SEMESTER VII

(AU617) ELECTRIC & HYBRID VEHICLES

1. COURSE OBJECTIVES: This course will introduce general aspects of advanced Hybrid Electric Vehicles (HEV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control. It will cover energy storage sources, electric propulsion systems, power electronics design, and HEV control.

2. TEACHING AND EXAMINATION SCHEME

Semester VII									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
AU617 Electric & Hybrid Vehicles	L	T	P	C	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	-	25	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU617CO1: State the role of hybrid/electric vehicles and its impact on the environment.

AU617CO2: Describe the construction and working of various systems and devices used in electric/hybrid vehicles.

AU617CO3: Explain the fundamentals and system configurations of electric/hybrid vehicles.

AU617CO4: Explain various energy storage technologies and energy management strategies used in hybrid and electric vehicles.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	0	2	0	3	2	3	2	2
CO2	2	2	2	2	0	0	2	2	2
CO3	2	2	2	2	2	2	3	2	2
CO4	2	2	2	2	2	2	2	2	2

Relationship: Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**			
Unit		**M**	**Thr**	**CO**
Unit 1 INTRODUCTION TO HYBRID/ELECTRIC VEHICLES:		**9**	**6**	
1.1 History of hybrid and electric vehicles				
1.2 Social and environmental importance of hybrid and electric vehicles				
1.3 Classification of EVs based on				**CO1**
-Propulsion devices (PEV and HEV)				
-Energy Sources (BEV, PHEV and FCEV)				
1.4 Benefits and comparison of EVs over IC Engines				
1.5 Challenges faced by EVs				
Unit 2 ELECTRIC MACHINES AND SIZING OF ELECTRIC MACHINES FOR ELECTRIC AND HYBRID VEHICLES		**15**	**10**	
2.1 Introduction to EV Motors, Requirement of DC Machine				
2.2 Compare Torque vs Speed and Power vs Speed Characteristic curve of IC engines vs EVs				
2.3 Working of 3 Phase AC motor				
2.4 Types of AC motors: Construction and Working - Induction Machine - Permanent Magnet Machine, - Switch Reluctance motor				**CO2**
2.5 Sizing of Electric Machines				
2.6 Peak Torque and Power				
2.7 Constant Power Speed Ratio				
2.8 EM Sizing				
2.9 Sizing Power Electronics				
Unit 3 ELECTRIC VEHICLE SUB-SYSTEMS AND CONFIGURATIONS		**18**	**12**	
3.1 Introduction to electric components/ subsystems used in EVs				
3.2 Basic Configuration and control of Battery Electric Vehicle (BEV),				
3.3 Basic Configuration and control of Fuel Cell Electric Vehicle (FCEV)				
3.4 Types of EV Propulsion systems				
3.4.1 Based on Mechanical Arrangements				**CO2 CO3**
-Longitudinal front wheel drive				
-Front Gearing and no clutch				
-Transverse front wheel drive				
-Dual motor drive				
-Outer motor drive				
3.4.2 Based on Energy Source				
-Battery Energy source				
-Hybrid battery source				
-Fuel cell arrangement				
3.5 Challenges faces by Battery Electric Vehicle (BEV)				
Unit 4 HYBRID VEHICLE SUB-SYSTEMS AND CONFIGURATIONS		**15**	**10**	
4.1 Introduction to Hybridization in EVs.				
4.2 Need for Hybridization.				

4.3 Conventional HEV- Micro Mild and Full			**CO2 CO3**
4.4 Energy use in conventional vehicles, Energy saving potential of hybrid drive trains			
4.5 Types of Hybrid EV Configuration			
-Series Hybrid EV			
-Parallel Hybrid EV			
-Series Parallel Hybrid EV			
-Complex Hybrid EV			
4.6 Challenges faces by Hybrid Electric Vehicle			
Unit 5 ENERGY SOURCE TECHNOLOGY AND ENERGY MANAGEMENT	**18**	**10**	
5.1 Introduction to energy sources			**CO4**
5.2 Types of Energy Sources: Construction, Working - Battery (Lithium ion batteries) - Ultra capacitor - Ultra Flywheel - Fuel Cells			
5.3 Regenerative Braking			
5.4 Introduction to Battery Charging Technology			
5.4.1 Charging schemes for EVs			
5.4.2 Charging Mechanism (Wire, Wireless)			
5.4.3 Inductive Power Transfer (IPT)			
5.4.4 Park and Charge			
5.4.5 Move and Charge			
5.5 Battery Management System			
5.6 Energy Management Strategies used in hybrid and electric vehicles - Function of Control System in HEVs and EVs - Overview of Control System: The Electronic Control Unit (ECU) - Control Area Network (CAN)			
Total			
	75	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	Introduction To Hybrid/Electric Vehicles	06	9
2	Electric Machines And Sizing Of Electric Machines For Electric And Hybrid Vehicles	10	15
3	Electric Vehicle Sub-Systems And Configurations	12	18
4	Hybrid Vehicle Sub-Systems And Configurations	10	15
5	Energy Source Technology And Energy Management	10	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Study various components of Electric Vehicles.	
2.	Demonstrate the wiring layout of Electric Vehicle.	
3.	Case Study: Car Comparison Project between one Hybrid and Non-Hybrid Vehicle.	
4.	Study of various Energy storage systems used in Electric vehicles.	
5.	Case Study of any Hybrid series parallel Circuit.	
6.	Study on Hybrid electric vehicle propulsion system.	
7.	Case study on Vehicle configuration (Electric, Hybrid, Engine)	
8.	Study on Energy management strategy for fuel cell hybrid vehicles.	
	Total	**25**

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Iqbal Husain	"Electic and Hybrid vehicles Design Fundamentals"	CRC Press, second edition 2013
2	James Larminie, John Lowry	"Electric vehicle technology Explained"	Second Edition, Wiley 2012
3	Ali Emadi	"Hand book of Automotive Power Electronics and Motor Drives"	CRC Press 2005
4	Ali Emadi, Mehrdad Ehsani, John M. Muller	“Vehicular Electric Power Systems”	Marcel Dekker, Inc., 2004

9.1 Internet and Web Resources

S. No.	Author	Title of Books	Publishers
1	NPTEL	https://nptel.ac.in/courses/108/103/108103009/	-

(AU702) AUTOMOBILE COMPONENT DESIGN

1. COURSE OBJECTIVES:

The students will able to gain basic understanding of how the material selection & design process is established for an automobile part. They will comprehend how a product is designed based on different types of stresses induced on it. Subject covers basic knowledge on design procedures of different automotive parts such as shafts, bolted joints, clutches, springs and internal combustion engine parts

2. TEACHING AND EXAMINATION SCHEME

Semester	**VII**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
		L	**T**	**P**	C	**TH**	**TM**	**PR /OR**	**TW**	
AU702 AUTOMOBILE COMPONENT DESIGN		**3**	**2**	**-**	**5**	**75**	**25**	**-**	**25**	**125**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU702CO1: Identify various types of loads and forces acting on the component and the stresses induced in them.
AU702CO2: Demonstrate understanding of basic concepts of design of automotive components.
AU702CO3: Discuss the design procedure used in automotive component design.
AU702CO4: Solve problems using the design methodology for various automotive components and systems.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	2	2	0	2	2	3	2
CO2	3	3	2	2	0	2	2	2	1
CO3	2	3	2	2	3	2	3	2	2
CO4	3	3	3	2	2	2	2	2	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
Unit 1 BASIC CONCEPTS OF DESIGN	**18**	**10**	**CO1 CO2 CO3 CO4**
1.1 Introduction to design.			
1.2 General consideration for selection of material and manufacturing processes.			
1.3 General design consideration.			
1.4 Design Procedure.			
1.5 Stress analysis: 1.5.1 Types of external loads. 1.5.2 Types of induced stresses: tensile, compressive, shear, crushing and bearing pressure, bending, torsion, thermal stresses, creep, proof stresses. 1.5.3 Stress – Strain diagram for ductile & brittle material & its importance. 1.5.4 Factor of safety, Selection of factor of safety. 1.5.5 Ergonomics: Design and requirement of driver, passenger seats.			
Unit 2 DESIGN OF SHAFTS	**09**	**06**	**CO1 CO2 CO3 CO4**
2.1 Design of shaft subjected to Twisting Moment			
2.2 Design of shaft subjected to Bending Moment and Twisting Moment			
Unit 3 DESIGN OF SCREWED FASTENERS	**12**	**08**	**CO1 CO2 CO3 CO4**
3.1 Bolts subjected to direct tensile load			
3.2 Bolts subjected to shear load			
3.3 Bolts subjected to eccentric load: 3.3.1 Bolt axis and load line are parallel to each other 3.3.2 Bolt axis and load line are perpendicular to each other			
Unit 4 DESIGN OF SPRINGS	**12**	**06**	**CO1 CO2 CO3 CO4**
4.1 Helical spring` 4.1.1 Spring terminology 4.1.2 End connections for compression helical springs 4.1.3 Design of helical compression spring 4.1.4 Applications and functions of helical spring			
4.2 Semi elliptical leaf spring 4.2.1 Design of semi elliptical leaf spring 4.2.2 Applications and functions of Semi elliptical leaf spring			

Unit 5 DESIGN OF CLUTCH & BASIC ENGINE COMPONENTS	**24**	**18**	
5.1 Design of Single plate clutch (Using Uniform Pressure & Uniform Wear Theory)			
5.2 Design of Multi plate clutch (Using Uniform Pressure & Uniform Wear Theory)			
5.3 Buckling of struts and columns			
5.4 Application of Euler's and Rankine's formulae			**CO1 CO2 CO3 CO4**
5.5 Design of connecting rod			
5.6 Design of connecting rod – small end			
5.7 Design of connecting rod –big end and bolts			
5.8 Design of push rods			
5.9 Design of piston crown by bending strength and thermal considerations			
5.10 Design of piston rings and skirt length			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and tutorials.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	BASIC CONCEPTS OF DESIGN	10	18
2	DESIGN OF SHAFTS	06	09
3	DESIGN OF SCREWED FASTENERS	08	12
4	DESIGN OF SPRINGS	06	12
5	DESIGN OF CLUTCH & BASIC ENGINE COMPONENTS	18	24
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK &PRACTICALS.

No	Class room Assignments	Marks
1	Problems on types of Induced stresses.	
2	Problems on Design of shafts under combined torsion & bending.	
3	Problems on Design of Screwed fasteners.	
4	Problems on Design of Helical Springs.	
5	Problems on Design of Semi- Elliptical leaf springs.	
6	Problems on Design of Single & Multi-plate clutches.	
7	Problems on Design of I.C. engine parts.	
	Total	**25**

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	R.S. Khurmi & J.K. Gupta	A Textbook on Machine Design	S. Chand
2	R.K. Jain	Machine Design	Khanna Publications
3	V.B. Bhandari	Design of Machine Elements	Tata McGraw Hill
4	Pandya and Shah	Machine Design	Dhanpat Rai & Sons

(AU703) AUTOMOBILE PROJECT

1. COURSE OBJECTIVES

Automobile project would enable the students to apply knowledge of Automobile Engineering to identify, analyze, solve and design a project work in order to provide effective solutions to an engineering problem so that it benefits the society and environment at large. In the process of doing so he would be called upon to carry out the tasks of Planning, Scheduling and Coordinating. Student would be able to develop the ability of problem solving and decision making. Student would be able to develop skills such as imagination, creativity & resourcefulness.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VII**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
AU703 AUTOMOBILE PROJECT		**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**
		-	**-**	**8**	**8**	**-**	**-**	**100**	**50**	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU703CO1: Identify problem areas requiring solutions.

AU703CO2: Plan the necessary activities for the implementation of the project.

AU703CO3: Apply engineering knowledge in arriving at innovative solutions.

AU703CO4: Execute the project and compile a project report.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	2	1	0	0	2	2	2	2
CO2	2	1	2	0	0	3	2	2	2
CO3	3	3	3	3	2	2	2	3	3
CO4	3	3	3	3	2	3	2	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

Unit
1 PROJECT SELECTION
Students in groups of not more than 5 will in consultation with the respective staff member appointed by the Head of Department, choose a developmental topic in Automobile Engineering for their project. Some areas or fields from which the project is chosen could include: 1.Modification of Existing automotive systems 2.Traffic investigations and surveys 3.Design & fabrication of auto systems 4.Design & fabrication of testing equipment and devices 5.Process improvement 6.Layout modification The project selected should be related to the courses covered by the students.
2 PLANNING
1. Listing down the various activities/tasks involved till the completion of the project. 2. Finalization of the plan in consultation with the guide.
3 EXECUTION
1. The work should proceed according to the plan. 2. Any deviations from the plans should be monitored & corrected or else the plan should be modified to suit the prevailing conditions. 3. Students should maintain a daily diary to record all the activities carried out. 4. All the activities should be in consultation & coordination with the guide.
4 REPORT WRITING
Students are required to prepare a detailed report containing some or all of the following information: 1. Introduction or foreword, theory related to the project, design calculations, drawings, charts, sketches, catalogues, graphs, photographs, etc related to the project, Observations ,readings or any other data, suggestions if any, Conclusions or inferences and References. 2. The above report should be typewritten and hard bound and submitted in duplicate to the department.
5 EVALUATION AND ASSESSMENT
The evaluation and assessment of the project will be done periodically during the term followed by an end of term oral examination.

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies.

7. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Project selection	10
2.	Planning	10
3.	Execution	40
4.	Report writing	40
	Total	**100**

PROJECT REVIEW SCHEDULE

SR.NO	REVIEW NO	WEEK OF SEMESTER
1	Review 1	Second Week
2	Review 2	Seventh Week
3	Review 3	Twelfth Week
4	Review 4	Fifteenth Week

Note: In the project review assessment to be done based on

1) Presentation made by the students showing the progress of their project.
2) Involvement and contribution of individual student in project group.
3) Uniqueness of project.

Project Guide should strictly follow the project review schedule.

(CC501) ENTREPRENEURSHIP DEVELOPMENT

1. COURSE OBJECTIVES:

Student will be able to start his own venture with all fundamentals of business. Today Entrepreneurship is given importance by the government to bring the youth of our country to overcome the problem of unemployment and bring them in the main stream of global business to strengthen Indian economy by Make in India philosophy. Government has announced various financial schemes for young youth and women to support them for setting up an enterprise. To fulfill this, youth are to be prepared for setting an enterprise. The students undergoing this course will develop entrepreneurial traits and confidence within themselves and choose entrepreneurship as a career to brighten their future.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CC501 Entrepreneurship Development	**L**	**T**	**P**	**C**	**-**	**-**	**PR/OR**	**TW**	25
	-	-	2	2	-	-	-	25	

3. COURSE OUTCOMES:

CC501CO1: List the terms associated with Entrepreneurship Development.

CC501CO2: Explain the terminologies and procedures involved in Entrepreneurship Development

CC501CO3: Identify legal implications for Entrepreneurs.

CC501CO4: Develop the project report for new enterprise.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	1	0	0	0	2	3	2	1	1
CO2	1	0	0	0	1	3	2	1	1
CO3	0	1	2	0	0	0	2	1	1
CO4	3	2	2	0	2	0	2	1	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS

M=Marks	Phr= Practical hours	CO – Course Outcomes			
Unit			M	Phr	CO
1 Introduction to Entrepreneurship Development				**4**	
1.1 Introduction to Entrepreneurship Development (EDP)					**CO1 CO2 CO3 CO4**
1.2 Entrepreneur definition, Types of Entrepreneur, Characteristics of entrepreneur and entrepreneurship					
1.3 Enterprises: Micro, Small and Medium Enterprises (MSME), Service industry, Manufacturing Industry, Franchises and Start up.					
1.4 Organisations: Sole proprietorship, Partnership, Public, Co-operative Society.					
2. Identification of business opportunity				**6**	
2.1 Business ideas- Exploring business ideas in terms of marketability, technical feasibility, financing and authorities					**CO1 CO2 CO3 CO4**
2.2 Business terms: - Clients, vendors market description, demand, supply, banking & non-banking, financing companies, Loans of various types, GST, peers Promoters, Lenders, Consortium.					
2.3Government Departments: - IDC, EDC, Civic Body, Pollution Control department.					
3. Market Research				**4**	
3.1 Data Collection: - Data collection of Business idea such as Number of players, Total demand, Total supply					**CO1 CO2 CO3 CO4**
3.2 Analysis of Data: - Analysis of data and projection of data with respect to various factor (such as GDP, Climate etc through case studies).					
3.1 Questionnaire: - Preparing a questionnaire for business idea to assess business opportunity.					
4. Legal Aspect				**10**	
4.1 Legal Financial Term: - Know the various terms such as Resources, Assets, Liabilities, Advances, Depreciations, Investments, Fixed Capital, Working Capital (cash credit), Employee Cost, Miscellaneous Expense, Other Income, Profit & Loss Statement, Cash Flow Analysis, and Balance Sheet.					**CO1 CO2 CO3 CO4**
4.2 Legal Aspects: - Procedure for Registration with various government agencies, GST, PAN, Slab of Income Tax. Difference in use of electricity, water & LPG for domestic purpose and industrial applications					
4.3 Business Analyses: - 1) Swot Analysis 2) Break – Even Analysis					
5. Project Report				**8**	

5.1 Need for project report, Importance of Project report, Scope of project report: Economic aspects, Technical aspects, Financial aspects, Managerial aspects, Production aspects. List the contents of a project report. Proforma of a project report which includes: -Introduction, Schemes, Profitability and Projections, Infrastructure, Break Even Point, Names and Addresses of suppliers, remarks.			**CO1** **CO2** **CO3** **CO4**
5.2 Project Profile: - Project appraisal criteria: - Technical feasibility, Financial feasibility, Economic viability, Commercial viability, Managerial competency, Political and Labour considerations			
5.3 Scope of Business: - Further scope with Capital infusion, Exit plan Analysis.			
Total	**25**	**32**	

6. COURSE DELIVERY:

Videos / Lectures/ Practicals /Expert lectures / Industry visits

7. SPECIFICATION TABLE FOR PRACTICALS

Unit No.	**Topic**	**Teaching Hours/ Semester**	**MARKS**
1	**Entrepreneurship Development**	4	3
2	**Identification of business opportunity**	6	5
3	**Market Research**	4	3
4	**Legal Aspect**	10	8
5	**Project Report**	8	6
TOTAL		**32**	**25**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICAL HOURS

No	**Classroom Assignments**	**Marks**
1.	Prepare a Case Study on leading enterprise	
2.	Prepare a Case Study on small scale unit	
3.	Prepare a report on various government schemes for startup.	
4.	Prepare SWOT analysis for a new business idea.	
5.	Prepare Project Report for a new business idea.	
	Total	**25**

9. LEARNING RESOURCES

S.No.	Author	Title of Books	Publisher
1.	Sharad Jawadekar, Shobha Dodlani,	Business entrepreneurship	Suvichar prakashan mandal, pune,
2.	S.S. Khanna	Entrepreneurship development	S. Chand & Co. Ltd, New Delhi,
3.	Vasant Desai	Management of small-Scale Industry in India	Himalaya Publishing House
4.	Dilip Sarwate	Entrepreneurial development Concepts and practices	Everest Publication House, Pune
5.	CB Gupta and P Srinivasan	Entrepreneurship Development	S. Chand and Sons, New Delhi

AUDIT COURSE

(AC101) ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

1. COURSE OBJECTIVES:

This course aims at imparting basic principles of thought process, reasoning and inferencing by human being. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogis, science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course thus focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(AC101) Essence of Indian Knowledge and Tradition	2	-	-	2	-	-	-	-	-

Course Content:

Basic Structure of Indian Knowledge System:

(i) वेद, (ii) उनवेद (आयुवेद, धनुवेद, गन्धवेद, स्थानत्य आदद) (iii) वेदांग (शिक्षा, कल्न, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उनाइग (धर्म ास्त्र, रीांसा, नुराण, तकमास्त्र)

 Modern Science and Indian Knowledge System

 Yoga and Holistic Health care

 Case Studies.

S. No.	Title of Book	Author	Publication
1.	Cultural Heritage of India- Course Material	V. Sivaramakrishna	Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2.	Modern Physics and Vedant	Swami Jitatmanand	Bharatiya Vidya Bhavan
3.	The wave of Life	Fritzof Capra	
4.	Tao of Physics	Fritzof Capra	
5.	Tarkasangraha of Annam Bhatta, Inernational	V N Jha	Chinmay Foundation, Velliarnad, Amakuam
6.	Science of Consciousness Psychotherapy and Yoga Practices	RN Jha	Vidyanidhi Prakasham, Delhi, 2016

ELECTIVES

II

(AU613) AUTOMOTIVE SALES

1. COURSE OBJECTIVES

Although sales is quite often considered as an 'art', it is based on a few basic principles which generally apply to all forms of sales. A person intending to venture into sales would need to familiarise himself with these basic fundamentals and aim to apply them in all his dealings whether it involves the task of selling vehicles or even for that matter service. This course would provide the student with fundamental knowledge of automotive sales, vehicle finance, and insurance, value added services and vehicle resale to make a successful career as a sales executive in automotive industry. After undergoing this course student will be able to apply the knowledge to make a successful career as a sales executive.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	C	TH	TM	TW	PR/OR	
AU613 AUTOMOTIVE SALES	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU613CO1: Understand the fundamentals of automotive sales.

AU613CO2: Describe the terminology used in automotive sales.

AU613CO3: Explain the processes used in automotive sales.

AU613CO4: Apply the principles of automotive sales in real life situations.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	2	2	0	2	3	2	2	2
CO2	2	2	1	1	2	3	2	2	2
CO3	2	3	2	0	2	3	3	2	2
CO4	3	3	2	2	3	3	3	2	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 SALES AND SALES PROCESS	**15**	**10**	
1.1 Introduction Definition and importance of sales.			**CO1** **CO2** **CO3** **CO4**
1.2 Salesmanship Definition, Features of salesmanship, Fundamentals of salesmanship, Importance of salesmanship.			
1.3 Factors affecting sales- Internal and external factors, Qualities of a good sales executive, Duties of a good salesman.			
1.4 Sales process Flow chart of sales process, Steps in sales process, After sales service and its importance.			
2 FINANCE	**15**	**10**	
2.1 Introduction Definition, Benefits of automotive finance.			**CO1** **CO2** **CO3** **CO4**
2.2 Terms used in Finance Rack rate, Reducing balance and Fixed interest rates, Subvention, Subvented loan and Subvented lease, Hypothecation, Foreclosure and prepayment charges, EMI-step up, step down and Bullet EMI, Processing fees, Late payment charges, Margin amount , Post datedcheque, Electronic clearance system (ECS) , Zero percent finance ,Loan to value (LTV) ratio.			
2.3 Finance documentation For- Salaried Individual ,Self employed Individual, Private and Public Limited Company. Differences between Proprietorship and partnership. Vehicle finance calculation.			
3 INSURANCE	**15**	**10**	
3.1 Introduction Definition and Purpose of vehicle insurance Benefits of vehicle insurance Auto Insurance in India What is covered and not covered under auto insurance			**CO1** **CO2** **CO3** **CO4**
3.2 Types of Auto Insurance With respect to vehicle type –Private car insurance, Two wheeler insurance and commercial vehicle insurance. Based on coverage- Third party Policy, Comprehensive policy, Nil or Zero depreciation policy. Difference between Zero Depreciation and normal car insurance. Decision on which policy to buy.			
3.3 Terms used in insurance IDV, Insurance coverage, proposal form, claim form, Premium– breakup and calculation, sum assured. Deductible- Compulsory and voluntary deductibles. Endorsement-Definition and types of endorsements. No claim bonus (NCB). Cashless insurance and its benefits to the customer. Personal accident cover.			

3.4 Process of making vehicle insurance policy			
4 VALUE ADDED SERVICES	**15**	**10**	
4.1 Introduction What are value added services in automobile sales			
4.2 Warranty and Extended warranty What is warranty and extended warranty, benefits to the customer, Services covered and not covered under warranty, Eligibility for extended warranty, Registration procedure for extended warranty, Claim procedure, precautions and important information.			**CO1** **CO2** **CO3**
4.3 Accessories Definition, Types of accessories, sources of accessories			
4.4 Teflon Cavity Antirust (TCA) What is TCA, Process of TCA on cars, Benefits of TCA to the customers, disadvantages of TCA.			
5 VEHICLE RESALE	**15**	**8**	
5.1 Introduction Overview of vehicle exchange market in India, Reasons for growth of used car market in India, Scope and future of vehicle exchange market in India			**CO1** **CO2** **CO3**
5.2 Objectives of exchange, Benefits of Vehicle Exchange to the customer and manufacturer, Initiatives taken by manufacturers to initiate an exchange of vehicle, assessment or evaluation of used vehicle			
5.3 Certified Pre-owned (CPO) cars			
5.4 Procedure for vehicle Resale			
Total	**75**	**48**	**-**

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	Sales and sales process	10	15
2	Finance	10	15
3	Insurance	10	15
4	Value added services	10	15
5	Vehicle resale	08	15
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Study the sales process of any one automobile dealership and prepare a report.	
2.	Collect and present interest rate, various charges, fees and penalties on vehicle loan of any bank and finance company.	
3.	Collect and study different types of vehicle insurance policies of any vehicle.	
4.	Collect and study Extended warranty document of any vehicle.	
5.	Study the vehicle resale/ exchange business in Goa and prepare a report.	
	Total	**25**

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Jeffrey Knott	From Zero to Hero: How to Master the Art of SELLING CARS	iUniverse Star
2	Graham Hill	Car Finance - A Simple Guide	GHAF Publishing
3	Emmett J. Vaughan	Fundamentals of Risk and Insurance	Wiley
4	Sheryl Lilke	Understanding Personal Auto Insurance	Dearborn Trade Pub

(AU615) AUTOMOTIVE SAFETY & ERGONOMICS

1. COURSE OBJECTIVES:

The students will able to gain exposure to several automotive safety technologies related to stability, suspension and braking. They will gain basic knowledge on the vehicle ergonomics and human-technology interaction.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	C	TH	TM	PR /OR	TW	
AU615 AUTOMOTIVE SAFETY & ERGONOMICS	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU615CO1: Relate to different concepts on vehicle safety.
AU615CO2: Understand the concept of vehicle ergonomics and human – technology interaction. AU615CO3: Explain the working principle of various vehicle safety systems and safety technology available in the market.
AU615CO4: Apply the knowledge of automotive safety and ergonomics for designing vehicles which are safe and comfortable.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	2	0	2	0	2	2	1
CO2	3	2	2	1	2	1	2	2	2
CO3	2	2	2	2	3	2	2	2	2
CO4	3	3	3	2	3	2	3	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
Unit 1 INTRODUCTION	**20**	**12**	**CO1**
1.1 Introduction to Vehicle Safety.			
1.2 Design Of The Body For Safety, Engine Location.			
1.3 Effects Of Deceleration Inside Passenger Compartment			
1.4 Deceleration On Impact With Stationary And Movable Obstacle			
1.5 Active And Passive Safety			
1.6 Types Of Crash / Roll Over Tests, Regulatory Requirements For Crash Testing			
Unit 2 SAFETY CONCEPTS	**15**	**12**	**CO1 CO2**
2.1 Active Safety- Driving Safety, Conditional Safety			
2.2 Perceptibility Safety, Operating Safety			
2.3 Passive Safety: Exterior Safety, Interior safety			
2.4 Deformation Behaviour Of Vehicle Body, Speed And Acceleration Characteristics Of Passenger Compartment on Impact			
2.5 Pedestrian Safety - Human Impact Tolerance Determination Of Injury Thresholds			
2.6 Severity Index, Study Of Comparative Tolerance, Study Of Crash Dummies			
Unit 3 VEHICLE SAFETY TECHNOLOGY	**15**	**8**	**CO1 CO2 CO3**
3.1 Crumple Zones			
3.2 Airbags & Active Head Rest			
3.3 Pedestrian Protection systems			
3.4 Conventional & Auto-Retracting Seatbelts			
3.5 Collision mitigation braking system & Lane assist systems			
3.6 Collapsible steering			
3.7 Antilock Braking System & Traction control system			
3.8 Electronic Brake distribution & Electronic Stability Program			
Unit 4 VEHICLE ERGONOMICS	**15**	**10**	**CO2 CO4**
4.1 Vehicle Ergonomics: 4.1.1 Introduction To Human Body - Anthropometrics And Its Application To Vehicle Ergonomics 4.1.2 Cockpit Design 4.1.3 Driver Comfort – Seating, Visibility 4.1.4 Passenger, Child seat and Luggage compartment design requirement: Requirements for passenger seats, Split seats for rear passengers, Child Lock, Child seat & luggage compartment requirements and design. 4.1.5 Vehicle Exterior ergonomics and dimensions (Engine compartment, Fuel tank, Spare tire, ground clearance, front & rear bumper positions)			

4.2 Environmental & Psychological Conditions: 4.2.1 Illumination. 4.2.3 Heat, Ventilation & Air-conditioning. 4.2.3 Noise, Vibration, Harshness. Speed and Acceleration. 4.2.4 Psychological Factors – Stress, Attention			
Unit 5 HUMAN-TECHNOLOGY INTERACTION	**10**	**6**	**CO2**
5.1 Human-Technology Interaction, Human – Machine Systems: Manual and Automated			
5.2 Human system reliability and conceptual designs & development.			
5.3 Human system modelling.			
5.4 Input Interfaces: Text, Symbols & Codes, Visual Display &Graphics, Tactual, Auditory & Speech Communications.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and tutorials.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	INTRODUCTION	10	15
2	SAFETY CONCEPTS	10	15
3	VEHICLE SAFETY TECHNOLOGY	10	20
4	VEHICLE ERGONOMICS	12	15
5	HUMAN-TECHNOLOGY INTERACTION	06	10
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK &PRACTICALS.

No	**Practical**	**Marks**
1	Study on types of vehicle crash situations.	
2	Study of Active and Passive safety systems.	
3	Study of Crash test dummies.	
4	Working of Air bags.	
5	Types of Pedestrian protection systems.	
6	Construction and working of Anti-lock braking system.	
7	Working of collision mitigation braking system.	
8	Comparison of visibility of different vehicles. Prepare a report.	
9	Study of ergonomics of human body & hence the design of driver's and passenger's seat.	
	Total	**25**

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	William B. Ribbens	Understanding Automotive Electronics	6th Edition, Newnes/ Butter worth Heinemann Woburn.
2	Crouse / Anglin	Automobile Mechanics	Tata McGraw- Hill
3	Robert N Brady	Automotive computers and Digital Instrumentation	A Reston Book, Prentice Hill, Eagle Wood Cliffs, New Jersey.
4	Ronald K Jurgen	Navigation and Intelligent Transportation systems – Progress in technology	Automotive Electronics Series, SAE, USA
5	Bechhold	Understanding Automotive Electronics	SAE
6	LjuboVlacic, Michel Parent and Fumio Harashima	Intelligent Vehicle Technologies	Butterworth-Heinemann publications, Oxford

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Robert Bosch	Automotive Handbook	SAE
2	Allan W M B	Automotive Computer Controlled Systems	Elsevier Butterworth-Heinemann

(AU616) AUTOMOTIVE INSURANCE

1. COURSE OBJECTIVES:

Vehicle Insurance is a mandatory requirement for all vehicles that ply on the road. One of the roles performed by a student who acquires a diploma in Automobile Engineering is that of an insurance surveyor. This course exposes a student to all aspects of motor vehicle insurance and provides the necessary knowledge and skills set for that of an insurance surveyor.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
AU616 AUTOMOTIVE INSURANCE	L	T	P	C	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU616CO1: Understand the history and basic principles of Insurance, motor Insurance, fraud management and Internal audit.

AU616CO2: Summarize the eligibility criteria for insurance and insurance surveyor.

AU616CO3: Apply Insurance norms and regulations to prepare Insurance documentation for a damaged vehicle.

AU616CO4: Estimate the repair cost of a damaged vehicle.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	1	1	1	2	1	2	1	1
CO2	2	2	2	2	2	2	2	2	2
CO3	2	3	3	2	2	2	3	1	2
CO4	3	3	3	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 History of Insurance	**09**	**06**	
1.1 History and development of Insurance			
1.2 General Insurance business			**CO1**
1.3 Structure of the Insurance market in India			**CO2**
1.4 Nature of Insurance business			**CO3**
1.5 Need for professionalism in Insurance Business			**CO4**
1.6 Continued professional development			
2 The Basic Principles of Insurance	**18**	**12**	
2.1 Utmost good faith:- Definition of Utmost good faith, Definition of Valid Contract, Essentials of a Valid Contract, Caveat Emtor, Insurance Contracts, Uberrima Fides, Reciprocal duty.			
2.2 Insurable Interest:- Concept of insurable interest, subject matter of insurance, subject matter of contract, essentials of insurable interest.			**CO1** **CO2**
2.3 Indemnity:- Definition of indemnity, link with insurable interest, how Indemnity is provided, cash payment , repair , replacement, Reinstatement.			**CO3** **CO4**
2.4 Corollaries of Indemnity:- Subrogation, corollary of indemnity, extent of subrogation rights.			
2.5 Proximate Cause:- Nature of perils, need for the doctrine, meaning of proximate cause.			
3 Eligibility to be a surveyor and Code of Conduct	**18**	**10**	
3.1 Application for, and matters relating to, grant of license to individual surveyors and loss assessors.			**CO2** **CO3**
3.2 Duties and responsibilities of a surveyor and loss assessor.			
3.3 Code of conduct of a surveyor and loss assessor.			
4 Motor Insurance	**15**	**10**	**CO1**
4.1 History of Motor Insurance			**CO2**
4.2 Law and Practice of Motor Insurance in India			**CO3**
4.3 Market scenario			**CO4**
4.4 New trends in Motor Insurance			
5 Fraud Management and Internal Audit	**15**	**10**	
5.1 Frauds in third party claims: a)Reason for claims occurrence b) Fraud management			**CO1**
5.2 Frauds in motor insurance: a) Meaning of fraud and legal provisions b) Provisions of Indian Penal Code c) Making a false document d) Fabricating false evidence e) Provisions of Civil Procedure Code f) Criminal procedure code.			**CO3** **CO4**
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	History of Insurance	06	09
2	The Basic Principles of Insurance	12	18
3	Eligibility to be a surveyor and Code of Conduct	10	18
4	Motor Insurance	10	15
5	Fraud Management and Internal Audit	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
2.	Preparation of Insurance documentation in motor insurance.	
5.	Estimate preparation of 2 damaged vehicles.	
1	Study the insurance business in India and prepare a report.	
3	Study the new trends in Motor Insurance and prepare a report.	
4	Interact with any insurance surveyor/ assessor and present a report on roles and responsibilities, process followed and challenges faced.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	P.Periaswami	Principles and Practice of Insurance	Himalaya Publishing House
2	Khan M.Y.	Financial Services	Tata Mc Graw Hill Co. Ltd.

(AU621) VEHICLE AERODYNAMICS AND DESIGN

1. COURSE OBJECTIVES:

The students will able to gain exposure to the basics of Aerodynamics & Ergonomics and understand its use in various applications to improve vehicle efficiency. They will be able to attain knowledge on Vehicle performance and stability.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	C	TH	TM	PR /OR	TW	
AU621 VEHICLE AERODYNAMICS & DESIGN	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU621CO1: Understand the fundamentals of vehicle aerodynamics and design.

AU621CO2: Describe the effect of various aerodynamic parameters on the design of vehicle body.

AU621CO3: Explain the concepts of aerodynamic drag, wind tunnel testing and ergonomics.

AU621CO4: Evaluate the aerodynamic parameters that decide the vehicle performance and directional stability of the vehicle.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	1	2	1	1	1	1	3	2
CO2	3	3	3	2	3	2	2	2	3
CO3	3	3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	2	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
Unit 1 AERODYNAMICS			**12**	**10**	**CO1 CO2**
1.1 Introduction of aerodynamics: Historical Examples and future trends.					
1.2 Classification & practical objectives of aerodynamics					
1.3 Fundamental aerodynamic variables like Pressure, Density, Temperature, Flow Velocity.					
1.4 Aerodynamic forces & moments like Relative Wind, Free Stream, Lift, Drag, Pitching, Rolling, Yawing & Side forces.					
1.5 Concept of an Airfoil (Aerofoil).					
Unit 2 AERODYNAMIC DRAG & WIND TUNNEL TESTING			**18**	**12**	**CO2 CO3**
2.1 Types of car bodies					
2.2 Flow field around the car - Air flow pattern, Pressure distribution					
2.3 Local origins of flow field - Front end, windshield wiper, A-pillar, Roof, Rear end.					
2.4 Water and dirt accumulation on the body -Safety, water flow, Dirt Deposits.					
2.5 Downforce and grounding effect in cars, Air Dams, Diffusers, Vortex generators, Spoilers.					
2.6 Wind tunnels: 2.6.1 Concept (no analytical treatment) 2.6.2 Construction 2.6.3 Existing wind tunnels:- Large, Small, full scale wind tunnel, Wind tunnel for scale model, Climatic tunnel, Climatic wind chamber					
2.7. Wind noise: 2.7.1 Wind noise sources: - Leak noise, Cavity noise, Wind- rush noise; 2.7.2 Design features of A-pillar, Outside rear view mirror, Windshield wipers, Radio antenna, Roof racks, Doors.					
Unit 3 ERGONOMICS			**15**	**8**	**CO2**
3.1 Concept of Visibility					
3.2 Concept of Blind spot					
3.3 Driver seat design requirement					
3.4 Passenger seat design requirement					
3.5 Child seat design requirement					

Unit 4 DIRECTIONAL STABILITY	**12**	**8**	
4.1 Aerodynamic stability			
4.2 Driving behavior in cross wind			**CO2 CO4**
4.3 Driving with trailer			
4.4 Stability of vehicle on slope (numerical problems)			
4.5 Stability of vehicle on turns (numerical problems)			
Unit 5 VEHICLE PERFORMANCE	**18**	**12**	
5.1 Various resistances faced by vehicle (air, rolling, gradient) (numerical problems)			
5.2 Power required to propel the vehicle (numerical problems)			**CO2 CO4**
5.3 Maximum Drawbar pull (numerical problems)			
5.4 Tractive effort & Traction. (numerical problems)			
5.5 Relation between vehicle & engine speed. (numerical problems)			
5.6 Acceleration and Gradeability			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and tutorials.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	AERODYNAMICS	12	20
2	AERODYNAMIC DRAG & WIND TUNNEL TESTING	12	15
3	ERGONOMICS	08	15
4	DIRECTIONAL STABILITY	08	12
5	VEHICLE PERFORMANCE	12	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK &PRACTICALS.

No	Practicals	Marks
1	Study of ergonomics of human body & hence the design of driver's and passenger's seat.	
2	Comparison of visibility of different vehicles. Prepare a report.	
3	Procedure for measurement of various aerodynamic forces and moments.	
4	Study of wind tunnel and procedure for wind load distribution on various body structures.	
5	Case study of an accidental vehicle, which took place due to improper body rework/body building.	
6	Procedure of measurement of air drag in wind tunnel.	
7	Prepare aerodynamic shape with the help of Graphics Software.	

8	Simple sketches of modern passenger car, truck, bus etc with suitable design showing importance of Aerodynamics.	
9	Simple sketches of airflow patterns on various types of vehicle.	
	Total	**25**

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	John. D Anderson, Jr.	Fundamentals of aerodynamics	McGraw-Hill Books Company, International student Edition
2	Wolf-Heinrich Hucho	Aerodynamics of road vehicles from fluid mechanics to vehicle	SAE International
3	Butterworth's, by Wolf-Heinrich Hucho	Aerodynamics of road vehicles from fluid mechanics to vehicle	SAE International
4	Richard stone, Jeffrey k. Ball	Automotive Eng. Fundamentals	SAE International

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	John Fenton	Vehicle body layout and analysis	Hutchinson, London
2	Lanusz Powloski	Vehicle body engineering	Business books Ltd., London

ELECTIVES

III

(AU619) AUTOMOTIVE AIR CONDITIONING

1. COURSE OBJECTIVES:

Through this course the students will acquire the knowledge of the basics of vehicle air-conditioning system, its components, working principle, control mechanism. They will learn and handle components of the automotive air-conditioning and their functions. They will also gain practical knowledge and will be able to carry out servicing of vehicle air conditioners and will diagnosing components and air conditioning systems. Student will also focus on the latest developments in this field.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
AU619 AUTOMOTIVE AIR CONDITIONING	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU619CO1: Describe the fundamentals of HVAC system in automobiles.

AU619CO2: Identify the different components of HVAC systems and their functions.

AU619CO3: Explain the construction and working of HVAC systems and control devices.

AU619CO4: Apply the knowledge for diagnosis and troubleshooting of HVAC systems.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	2	0	0	2	2	2	1
CO2	2	1	1	2	0	2	2	2	0
CO3	2	2	2	2	1	3	2	2	2
CO4	3	3	3	3	2	3	3	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**			
Units:		**M**	**Thr**	**CO**
1. AUTOMOTIVE AIR CONDITIONING FUNDAMENTALS		**9**	**7**	
1.1 Purposes of Heating, Ventilation and Air Conditioning.				
1.2 Definitions: Heat, Heat intensity, Sensible heat, Specific heat capacity, latent heat and change of state, Conduction Convection and Radiation. Enthalpy Pressure and critical temperature pressure, Humidity, Dry and wet bulb temperature.				**CO1**
1.3 Vapour Compression Refrigeration. Principle, components & working.				
1.4 Vapour Absorption Refrigeration, Principle, components & working.				
1.5 Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system.				
1.6 Introduction to Psychometry – Basic terminology and Psychometric mixtures-Psychometric Chart				
2. AUTOMOTIVE COOLING AND HEATING SYSTEM		**18**	**12**	
2.1 Vehicle Refrigeration Systems i. Fixed thermostatic and Orifice tube system. ii.Variable displacement thermostatic and Orifice tube system.				**CO1** **CO2**
2.2 Types of Compressor i. Swash plate type ii. Scroll type iii. Vane type				**CO3**
2.3 Compressor Clutches, Compressor Clutch electrical circuit.				
2.4 Compressor lubrication.				
2.5 Construction and working of Condensers, Evaporators, Expansion devices.				
2.6 Description and function of i. Evaporator temperature and pressure controls ii. receiver iii. drier iv. Accumulators v. refrigerant hoses vi. Connections and other assemblies.				
2.8 Heating system.				
3. AIR-CONDITIONING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS		**18**	**12**	
3.1 Types of Control devices.				**CO2**
3.2 Preventing Compressor damage, Preventing damage to other systems, Maintaining drivability, Preventing Overheating Ram air ventilation,				
3.3 Air delivery Components, Control devices, Vacuum Controls Containers.				
3.4 Refrigerant, Classification of refrigerants, Classification based on toxicity and flammability. Desirable properties of an ideal refrigerant.				
3.5 Environmental Concerns and Eco friendly refrigerants				
3.6 Important properties of commonly used refrigerants, R12 and R134a				
4. AUTOMATIC TEMPERATURE CONTROL		**12**	**06**	
4.1 Different types of sensors and actuators used in automatic temperature control				**CO2**
4.2 Fixed and variable displacement temperature control				
4.3 Semi-Automatic- Controller design for Fixed and variable displacement type air conditioning system				
5. SYSTEM SERVICING AND TESTING		**18**	**11**	

5.1 Special tools for servicing vehicle air conditioning			**CO4**
5.2 Refrigeration system diagnosis, Diagnostic procedure Handling, Discharging, Charging & Leak detection			
5.3 Handling, Identification, Storage, Transfer and Disposal of Recycled, Reclaimed and Extracted Refrigerant.			
5.5 Diagnosing components and air conditioning systems			
5.6 Diagnosing cooling system and Air delivery system			
5.7 Automatic temperature Control system diagnosis and service			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and tutorials.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	Automotive air conditioning fundamentals	7	9
2	Automotive cooling and heating system	12	18
3	Air conditioning controls, delivery system and refrigerants	12	18
4	Automatic temperature control	6	12
5	System servicing and testing	11	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	**Practical**	**Marks**
1.	To study Schematic layout of a vehicle refrigeration system and Location of air conditioning components in a car.	
2.	To study fixed thermostatic and Orifice tube system.	
3.	To study Variable displacement thermostatic and Orifice tube system.	
4.	To study different types of compressor, Compressor Clutches, Compressor Clutch electrical circuit and Compressor lubrication.	
5.	To study Condensers, Evaporators, Expansion devices, Evaporator temperature and pressure controls, receiver, drier, Accumulators, refrigerant hoses, Connections and other assemblies.	
6.	To study types of Control devices and their role in Preventing Compressor damage, Preventing damage to other systems, Maintaining driveability, Preventing Overheating Ram air ventilation.	
7	To study Air delivery Components, Control devices, Vacuum Controls Containers.	
8	To study different types of sensors and actuators used in automatic temperature control.	
9	To study Special tools for servicing vehicle air conditioning.	
10	Diagnosing components and air conditioning systems.	
11	Diagnosing cooling system and Air delivery system.	
12	Automatic temperature Control system diagnosis and service.	
13	Identify Refrigerant service connectors and hoses for R12 and R134a.	
	Total	25

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	Warren Farnell and James D.Halderman	"Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual	Pearson Prentice Hall, 2004
2	Warren Farnell and James D.Halderman,	"Automotive Heating, Ventilation, and Air Conditioning systems"	Shop Manual, Pearson Prentice Hall, 2004
3	William H Crouse and Donald L Anglin,	"Automotive Air conditioning"	McGraw Hill Inc., 1990

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Goings,L.F.	"Automotive Air Conditioning"	American Technical services, 1974
2	Mitchell Information Services, Inc.	"Mitchell Automatic Heating and Air Conditioning Systems"	Prentice Hall Inc., 1989
3	McDonald,K.L.	"Automotive Air Conditioning"	Theodore Audel series, 1978.
4	Paul Weisler	"Automotive Air Conditioing"	Reston Publishing Co. Inc., 1990.

(AU701) ROAD TRANSPORT MANAGEMENT

1. COURSE OBJECTIVES:

Organisation and management of any motor and transport industry forms a very important activity of an automobile engineer. A clear idea of the operation and management of the bus and goods transport will result in effective handling of this industry. This course provides sufficient insight in the area.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
AU701 ROAD TRANSPORT MANAGEMENT	L	T	P	C	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU701CO1: Understand the functioning of motor and transport Industry.

AU701CO2: Explain the organisation and operation of motor and transport Industry.

AU701CO3: Apply costing and legal laws to motor and transport Industry.

AU701CO4: Plan a new transport service.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	2	2	2	1	1	2	2	2
CO2	2	1	2	2	2	3	2	2	2
CO3	2	3	3	2	3	2	3	2	2
CO4	2	3	3	2	3	2	3	2	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 ROAD TRANSPORT	**15**	**06**	
1.1 History of road transport			
1.2 Functions of transport: Economic, Social, Military			**CO1**
1.3 Modes of urban passenger transport			**CO4**
1.4 Modes of rural passenger transport			
1.5 Demand for transportation service			
1.6 Characteristics of different modes of transport.			
2 BUS TRANSPORT OPERATION	**15**	**12**	
2.1 Fare, Basic principles of fares charging: Flat fares, Telescopic fares, Cost of service, Value of service, Special rates, Differential rates for different types of services.			**CO1**
2.2Organization Setup: Government, Semi- Government, Private.			**CO2** **CO3**
2.3 Labour and labour relations, Incentive Schemes: Financial Incentive, Semi-Financial Incentive, Non-Financial Incentive.			**CO4**
2.4 Taxation: Types of Taxes: Road Tax, Passenger Tax, GST			
2.5 Passenger amenities.			
3 BUS TRANSPORT MANAGEMENT	**15**	**12**	
3.1 Essentials of transport system, Planning a new service: Geographical and Economic considerations			**CO1** **CO2**
3.2 Depot layout, Object of a good layout, Effective handling of peak load, Depot Management, Developing the traffic, Traffic Investigation, Route planning and development, Management Information systems.			**CO3** **CO4**
3.3 Scheduling: Basic factors in bus, crew and maintenance scheduling.			
4 GOODS TRANSPORT	**15**	**08**	
4.1 Goods Vehicle, Route, Trip.			
4.2 Market potential: Type of goods, types of consignments, Period of use, Probable competition.			**CO1** **CO2** **CO3**
4.3 Legal Compliance: Documents required as per M.V.A.			**CO4**
4.4 Freight Calculation: Time base, distance base, Contract, Cubic feet, Tone method, Hiring of trucks, Toll, Staff wages.			
5 MOTOR INDUSTRY	**15**	**10**	
5.1 The Automobile Industry In India			

5.2 Importance of Automobile Engineer.			**CO1**
5.3 Working of Various State Transport Organizations. (KTCL,MSRTC, BEST)			**CO2** **CO3** **CO4**
5.4Various Research Organizations like- Central Institute of Road Transport. Automotive Research Association of India. Vehicle Research, Development & Establishment. Central Road Research Institute. Petroleum Conservation & Research Association			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures and class room interactions.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	ROAD TRANSPORT	06	15
2	BUS TRANSPORT OPERATION	12	15
3	BUS TRANSPORT MANAGEMENT	12	15
4	GOODS TRANSPORT	08	15
5	MOTOR INDUSTRY	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical**	**Marks**
1.	Study of a Fare table of the State of Goa.	
2.	Prepare layout of a Depot.	
3.	Study of Road Tax and Passenger Tax of the State of Goa and prepare a report.	
4.	Study of the different documents used in transport organization.	
5.	Collection of Data of various automobile industries in India.	
	Study the working of KTCL and prepare a report	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Dr. P. Sudarsanam.	Passenger Amenities in STU	CIRT, Pune
2	Dr. P. Sudarsanam.	Fare structure in STU	CIRT, Pune
3	Dr. P. Sudarsanam.	Bus station Management	CIRT, Pune
4	Dr. P. Sudarsanam.	Bus & Crew scheduling	CIRT, Pune
5	O.P. Khanna.	Industrial Organization & Management	Dhanpat Rai & sons
6	Dr. P.G. Patankar. Director.	Compedium of Transport Terms	CIRT, Pune

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Andrew Hastie	Practical Transport management	

(MC631) LEAN MANUFACTURING

1. COURSE OBJECTIVE:

This course will enable the student to understand the basics of Lean Manufacturing and its different tools used in Industries. Its set of principles and processes leads to identifying and eliminating different wastes in the system. Lean Manufacturing helps in streamlining operations or manufacturing with Customer TAKT time, identifying the bottle neck areas and eliminates the same, which in turn will lead to Reduced Cycle Times.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/Week in Hours			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	OR	TW	
(MC631) LEAN MANUFACTURING	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC631CO1: Identify value added and non-value-added activities in a workplace

MC631CO2: Apply 5S concept to maintain a workplace.

MC631CO3: Use Lean tools to make improvements in the system

MC631CO4: Select Standard Work/ Best Method.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	2	1	2	2	2	1	3
CO2	3	2	2	3	3	2	2	2	2
CO3	3	2	3	3	3	3	2	2	2
CO4	3	3	3	3	3	3	2	2	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours	CO = Course Outcomes

Unit	M	Thr	CO
1 INTRODUCTION TO LEAN MANUFACTURING	**22**	**13**	
1.1 History of lean manufacturing.			**CO1 CO2 CO3 CO4**
1.2 Lean –Meaning &Definition, Objectives of Lean Manufacturing system			
1.3 Lean Manufacturing V/s Traditional Manufacturing			
1.4 Value added Activity, Non-Value-added activity			
1.5 Internal Customer and External Customer			
1.6 Concepts of Waste, Eight Types of Wastes			
1.7 Pull System and Push system, Difference between Pull and Push system,			
1.8 Introduction to Lean Six sigma, Lean v/s Six Sigma			
2 5S ORGANIZATION SYSTEM	**9**	**5**	
2.1 "5S" Terminology			**CO1 CO2 CO4**
2.2 The Concept of 5-S with Examples			
2.3 Importance of 5S in Industry / Office,			
2.4 5S Visuals control.			
2.5 5S Audit			
3 ESSENTIAL LEAN TOOLS	**22**	**15**	
3.1 Standardized Work			
3.2 KAIZEN			**CO1 CO2 CO3 CO4**
3.3 One-piece Flow or Continuous flow			
3.4 Pull system and Kanban, Heijunka /Leveling			
3.5 Visual Control / Management			
3.6 TAKT Time, Cycle Time, SMED/OTS (Single Minute Exchange of Dies/One Touch Setup)			
3.7 Jidoka,/Mistake proofing / Poka Yoke			
3.8 Introduction to Total Productive Maintenance			
4 JUST IN TIME	**12**	**8**	
4.1 Introduction			**CO1 CO3 CO4**
4.2 Elements of JIT: Small lot Sizes, set up Time, Pull production system, Cellular layouts, Standardization of components and work methods, Supplier network, Flexible Resources, Continuous Improvement			
4.3 Just in Time Manufacturing			
4.4 Benefits of JIT			
5 VALUE STREAM MAPPING	**10**	**8**	
5.1 Concept of VSM			**CO1 CO2 CO3 CO4**
5.2 VSM Methodology, symbol used			
5.3 Current and Future State Map			
5.4 Examples of VSM			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	No of lectures	Marks
1	Introduction to Lean manufacturing	13	22
2	5S Organisation System	05	9
3	Essential Lean Tools	15	22
4	Just in Time	08	12
5	Value Stream Mapping	08	10
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS (ANY FIVE)

No	Practical	Marks
1	Identifying Wastes in an Industry where you had undergone training and suggest ways to improve.	
2	Set up Institute's Workshop / Office / Lab or any other workplace to 5S Standard & prepare a detailed report	
3	Case study on application of 5S in Industry.	
4	Pull System demonstration	
5	Prepare a report on implementation of Kaizen at workplace.	
6	Industry Visit to check best practices and make a Report.	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Jeffrey K. Liker	The Toyota way	McGraw Hill Professional
2	James P. Womack, Daniel T. Jones	The Machine That changed the world	Free Press, New York
3	Gopalkrishnan N.	Simplified Lean Manufacture: Elements, Rules, Tools and Implementation	PHI
4	Eric Ries	The Lean Startup	Penguin
5	Christopher Jahns, Nicolas Reinecke	Lean Production	DGM Icfai Books

9.2 **Reference Books for further study**

S. No.	Author	Title of Books	Publishers
1	James P. Womack and Daniel T. Jones	Lean thinking	Lean enterprise Institute Cambridge
2	Mike Rother & John shook	Learning to See	Lean enterprise Institute Cambridge

(AU618) SPECIAL PURPOSE VEHICLES

1. COURSE OBJECTIVES:

Through this course the students will acquire the knowledge of different types and various classifications of special purpose vehicles. They will go in depth of the constructional details of special purpose vehicles and know their applications. They will also gain knowledge about the fundamentals of special purpose vehicles. Student will also focus on the latest developments in this field.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
AU618 Special Purpose Vehicles	L	T	P	H	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

AU618CO1: List the various special purpose vehicles.

AU618CO2: Understand the concept of various special purpose vehicles and their applications.

AU618CO3: Explain the constructional details and functions of various special purpose vehicles.

AU618CO4: Select the special purpose vehicles based on different applications.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	1	1	0	0	1	0	1	0
CO2	3	1	1	1	0	1	1	2	2
CO3	3	3	3	3	2	3	2	2	2
CO4	3	3	3	3	3	3	3	2	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**			
Units:		**M**	**Thr**	**CO**
1. OFF ROAD EQUIPMENTS		**15**	**10**	
1.1 Transport Equipment: Powered Equipment, Tractors And Trolleys, - Constructional Details, Applications.				
1.2 Trailers, Platform Lift Trucks, Fork Lift Trucks, Containers And Supports.- Constructional Details, Applications				**CO1 CO2**
1.3 Hauling Equipment: Types Of Dump Trucks, On-High Way Vehicles, Off High Way Vehicles. - Constructional Details, Applications				**CO3 CO4**
1.4 Hoisting Equipment: Jacks, Truck Mounted Crane, Crawler Crane, and Outriggers. - Constructional Details, Applications				
2. FARM EQUIPMENTS		**15**	**12**	**CO1**
2.1 Tractors In Earth Moving ,Applications Of Tractors, Rating of Tractors				**CO2**
2.2 Wheeled And Crawler Tractor - Constructional Details, Applications				**CO3**
2.3 Recent Trends In Tractor Design				**CO4**
2.4 Power Shift Transmission And Final Drive In Caterpillar Tractor. – Mechanism				
3. EARTH MOVING MACHINES		**15**	**12**	
3.1 Bulldozers, Cable And Hydraulic Dozers. Constructional Details, Applications				
3.2 Crawler Tractor, Running And Steering Gears. Constructional Details, Applications				**CO1 CO2**
3.3 Dump Trucks And Dumpers Constructional Details, Applications				**CO3**
3.4 Loaders: Single Bucket, Multi Bucket And Rotary Types Constructional Details, Applications				**CO4**
3.5 Power And Capacity Of Earth Moving Machines, Constructional Details, Applications				
4. CONSTRUCTION MACHINES		**15**	**09**	**CO1**
4.1 Scrapers: Self-Powered Scrapers. Constructional Details, Applications				**CO2**
4.2 Graders: Elevating Graders. Constructional Details, Applications				**CO3**
4.3 Bush Cutters, Stumpers. Constructional Details, Applications				**CO4**
4.4 Dozer, Rippers. Constructional Details, Applications				
5. SPECIAL APPLICATION MACHINES		**15**	**05**	
5.1 Power Shovel - Constructional Details, Applications - Drag Lines				**CO1 CO2**
5.2 Revolving And Stripper Shovels				**CO3**
5.3 Capacity Of Shovels				**CO4**
5.4 Ditchers - Constructional Details, Applications				
Total		**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and tutorials.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	Off Road equipment's.	10	15
2	Farm equipment's	12	15
3	Earth moving machines	12	15
4	Construction machines	9	15
5	Special application machines	5	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
1.	Visit a service center of Tractor or Dozer or Excavator or Fork lift or Road Roller. Write report on various mechanisms used, service procedure adopted, cost of equipment and other financial aspects.	
2.	Visit to a mine/ Construction site to observe various operations of earth moving machines. Write report on the visit.	
3.	Demonstration to understand specifications and features like hydraulic circuit, control system of any one earth moving machine.	
4.	Demonstration on specifications and capacities of any one dozer. Draw the sketches and identify various dozer blades stating their applications.	
5.	Demonstration of any one Rope operated excavator/ fork lift in view of construction and operation.	
6.	Demonstration of crawler loader and its attachments/ road roller types and operations.	
	Total	25

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	Wang. J. T.	Theory of Grand vehicles	Butterworth – Heinemann ltd, second edition,oxford,2000
2	Jagman Singh	Art of earth moving	APICS, 2001
3	Radichev	Tractor and Automobile	
4	Burge	Tractors and their power units	
5	Trucker	Earth moving Plants	

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	nil	Off the Road Wheeled and Combined Traction Devices	Ashgate Publishing Co. Ltd. 1998
2	Peurifoy R L	Construction Planning Equipment and Methods	Tata McGraw Hill, New Delhi, 2002.
3	Ian Graham	Off-Road Vehicles	Heinemann Library, 2008.
4	Wong J	Terramechanics and Off-road Vehicle Engineering	Butterworth-Heinemann, 2009.
5	Roninson E G	Motor Graders	MIR Publications, Muscow, 1985
6	Rodhiev and Rodhiev	Tractors and Automobiles	MIR Publishers, Moscow, 1984
7	Greenwich and Soreking	Tractors	MIR Publishers, Moscow, 1967