO3		M		S	
CO4	S		M	M	
CO5		S	S		M

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I INTRODUCTION 9

Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT II SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, and speed and acceleration characteristics of passenger compartment on impact.

UNIT III SAFETY EQUIPMENTS 9

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety, antiskid braking system, regenerative braking system, speed control devices.

UNIT IV COLLISION WARNING AND AVOIDANCE 9

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, driver fitness detection.

UNIT V COMFORT AND CONVENIENCE SYSTEM 9

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system, manual and automated wiper system, satellite control of vehicle operation for safe and fast travel.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Bosch, "Automotive Handbook", 6th edition, SAE, 2004.

REFERENCES:

1. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.
2. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.
3. ARAI Safety standards

MAM014 ELECTRIC AND HYBRID VEHICLES L T P C
3 0 0 3

OBJECTIVE:

To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

Course Outcomes

CO01 - To learn the detailed study of electric vehicles

CO02 - To learn the detailed study of battery

CO03 - To learn the detailed study of dc & ac electrical machines

CO04 – To learn the detailed study of electric vehicle drive train

CO05 - To learn the detailed study of hybrid electric vehicles

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5							
CO1	S											
CO2		W	S		M							
CO3		M		S								
CO4	S		M	M								
CO5		S	S		M							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I ELECTRIC VEHICLES 6

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II BATTERY 7

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES 8

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN 12

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES 12

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components

TOTAL : 45 PERIODS

REFERENCES :

1. Iqbal Hussain, Electric & Hybrid Vechicles – Design Fundamentals, CRC Press.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles.

MAM015 **SPECIAL TYPES OF VEHICLES** **L T P C**
3 0 0 3

OBJECTIVE:

The main objective of this course is to impart knowledge earth moving and constructional equipments, power train concepts, sub systems of stv, special purpose vehicles for industrial applications, farm equipments, military and combat vehicles will be taught to the students.

Course Outcomes

CO01 - To learn the detailed study of earth moving and constructional equipments
CO02 - To learn the detailed study of power train concepts
CO03 - To learn the detailed study of sub systems of STV.
CO04 – To learn the detailed study of special purpose vehicles for industrial applications
CO05 - To learn the detailed study of farm equipments, military and combat vehicles

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S									M		S
CO2		W	S		M		S		M		S	
CO3		M		S								M
CO4	S		M	M						S		
CO5		S	S		M			M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT – I EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS 11

Construction layout, capacity and applications of earthmovers like dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrappers, motor graders, and Water sprinklers etc. criteria for selection of prime mover fro dumpers and front end loaders based on vehicle performance characteristics.

UNIT – II POWER TRAIN CONCEPTS 7

Engine – converter match curves. Hauling & cyclic type transmissions. Selection criteria for universal joints. Constructional details of steerable and drive axles of dumper.

UNIT – III SUB SYSTEMS OF STV 11

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. 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 – IV SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 8

Cranes- Types, Constructional features, capacity and stability, Vibratory compactors, Material Handling vehicles- Forklift- Tippers-Others.

UNIT – V FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 8

Ride and stability characteristics, power take off, special implementations. Special features and constructional details of tankers, gun carriers and transport vehicles. Classification of tractors – Main components of tractor – Safety rules. Working attachment of tractors – Farm equipment – Classification – Auxiliary equipment – Trailers and body tipping mechanism.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Abrosimov. K. Bran berg.A. and Katayer.K., " Road making Machinery ", MIR Publishers, Moscow, 1971.
2. Wong.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York, 1987.
3. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.

REFERENCES:

1. Off the road wheeled and combined traction devices - Ashgate Publishing Co. Ltd. 1998.
2. Astokhov, Truck Cranes, MIR Publishers, Moscow.
3. Kolchin,A., and V.Demidov, Design of Automotive Engines for Tractor, MIR Publishers, 1972.

MAM 016 **VEHICLE MAINTENANCE** **L T P C**

3 0 0 3

OBJECTIVE

At the end of the course, the students will be able to have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.

Course Outcomes

CO01 - To learn the detailed study of maintenance tool, shop, schedule, records

CO02 - To learn the detailed study of power plant repair and overhauling
CO03 - To learn the detailed study of maintenance, repair and overhauling of the chassis
CO04 – To learn the detailed study of maintenance and repair of vehicle body
CO05 - To learn the detailed study of maintenance and repair of electrical systems

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S							M				S
CO2		W	S		M						S	
CO3		M		S				S		M		
CO4	S		M	M			S					
CO5		S	S		M						M	

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS 8

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING 12

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system, - lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 12

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 6

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 7

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

TOTAL: 45 PERIODS

TEXTBOOK:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London, 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963

REFERENCES:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. John Dolce, Fleet maintenance, McGraw Hill, Newyork, 1984
4. A,W.Judge, Maintenance of high speed diesel engines, Chamman Hall Ltd., London, 1956.
5. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork, 1995.
6. Vehicle servicing manuals.
7. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963.

RESEARCH METHODOLOGY

Objectives

- To Get adequate knowledge about research concepts
- To describe mathematical modeling and simulation
- To understand experimental modeling
- To get knowledge about the interpretation of result

Course Outcomes after successful completion of this course, the students should be able to

CO 1: To describe research concepts.
CO 2: To Get adequate knowledge about mathematical modeling

CO 3: To describe experimental modeling
CO 4: To understand analysis of results.
CO 5: To know about report writing

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak							
COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M				M	M
CO2	S	M				M	M
CO3	S	M				M	M
CO4	S	M				M	M
CO5	S	M				M	M

ASSESSMENT METHOD:

Direct		**Indirect**	
1	Internal Tests	1	Students Exit Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
4	Online test		
5	End Semester Examinations		

1. RESEARCH CONCEPTS 9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).
Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION 9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING 9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS 9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING 9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis", Himalaya Publication.
2. Schank Fr.,"Theories of Engineering Experiments", Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, "Design of Experiments", Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design", John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education", PHI Publication.
5 Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication.
6. S. S. Rao, „Optimization Theory and Application", Wiley Eastern Ltd., New Delhi, 1996.