Dr. Babasaheb Ambedkar Marathwada University

Aurangabad- 431004 (MS) India

Master of Vocation
(M. Voc.)

in

Automobile Technology

Course Structure and Curriculum

Choice Based Credit System

(Effective from July 2020 onwards)

Deen Dayal Upadhyay KAUSHAL Kendra

Structure and Curriculum for Master of Vocation (M. Voc) in Automobile Technology (Choice Based Credit System)

The M.Voc (Automobile Technology) program is divided in four semesters having 120 credits.

Preamble:

Dr. Babasaheb Ambedkar Marathwada University (BAMU) proposes to offer a two year Master programme invocation (M. Voc.).The curriculum design of this program is undertaken in the following framework (assumptions).

a) Although there has been remarkable progress in all sectors of education in last couple of decades, the less regulated area of the education sector-vocational training—seems to have lost its significance/importance. This has led to the widening gap between the supply and demand for skilled manpower across various industries and R&D organizations. This shortage of skills has translated directly into unemployment among an increasing number of graduates who pass-out every year and are forced to bare-trained in order to become market table.

This program is designed to produce a skilled manpower in Automobile Technology to improve the opportunities for the unemployed youths in the country in both the private and public sectors.

b) According to a study conducted by the Associated Chambers of Commerce and Industry of India(ASSOCHAM), therewillbeadeficitof40millionworking professionals by the year 2020 and the employers would face the difficulty of filling positions because of the dearth of suitable talent and skilled person all in their industry. **This program aims to provide some solution for this problem and this would facilitate to improve:**

(i) Quality of training
(ii) High drop-out rates
(iii) Linkages with Universities and industry
(iv) Inadequacy of resources.

c) **This program is intended to offer practical training and skills needed to pursue an occupation straight away. It will provide options to the students to select the courses of their choice which are directly aligned to land a job in a chosen profession or a skilled trade.**

d) **This program is intended to offer students with life-long independent and reflective learning skills in their career.**

Program Educational Objectives (PEO):

The Objective of the M.Voc. Automobile program are to produce post graduates who:

1. Have a strong foundation in Automobile systems and Automobile Troubleshooting and Diagnostics with an ability to solve important problems in modern technological society as valuable, productive Supervisors and Managers.
2. Have a broad based background to practice Automobile Technology in the areas of Automobile Manufacturers, Service Industry, Autotronics, Auto Ancillary industry and Government sectors meeting the growing expectations of stakeholders.
3. Have an ability to pursue higher studies and succeed in academic and professional careers.
4. Have the ability to address professional demands individually and as a team member communicating effectively in technical environment using modern tools.
5. Recognize the need for and possess the ability to engage in lifelong learning.
6. Will be sensitive to consequences of their work both ethically and professionally for productive professional career.

Program Outcomes:

Vocational Education is education that prepares the students for specific trades, crafts and career sat various levels and scopes. It trains the students from a trade/ craft, technician or professional position in R & D organizations.

The Program Outcomes are the skills and knowledge which the students acquire throughout the course. These outcomes are generic and as per following-

PO 1. **Basic knowledge:** Apply knowledge of basic sciences, basic statistical and fundamental engineering/ technology to solve the structured Automobile related problems.

PO 2. **Discipline knowledge & Problem Analysis:** Apply transboundary knowledge of a broad spectrum of technology that encompasses (but not limited to) electronics, mechatronics, electrical, robotics and control system to identify Automobile related problems.

PO 3. **Design Development of solutions:** Design / develop solutions for complex engineering or technological problems or challenges for Automobile related problems

PO 4. **Conduct Investigation of complex problems:** Use research based knowledge and research method including design of experiments/systems, analysis and interpretation of data and synthesis of information to provide valid conclusion

PO 5. **Modern tools:** Apply relevant and recent Automobile technologies and tools with an understanding of the limitations.

PO 6. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Automobile.

PO 7. **Environment and sustainability:** Apply Automobile solutions for sustainable development practices in societal and environmental contexts.

PO 8. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Automobile**.**

PO 9. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO 10. **Communication:** Communicate effectively in oral and written form.

PO 11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in a team, to complete project in any environment.

PO12. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Automobile based industry.

Program Specific Outcomes (PSO):

After 3-4 years of completion of the program, students will be able to –

1. Apply knowledge of Automobile Technology to serve manufacturing, service & sales industries in solving complex problems in automotive field.
2. Design systems for motor vehicles, their manufacturing & servicing & repair sectors.
3. Diagnose faults in motor vehicles and its systems.

Eligibility:

Those who have completed B.Voc. (Automobile)/ B.Sc with Automobile / B. E/ B. Tech (Automobile/ Mechanical/Production) from any recognized Board/Institution are eligible for registration / admission.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves. Admission will be done on the basis of performance of students at Common Entrance Test (CET). The CET will be conducted in the month of June every year.

There is Full Carry on for M.Voc i.e. irrespective of individual performance in first year; a student will be promoted to Second Year. However, for obtaining M. Voc. Degree, a student will have to complete all semesters successfully within 4 years/08 semesters.

Choice Based Credit System (CBCS):

The choice based credit system is going to be adopted by this Centre. This provides flexibility to make the system more responsive to the changing needs of our students, the professionals and society. It gives greater freedom to students to determine their own pace of study. The credit based system also facilitates the transfer of credits. Students will have to earn 102 credits for the award of two years Master of Vocation (M.Voc)

Credit-to-contact hour Mapping:

(a) One Credit would mean equivalent of 15 periods of 60 minutes each for theory lecture.

(b) For lab course/ workshops/internship/field work/project, the credit weightage for equivalent hours shall be 50% that for lectures /workshop

(c) For self- learning, based on e-content or otherwise, the credit weightage for equivalent hours of study should be 50% or less of that for lectures/workshops.

Attendance:

Students must have 75 % of attendance in each course for appearing examination, otherwise he / she will be strictly not allowed for appearing the semester examination of each course. Frequent absence from regular lecture/practical course may lead to disqualification from CIA process in respective subject.

Departmental Committee:

The Departmental Committee (DC) of the Centre will monitor smooth functioning of the program.

Results Grievances / Redressal Committee

Grievances / redressal committee will be constituted in the department to resolve all grievances relating to the evaluation. The committee shall consist of Head of the department, the concerned teacher of a particular course and senior faculty member of Department of Committee. The decision of Grievances / redressal committee will have to be approved by Department committee.

Evaluation Methods:

- The assessment will be based on 20: 80 ratio of continuous internal assessment (CIA) and semester end examination (SEE). Performance will be decided after combining performance in CIA and SEE. In case of failure in SEE in particular course(s), exam will be conducted in immediate subsequent semester. However, if a student fails in CIA (considering independent CIA score), he/she may appear for the same CIA, at his/her own responsibility in the next academic year, when the same course is offered during regular academic session.
- In case a student fails in certain course(s) in a particular semester and the same course(s) are modified/ revised/ removed from the curriculum in due course, the student will have to appear as per the newly framed curriculum and/or pattern in subsequent semester, at his/her own responsibility.

Continuous Internal Assessment (CIA):

There will be 20 marks for Continuous Internal Assessment. Weekly tests of 20 marks each based on subjective short questions/ objective questions (as deemed fit by respective subject teacher) will be conducted every week during the semester as a part of continuous assessment. At the end of the semester, average of all weekly tests will be considered for calculation of final marks.

Semester End Examination (SEE):

- The semester end theory examination for each theory course will be of 80 marks. The total marks shall be 100 for 4 credit theory course (80 marks semester end exam + 20 marks CIA).

- Semester end examination (SEE) time table will be declared by the departmental committee (as per the university annual calendar). The paper setting and assessment of theory courses, laboratory courses and industrial project will done by external (50 %) and internal (50%) examiners. However, in case of non-availability of external examiner for

either paper setting or assessment or both, department committee will be empowered to take appropriate decision.

- Pattern of semester end question paper will be as below:
    - The semester end examination of theory course will have two parts (20+60 = 80 Marks)
    - Part A will be consisting of 10 questions having 2 marks each (multiple choice questions / fill in the blanks/ answer in sentence) as compulsory questions and it should cover entire course curriculum (10 Marks)
    - Part B will carry 5 questions and students will have to attempt 03 questions out of 05 (60 Marks).
    - 20 to 30% weightage can be given to problems/ numerical wherein use of non-programmable scientific calculator may be allowed by invigilator.
    - Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

- Assessment of laboratory courses will also have 100% semester end assessment. Semester end practical examination will be of 100 marks.
  The semester end practical examination will be conducted at the end of each semester along with the theory examination.

- Apart from regular semester wise detailed report and presentations (for evaluation purpose in that particular semester), students will have to submit detailed final dissertation. Draft of dissertation will only be approved for final documentation after a preliminary presentation and defense examination by departmental faculty committee. Once approved, the student will be allowed to prepare his final dissertation. The dissertation will be evaluated by one internal and one external examiner. Student will have to appear for final defense of his dissertation in an open- presentation followed by viva-voce in front of internal examiner, external examiner, departmental faculties and students.

- At the end of each semester the Departmental Committee will assign grades to the students. The result sheet will be prepared in duplicate.

- The Director of the Centre shall send all results to the Controller of Examination for further processing.
    - Every student will have privilege for seeing answer sheets after examinations are finished and he can see answer sheets as specified by respective faculty, where he can see his marks and sign with remark seen and satisfied.

    - No rechecking of Papers

Earning Credits:

At the end of every semester, a letter grade will be awarded in each course for which a student

had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the final exit.

Grading System:

- The grading reflects a student-own proficiency in the course. A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Master Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course.

The grade points and their equivalent range of marks are shown in Table-I

Table – I : Ten point grade and grade description

Marks Obtained (%)	Grade Point	Letter Grade	Description
90-100	9.00- 10	O	Outstanding
80-89	8.00-8.99	A^{++}	Exceptional
70-79	7.00-7.99	A^{+}	Excellent
60-69	6.00-6.99	A	Very Good
55-59	5.50-5.99	B^{+}	Good
50-54	5.00-5.49	B	Fair
45-49	4.50-4.99	C^{++}	Average (Above)
41-44	4.01-4.49	C	Average
40	4.0	P	Pass
< 40	0.0	F	Fail (Unsatisfactory)
	0.0	AB	Absent

- Non-appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.
- Minimum P grade (4.00 grade points) shall be the limit to clear / pass the course / subject. A student with F grade will be considered as "failed" in the concerned course and he / she has to clear the course by appearing in the next successive semester examinations. There will be no revaluation or recounting under this system.
- Every student shall be awarded grade points out of maximum 10 points in each subject (based on 10 point scale). Based on the grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and CGPA will be given at final exit.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / course will be calculated based on the summation of marks obtained in all five modules.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows

$$SGPA = \frac{\text{Sum (Course Credits) X Number of Grade Points in concerned Course Gained by the Student}}{\text{Sum (Course Credits)}}$$

Grade in each subject / course will be calculated based on the summation of marks obtained in all five modules.

The SGPA will be mentioned on the grade card at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$CGPA = \frac{\text{Sum (All six Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card

Results should be declared by the Centre and the grade card (containing the grades obtained by the student along with SGPA) should be issued by the university after completion of every semester. The grade card should be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at final exit)

Cumulative Grade Card

The grade card showing details grades secured by the student in each subject in all semesters along with overall CGPA should be issued by the University at final exit.

Course Structure

Master of Vocation (M.Voc) Automobile Technology

Sr. No.	Course Code	Name of the Course	Contact Hours Per Week			Evaluation Scheme		Credit
			Lecture	Tutorial	Practical	CIA	SEE	
		Semester – I						
1	CC100	Constitution of India	2	0	0	10	40	2
2	ATF 121	Fuels and Combustion	3	1	0	20	80	4
3	ATF 122	Automobile Engine Components Design	3	1	0	20	80	4
4	ATC123A	Automobile Air Conditioning	3	1	0	20	80	4
	OR							
5	ATC 123B	Automobile Control systems						
6	ATC124A	Measurement and Control	3	1	0	20	80	4
	OR							
7	ATC124B	Vehicle Dynamics						
8	ATC 125	Project Management	3	1	0	20	80	4
9	ATLC 126	Lab course based on Fuels, combustion and Engine Design (Auto-CAD)	0	0	6	00	100	3
10	ATR 121	Industrial Project- Phase I		100 hours (through semester)		-	150	5
				Total Credits				30

		Semester- II						
1	ATF 221	Electrical Vehicles	3	1	0	20	80	4
2	ATF 222	Automobile Body Engineering	3	1	0	20	80	4
3	ATC 223	Advanced Hydraulics and Pneumatics	3	1	0	20	80	4
4	ATC 224	Transmission System Design	3	1	0	20	80	4
5	ATC225A	Automobile Systems Design	3	1	0	20	80	4
	OR							

6	**ATC225B**	**Vehicle Aerodynamics and Design**						
7	**ATLC226**	**Mini Project**	**---**	**----**	**---**	**---**	**150**	**5**
8	**ATR 221**	**Industrial Project- Phase II**		**100 hours (through semester)**		**---**	**150**	**5**
			Total Credits					**30**

Semester- III							
1	**ATC321**	**Autotronics (Self-Study Mode)**	**04**	**0**	**20**	**80**	**4**
2	**ATC322**	**Mini Project with Lab course on Autotronics**	**06**	**0**	**--**	**200**	**6**
3	**ATR321**	**Industrial Project- Phase III**	**400 hours (through semester)**		**00**	**600**	**20**
			Total Credits				**30**

Semester- IV							
1	**ATC421**	**Intellectual Property Rights (Self-Study Mode)**	**4**	**0**	**20**	**80**	**4**
2	**ATLC421**	**Case Study Report of Any Existing Industrial Project**	**0**	**6**	**00**	**200**	**6**
3	**ATR 421**	**Industrial Project- Phase IV**	**400 hours (Through Semester)**		**---**	**600**	**20**
			Total Credits				**30**
CUMULATIVE CREDIT- 120							

SEMESTER – I

ATF 121 - Fuels and Combustion

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To gain knowledge about the characteristics of Conventional and Alternate fuels
2. Understand the performance characteristics of SI and CI engines.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Describe alternative fuels used in IC engines.
CO2	Evaluate performance of alternative fuels.
CO3	Prepare report of performance of alternative fuels.
CO4	Suggest alternative energy source for various applications of IC engines.
CO5	Explain combustion in CI and SI engines.
CO6	Compare performance of SI and CI engines.

Course Content:

Unit –I: Conventional Fuels ***4 hours***

Introduction, Types of Fuels – Solid, Gaseous and Liquid fuels, Important qualities of SI and CI engine fuels, Rating of SI and CI engine fuels

Unit –II: Alternate fuels ***11 hours***

Introduction, Possible alternatives to solid fuels and liquid fuels, Surface-Ignition Alcohol CI engines, Spark assisted Diesel engines, LPG, Vegetable oils, Biodiesels, Gaseous fuels, Hydrogen engines, Duel fuel operation, Other possible fuels.

Unit – III: Properties of Fuels ***10 hours***

Cetane number, Octane number, Flash point, pour point, Fire point, proximate analysis, ultimate analysis, Combustion equations and calculation of Air-Fuel ratio, Analysis of Exhaust and Flue gas, Orsat Apparatus.

Unit –IV: Combustion in SI Engines ***12 hours***

Introduction, Homogeneous mixture, Heterogeneous mixture, Stages of Combustion in SI Engines, Pre-ignition, Ignition lag, Flame Front Propagation, Factors influencing flame speed, Rate of pressure rise, Abnormal combustion, Phenomenon of knock/detonation in SI engines, Effects of engine variables on knock, Combustion chambers for SI engines.

Unit –V: Combustion in CI Engines ***08 hours***

Introduction, Stages of Combustion in CI Engines, Factors affecting the delay period, diesel knock, Phenomenon of knock in CI engines, Effects of engine variables on knock, Combustion chambers for CI engines.

Unit -VI Tutorials, case studies and presentation based on Unit I to V ***15 hours***

References:

1. Combustion Engineering – Gary L. Borman, Kenneth W. Ragland, McGraw Hill, 1998 ISBN 10: 0070065675 / ISBN 13: 9780070065673
2. Principles of Combustion – Kenneth K. Kuo, John Wiley & Sons, 2nd edition, (2005), ISBN-13: 978-0471046899, ISBN-10: 0471046892
3. Fundamentals and Technology of Combustion, Mahallawy-Habik, *Elsevier Science (2002). ISBN* 10: 0080441068 *ISBN* 13: 9780080441061.
4. Fuels & Combustion – S. P. Sharma & Chander Mohan, Tata McGraw Hill, (1987) ISBN: 0070966273 9780070966277
5. Fuels & Combustion – Samir Sarkar, Universities Press, 3rd edition (2010), ISBN 1439825416, 9781439825419
6. A Course in Internal Combustion engine, Mathur-Sharma, Dhanpat Rai Publication (2010), ISBN-10: 8189928465, ISBN-13: 978-8189928469
7. Internal Combustion Engines, Ganesan.V, Tata McGraw Hill Publishing Co., New York, 4th Edition (2012), *ISBN*-0-07-049457-6.
8. Internal Combustion Engines, K.K. Ramalingam, SCITECH, 2nd edition (2011), *ISBN* 13: 9788183711029

ATF 122 - Automobile Engine Components Design

(04 credits – 100 marks)

Learning Objective:

1. To make the students understand the design concept and principles of various engine components.
2. These concepts and principles are familiarized for design of components.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Differentiate between various types of stresses and failures of material.
CO2	Identify the failure of piston rings, valves and crankshaft bearings.
CO3	Select the material for engine cylinder, piston and crank shaft.
CO4	Design the cylinder head, piston and piston rings.

Course Content:

Unit-I: Introduction to Design ***08 hours***

Stress, types of stresses, Engineering materials and their physical properties applied to design, selection of materials , Factor of safety, Theory of failures, Static load, dynamic load, failure modes, endurance limit, notch sensitivity, principles of design optimization.

Unit-II: Design of Cylinder and Piston ***10 hours***

Choice of material for cylinder and piston, load on cylinder, stress in cylinder, piston friction, piston slap, load on piston, stresses in piston, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly, types of tolerances and fits, design considerations for interference fits, surface finish, and surface roughness.

Unit – III: Design of Connecting rod, Crankshaft ***10 hours***

Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, connecting rod failures, balancing of I.C. Engines, significance of firing order, material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations.

Unit –IV: Design of Valves and Flywheel ***08 hours***

Design aspects of intake and exhaust manifolds, inlet and Exhaust valves, valve springs, tappets, valve train, Materials and design of flywheel, Design of Solid flywheel, Rimmed Flywheel, stresses in flywheel, Coefficient of fluctuation of speed, Coefficient of fluctuation of energy.

Unit –V: Statistical Considerations in Design ***09 hours***

Frequency distribution-Histogram and frequency polygon, normal distribution - units of central tendency and dispersion- standard deviation - population combinations - design for natural tolerances - design for assembly - statistical analysis of tolerances, mechanical reliability

Unit –VI: Tutorials, case studies and presentation based on Unit I to V ***15 hours***

References:

1. Design of Automotive Engines", A.Kolchin and V.Demidov, MIR Publishers, Moscow (1984).
2. Design Techniques for Engine Manifolds, D.E. Winterborne and R.J.Pearson, SAE Int. Publisher, 1999.
3. The Internal Combustion Engine in Theory and Practice, C.F. Taylor, The M.I.T. Press, Cambridge, MA, 1985
4. Internal combustion engines fundamentals, J.B. Heywood McGraw-Hill, N.Y., 1988.
5. Diesel-Engine Management, H. Bauer, K.H. Dietsche, J. Crepin, F. Dinkler, Bosch-SAE Publishers, 1999.
6. Design of Machine Elements, V.B.Bhandari, Tata McGraw Hill publication, 3rd Edition, (2010), ISBN-10: 0070681791 ISBN-13: 9780070681798
7. Machine Design, P.Kannaiah, Scitech, (2010) ISBN 10: 8183711510 / ISBN 13: 9788183711517

ATC 123A - Automobile Air Conditioning

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To identify various HVAC systems and sub systems.
2. To explain working & construction of HVAC Systems and sub systems.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Explain working and construction of HVAC systems and sub systems.
CO2	Carry out repair and maintenance of HVAC systems and sub systems.
CO3	Carry out retrofitting and alteration of HVAC systems.
CO4	Explain environmental aspects related to HVAC systems.

Course Content:

Unit –I: Introduction to Automobile Air Conditioning ***12 hours***

Environmental and safety aspects in Heating, Ventilation and Air Conditioning (HVAC) systems, Human comfort control, Heat transfer fundamentals, Requirements of HVAC system for light motor vehicle, Heavy goods vehicle, Heavy passenger vehicle, Controlled and uncontrolled ventilation, Case and Duct System**,** Downstream, upstream, split and hybrid, Rear heating and cooling system

Unit –II: Air Conditioning System ***06 hours***

General layout of Automotive Air conditioning system, vapour compression cycle**,** Construction and working of refrigeration sub systems, evaporator, condenser, accumulator, Receiver, driers and accumulator. Reciprocating, scroll and rotary vane compressors.

Unit III -: Refrigerants ***4 hours***

Refrigerant- Properties**,** types, Packaging and storage, color code and purity test, Metering devices, Thermostatic Expansion valve and fixed orifice tube, Functions of thermostatic expansion valve.

Unit –IV: System Control Devices ***12 hours***

System controls - typical vacuum system and electronic temperature control system, vacuum operated devices i.e. vacuum reserve tank, vacuum restrictor, vacuum motor, check valve and check relays.

Switches - high- Side temperature switch, low-side temperature switch, high pressure switch, low- pressure switch, pressure regulator, ambient switch and superheat switch.

Sensors- sun load sensor, outside temperature sensor and in car temperature sensors.

Controls- Concept of Aspirator, blower clutch control, heater control, and time delay relay for heater control. Block diagram of climate control system and Electronic climate control system.

Unit –V: Repairs and Maintenance of Air Conditioning System ***11 hours***

Maintenance Of A.C. Systems - Visual and acoustic check, side glass, leak test, Temperature test, procedure of charging and discharging. Moisture removal procedure, Service equipments and tools- Vacuum pump, Manifold and gauge i.e. Low side and high side, gauge calibration recovery unit and recycling unit, Halide (Freon) and Fluorescent leak detector, nitrogen leak tester. Symptoms, Faults, causes and remedies, Hoses and connectors - construction of

system hoses, charging hose with shut off valve and connectors, Comfort heating system - Function, Construction and working, Maintenance general faults and their remedies

Unit –VI: Tutorials, case studies and presentation based on Unit I to V ***15 hours***

References:

1. Automobile Air Conditioning, Boyce H. Dwiggins, Thomson Learning, 8th Edition, (2001) ISBN-13: 978-0-7668-0788-4, ISBN: 0-7668-0788-6
2. Automotive Heating and Air Conditioning, John H Haynes and Mike Stubblefield, Haynes Publishing Group, 2nd edition (January 1994), ISBN-10: 1563920719, ISBN-13: 978-1563920714
3. Automotive Mechanics, Crouse, Anglin, Tata McGraw - Hill Career Education ISBN 10: 0028009436 ISBN 13: 9780028009438
4. A text book of Refrigeration and Air Conditioning, R. S. Khurmi and J. K. Gupta, S. Chand, (2006), *ISBN* 10: 8121927811 - *ISBN* 13: 9788121927819
5. Refrigeration and Air Conditioning, P. N. Ananthanarayanan, Tata McGraw Hill, (2015), ISBN 10: 1259062708 / ISBN 13: 9781259062704
6. Principles of Refrigeration, Roy Dossat, Pearson Education, 4th Edition, *ISBN* 10: 8177588818 / *ISBN* 13: 9788177588811
7. Refrigeration and Air Conditioning, Domkunwar and Arora, Dhanpat Rai & Co.(p) Ltd-Delhi, 6th Edition, ISBN-10: 0000229660, ISBN-13: 9780000229663

ATC 123B - Automobile Control Systems

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. Understand construction, working and functions of Automobile Systems.
2. Understand construction, working and functions of Automobile control systems such as steering, braking and suspension.
3. Compare the developments in control systems and safety equipment.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Identify necessary system requirements for control systems,
CO2	Compare the developments in control systems and safety equipment
CO3	Demonstrate the braking system and its functional requirements
CO4	Select the suspension system for two wheeler and four wheeler vehicle

Course Content:

Unit –I: Car braking-system components ***11 hours***

Overview, Brake pedal, Brake servo unit, pilot pressure valve, Tyre selection, air resistance, rolling resistance, requirement of engine power, ABS system- System overview, Requirements placed on ABS, Dynamics of braked wheel, ABS control loop.

Unit –II: Sensotronic Brake Control (SBC) ***10 hours***

SBC – Purpose and function, Design, Method of operation, Wheel speed sensors, Hall-effect acceleration sensors, Micromechanical yaw-rate sensors, Steering-wheel-angle sensors, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering

Unit –III: Braking system: **06** ***hours***

Types of brakes, brake-actuating mechanisms, factors affecting brake performance, power & power assisted brakes, Brake system design, Recent developments in transmission & braking system, EBD system

Unit –IV: Suspension systems **1*0 hours***

Rigid and independent Suspension, Types of Independent suspension system-McPherson strut, wishbone type, Semi-elliptical Leaf spring, coil spring , torsion bar arrangement, Construction and working of Air Suspension System, Construction and working of-Shock absorbers -Telescopic and Gas filled, Anti roll bar or stabilizer bar.

Unit –V: Traction Control system (TCS) and Occupant Protection system ***08 hours***

Introduction, tasks, functions of traction control, Structure of traction control system, typical control situations, vehicle safety, seat belts, seat belt tensioners, front air bag, side air bag, roll over protection sytem.

Unit –VI: Tutorials, case studies and presentation based on Unit I to V ***15 hours***

References:

1. Automotive Mechatronics, Konrad Reif
2. The Automotive Chassis – Engineering Principle – Jornsen *Reimpell,* Helmut Stoll, Jurgen Betzler, (2001), 2nd Edition *ISBN*-9780080527734
3. Automotive Chassis – Design & Calculation – P. Lukin, G. Gasparyarts, V. Rodionov, MIR Publishing, Moskow (2005)
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK, 2012, ISBN-13:9781258374150, ISBN-13: 9781258386382
5. Mechanics for Road Vehicles – W. Steed, Illiffe Books Ltd., London (1960), ASIN: B0000CKKGV
6. Automotive Mechanics, Crouse, Anglin, Tata McGraw - Hill Career Education ISBN 10: 0028009436 ISBN 13: 9780028009438
7. Machine Design, P.Kannaiah, Scitech, (2010) ISBN 10: 8183711510 / ISBN 13: 9788183711517
8. Auto design, R. B Gupta, Satya Prakashan, ISBN: 8176840106 ISBN-13: 9788176840101

ATC 124A – Measurement and Control

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To understand the Static and Dynamic Characteristics of instruments.
2. To understand procedure adopted for measuring pressure, temperature and flow.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Classify Static and Dynamic characteristics of instruments.
CO2	Perform Pressure, Flow, and Temperature measurement.
CO3	Perform speed, force torque measurement with the help of various sensors.
CO4	Handle Resistance strain gauges.

Unit-I: Static and Dynamic characteristics of Instruments: (*12 hours)*

General Concept: Need and classification of measurements and instruments, basic and auxiliary functional elements of a measurement system, Mechanical versus electrical/electronic instruments, primary, secondary and working standards. Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution: speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, first and second order systems and their response to step, ramp and sinusoidal input signals. Error in Measurement: Sources of errors, systematic and random errors: Statistical analysis of test data.

Unit: II Functional Elements (*10 hours)*

Review of Electro-mechanical sensors and transducers –variable resistance, inductance and capacitive pickups, photo cells and piezo-electric transducers, and application of these elements for measurement of position/displacement, speed/velocity/acceleration, force and liquid level etc.

Resistances strain gauges, gauge factor, bonded and unbonded gauges, surface preparation and bonding technique, signal conditioning and bridge circuits, temperature compensation, Application of strain gauges for direct, bending and torsional loads.

Unit: III Pressure and Flow Measurement (*06 hours)*

Bourdon tube, diaphragm and bellows, vacuum measurement – Mecleod gauge, thermal conductivity gauge and ionization gauge, Dead weight gauge tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: Flow visualization technique.

Unit: IV Speed, Force, Torque and Shaft Lower Measurement (*10 hours)*

Mechanical tachometers, vibration and tachometer and stroboscope; proving ring, hydraulic a pneumatic load cells, torque on rotating shafts, absorption, transmission and driving dynamometers.

Controls: Control system-open and closed loop system; elements of a control system; servo

mechanism process control and regulators, transfer function; block diagram and overall transfer function of a multi loop control system, signal flow graph and Mason's Rule system stability – Routh and Harwitz criteria stability; Time and frequency domain Nyquist plot for stability study.

Unit–V: Temperature Measurement: **(*07 hours)***

Thermal expansion methods – bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers, thermo-electric sensors common thermo- couples, reference junction considerations, special materials and configurations: metal resistance thermometers and thermistors; optical and radiation pyrometers, calibration, standards.

Unit -VI Tutorials, case studies and presentation based on Unit I to V **(*15 hours)***

References:

1. Experimental Method for Engineers by Holman J.P., McGraw Hill Publication Company.
2. Automatic Control System by Kuo B.C., Prentice Hall of India.
3. Measurement system: Application and Design by Doebelin E.O., McGraw Hill.
4. Mechanical Measurement and Control by Kumar D.S., Metropolitan Book Co. Pvt. Ltd., New Delhi.

ATC 124B - Vehicle Dynamics

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To understand the vehicle coordinate system.
2. To understand vehicle performance characteristics of road vehicle for steady state operation and transient operation.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Differentiate between sprung mass and unsprung mass of vehicle.
CO2	Explain the gyroscopic effect, ride and handling in vehicle design
CO3	Demonstrate acceleration and braking characteristics, effect on vehicle due to various forces.
CO4	Distinguished between vehicle coordinate system and earth fixed coordinate system.

Course Content:

Unit –I: Introduction of Vehicle Dynamics (06 Hours)

Vehicle coordinate system, earth fixed coordinate system, longitudinal, lateral and vertical vehicle dynamics, vehicle springing system - requirements, sprung mass and unsprung mass, performance characteristics of road vehicles,

Unit –II: Steady State and Transient Operation (10 Hours)

Various external forces acting on vehicle, Nature of the forces and factors affecting the forces, Tractive effort and Power available from the engine, equation of motion, maximum tractive effort, weight distribution, stability of vehicle on slope, road performance curves, acceleration, gradibility and drawbar pull, Inertia effect, Equivalent mass, Equivalent moment of inertia, Equivalent ungeared system, Time to produce synchronizing during gear change, Effect of engine flywheel on acceleration, Dynamics of vehicles on Banked tracks, Gyroscopic Effects, Net driving power.

Unit –III: Acceleration and Braking Characteristics: (12 Hours)

Acceleration - Power limited acceleration: Engines, Power Train, And Automatic Transmission. Traction Limited Acceleration: Transverse Weight Shift, Traction Limit, Numerical Treatment.

Braking – Constant Deceleration, Braking Force, Brake Factor, Braking Efficiency And Stopping Distance, Reaction Time And Stopping Time, Braking Applied To Rear Wheels, Front Wheels And All Four Wheels, On Straight And Curved Path, Mass Transfer And Its Effect.

Unit –IV: Handling Mode: (09 Hours)

Mathematical model of handling, Fundamental condition for true Rolling Steady State Handling: Slip angle, cornering power, Neutral steer, under steer and over steer, Steady state response, Yaw velocity, Lateral Acceleration, Curvature response and Directional stability. Transient Handling: Basic principles, differential equations of motions. Vehicle Test for handling performance: Steady state testing, constant speed test, constant steer angle test, Constant radius test.

Unit-V: Ride Mode: (08 Hours)

Ride performance criteria: Mathematical modeling of vehicle ride, Excitation sources Vehicle Response Properties: Effects of damping the vibration, vibration absorbers, oscillation centers, active and semi active suspension, orthogonlity of mode shapes, modal analysis

Unit –VI: Tutorials, case studies and presentation based on Unit I to V (15 Hours)

References:

1. Theory of Ground Vehicles - J. Y. Woung - John Willey & Sons, NY, ISBN: 9780471354611
2. Steering, Suspension & Tyres – J. G. Giles, Illefe Books Ltd., London, ISBN-10: 0-592-00620-4
3. Mechanics of Road Vehicles – W. Steed, Illefe Books Ltd. London, ASIN: B0000CKKGV
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK, ISBN-13: 9781114312395
5. Mechanical Vibrations, S. S. Rao Pearson Education, ISBN: 9780201065510
6. Vibration and Noise for Engineers, Kewal Pujara and R.S. Pujara, Dhanpat Rai and Sons, Delhi, *ISBN* : 0-7680-0403-9 – 1999.
7. Fundamentals of Vehicle Dynamics, Gillespie Thomas D, SAE USA ,1992, ISBN: 9781560911999
8. Tyre and Vehicle Dynamics, Hans B, Pacejka SAE Publication – 2002, ISBN-9780080970165

ATC 125 Project Management

(04 credits –100 marks)

Learning Objectives-

To introduce students to project management and use this skill-set in relevant fields.

Learning Outcomes-

After completion of the course, students should be able to –

1. Apply Project management in essential skill-set for many careers and in many contexts in our lives
2. Apply Project Management to manage projects at work

Course Contents

Unit-I **(09 Hrs)**

Introduction of Project Management, Project Success, Types of Structure Organizations, Project Management Office, Stakeholders Management

Unit-II **(09 Hrs)**

Types of Projects and Project Life Cycle, Project Life Cycle Phases & Project Appraisal, Methods of Project Selection, Market and Demand Analysis

Unit-III **(09 Hrs)**

Financial Analysis, Capital Budgeting Techniques, Risk Management, Stand Alone Risk Analysis, Hillier Model, Simulation Analysis, Product Mix and Plant Capacity Analysis

Unit- IV **(09 Hrs)**

Project team building, conflict, negotiation, HRM Issues and time Management, Project Time Management- Introduction, Project Time Management (Project Scheduling), Project Time Management- PERT Networks, Project Time Management- CPM, probability models in networks

Unit -V **(09 Hrs)**

Time and Cost Relationship, Crashing of Networks, Introduction to Project Cost Management, Cost Control (Tools and Techniques), Cost Estimation, Introduction to Quality Management, Cost of Quality, Quality Management (Six Sigma Tools), Procurement Management

Unit –VI: Tutorials, case studies and presentation based on Unit I to V ***15 hours***

REFERENCES:

TEXT:

1. The certified six sigma Green Belt Handbook,by Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak,; ASQ Quality Press and Infotech Standards India Pvt. Ltd. , ISBN-978087389891:
2. The Certified Six Sigma Black Belt Handbook by T. M. Kubiak and Donald W. Benbow; Pearson Publication, ISBN- 9788131728697

SUGGESTED READING:

1. Fundamentals of Quality Control and Improvement by Mitra, Amitava; Wiley India Pvt Ltd, ISBN-9781118491645

WEB

1. https://www.youtube.com/channel/UC35NsIdqUF3RPCM_J7djCYg
2. https://www.youtube.com/channel/UCixCsqrW8tcoZMn_24f9wGA
3. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
4. https://onlinecourses.nptel.ac.in/noc19_mg31/preview

ATLC 126 - Laboratory Coursework based on Fuels, combustion and Engine Design (Auto-CAD)

(03 credits – 100 marks)

1. **Students have to perform at least 04 experiments from each section.**
2. **Students have to choose any one section each from Section C and Section D according to the optional subject they have chosen as theory**

Section A: (Any 04 Practical can be performed)

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing naming layers, setting line types for different layers using various type of lines in Engineering drawing, saving the file with .dwg Extension using Auto CAD software.
2. To Draw Orthographic projection drawings (Front, Top and side) of machine part in AutoCAD.
3. Make an Isometric dimensioned drawing of a connecting Rod using Isometric grid and snap.
4. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
5. Draw a 3D model of a machine component using 3D primitives and using commands like Union. Subtraction, Revolve, Slice, Rotate 3D etc.
6. Draw a spiral by extruding a circle

Section B: (Any 04 Practical can be performed)

1. Determination of flash point and fire point of fuels using Pensky Martin Apparatus.
2. Determination of Calorific Value of liquid Fuel using Digital Bomb Calorimeter
3. Determination of Aniline point of fuel using aniline point test apparatus.
4. Determination of vapor pressure of fuel using reid vapor pressure apparatus.
5. Perform exhaust gas analysis of an engine exhaust using 4-gas analyzer. Diagnose engine condition from exhaust gas analysis
6. Study of Orsat apparatus.
7. Viscosity Index of lubricating oil by Saybolt Viscometer

Section C (A): (Any 04 Practical can be performed)

1. Observe and draw layout of Automobile Air Conditioning System and sub systems. Observe and Sketch of all types of Duct system.
2. Observe and write the procedure of evacuation and charging of refrigerant from A.C. system.
3. Test on vapor compression test rig.

4. Observe and write the procedure of leakage test of A.C. system.
5. Diagnosis of various running faults in car HVAC and write causes and remedies.
6. Perform trial on A.C. test rig and report the performance.

Section C (B): (Any 04 Practical can be performed)

1. Diagnosis of control systems faults and write causes and remedies.
2. Trial on Common Rail direct injection engine.
3. Dismantle telescopic shock absorber, identify components and draw sketches of components with labels and understand it's working.
4. Observe and sketch the construction of Mc-pherson and wishbone type suspension with labels. Dismantle semi elliptical leaf spring, sketch its components with labels and understand it's working.
5. Observe air suspension system, air brakes, power steering system and draw layout.
6. Fuel injector cleaning and perform various tests on injector.

Section D (A) (Any 04 Practical can be performed)

1. Measurement of Temperature using thermocouple and RTD.
2. Calibration of thermocouple
3. Measurement of displacement using LVDT.
4. Measurement of flow using Rotameter.
5. Measurement of Force using strain gauge.
6. Measurement of Torque using strain gauge.
7. Measurement of Force using Load Cell.

Section D (B) (Any 04 Practical can be performed)

1. Use of oscilloscope to test vehicle components like sensors and actuators.
2. Use of engine analyzer for faultfinding modern vehicle engine system.
3. Diagnosis of battery faults and battery testing.
4. Diagnosis of starting system and charging system.
5. Diagnosis of lighting system faults.
6. Diagnosis of body electrical system faults.
7. Diagnosis of instruments system faults.
8. Diagnosis of auxiliary system faults

ATR 121 Industrial Project- Phase I

(05 credits – 150 marks)

(Review of Literature / Industrial Orientation, Formulation of Topic, Experimental Plan)

Students are expected to go through review of literature on a particular technical aspect and/or pay industrial visit to identify a point of further study and research/investigation. The

student (or group of students), thereafter, would propose a subject on basis of literature review and/or industrial orientations and will have to present a short seminar on his/her proposal to the board of examiners constituted by faculties of the department. If approved, he/she will be allowed to work on that particular project. Within a week after this approval, the student(s) will have to finalize their topic/subject of project and duly officiate it.

During phase – I of Research/Industrial Project, it is expected that the student(s) will–

i. Build up a concrete fundamental of the concept on which they are going to work,

ii. Carry out thorough literature survey to find out scope of work in the particular field

iii. Thereby, finalizing the topic of further study/investigation and finally, draft a systematic experimental plan to achieve projected goal

iv. Deliver regular presentations

v. Systematically document the above activities in bound volume and submit one copy to the department, one copy to concerned faculty and retain one copy with him/her.

ATF 221 Electrical Vehicles

(4 Credits 100 Marks)

Learning Objectives:

1. To provide students with consideration aspects of Drive train in Electric Vehicles
2. To provide students with basic knowledge of propulsion unit in Electric Vehicles
3. To provide students with fundamental energy storage in Electric Vehicles
4. To introduce students with energy management strategies in Electric Vehicles

Course Outcomes:

On completion of the Course, students should be able to-

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2. Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
3. Analyze various electric drives suitable for hybrid electric vehicles.
4. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Contents :

Unit 1 : Introduction to Hybrid Electric Vehicles (9 Hours)

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit 2 : Hybrid Electric Drive-trains (9 Hours)

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit 3 : Electric Propulsion unit (9 Hours)

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit 4 : Energy Storage: (9 Hours)

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Unit 5 : Energy Management Strategies: (9 Hours)

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Unit :6 : (15 Hours)

Tutorials, Assignments, Demonstrations and Presentation based on Unit 1 to 5

References:

Text:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003 ISBN 0203009398, 9780203009390.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004, ISBN 0-8493-3154-4.

Suggested reading:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003, ISBN: 978-1-119-94273-3.

WEB:

1. https://nptel.ac.in/courses/108/106/108106170/
2. https://nptel.ac.in/courses/108/103/108103009/

ATF 222 - Automobile Body Engineering

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To understand the construction of vehicle and concept of aerodynamics.
2. To understand different types of cars and passenger bus bodies.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Analyze the physics of fluid flow over vehicle body and its optimization techniques.
CO2	Demonstrate the various car body parts and its functions
CO3	Identify painting defects and describe their causes and remedies.
CO4	Carry out repair methods of body and repainting.

Course Content:

Unit –I: Car Body (09 Hours)

Types - Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility - Regulations, Driver's Visibility, Tests For Visibility, Methods of Improving Visibility and Space In Cars. Safety - Safety Design, Safety Equipments For Cars. Car Body Construction - Design Criteria, Prototype Making, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation

Unit –II: Vehicle Aerodynamics (09 Hours)

Objectives - Vehicle Drag and Types - Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques For Minimum Drag, Wind Tunnel Testing - Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces And Moments.

Unit –III: Bus Body (09 Hours)

Types - Mini Bus, Single Decker, Double-Decker, Two Level and Articulated Bus. Bus Body Layout - Floor Height, Engine Location, Entrance and Exit Location, Seating Dimensions. Constructional Details - Frame Construction, Double Skin Construction, Types of Metal Sections Used, Regulations, Conventional And Integral Type Construction..

Unit –IV Commercial Vehicle (09 Hours)

Types of Body - Flat Platform, Drop Side, Fixed Side, Tipper Body, Tanker Body And Haulage Vehicle. Light Commercial Vehicle Body Types. Dimensions of Driver's Seat Relation to Controls. Drivers Cab Design

Unit –V Body Materials, Trim and Mechanisms (09 Hours)

Steel Sheet, Timber, Plastic, GRP, Properties of Materials - Corrosion, Anticorrosion Methods. Selection of Paint And Painting Process. Body Trim Items. Body Mechanisms

Unit –VI: Tutorials, case studies and presentation based on Unit I to V (15 Hours)

References:

1. Vehicle Body Engineering – Pawloski J., Business Books Ltd**.,** ISBN 10: 0220689164
2. The Automotive Chassis: Engineering Principles – Reimpell J., ISBN: 9781493302864
3. Vehicle Body Layout and Analysis – John Fenton, Mechanical Engg. Publications Ltd. London, ISBN: 9780852984451
4. Body Construction and Design – Giles J. G., Illife Books, Butterworth and Co., ISBN: 1-4051-5592-2.

ATC 223: Advanced Hydraulics and Pneumatics

(4 Credits: 100 Marks)

Learning Objectives:

1. To provide students with consideration aspects in hydraulic circuit components
2. To provide students with basic tools for designing hydraulic circuits
3. To provide students with fundamental traits of pneumatic circuit design
4. To introduce students with advance trends and maintenance practices in hydraulics and pneumatics

Course Outcomes:

On completion of the Course, students should be able to-

1. Implement selection consideration of primary hydraulic components
2. Explain basic aspects of hydraulic circuit design
3. Implement basic principles for designing pneumatic circuits
4. Recognize advance trends in hydraulic and pneumatic technology
5. State and Implement key rules of maintenance practice in hydraulics and pneumatics

Course Contents:

Unit 1: Selection Considerations of Hydraulic Circuit Components (09Hours)

Recapitulation of basic hydraulic components, Hydraulic Pumps - Selection and sizing of hydraulic pump; Oil compatibility; Linear actuators- Cylinder force, flow velocity, cylinder efficiency, sizing, piston rod; Cylinder mounting; DCVs - Size and capacity ratings; General Guidelines for seal selection; Hydraulic pipes hoses and fittings- Pipe specification, Pipe Fittings- Selection of fittings and connectors, Energy Loss, Estimation of line diameter, Synthetic hydraulic hoses, Hose selection criteria, End fittings, Quick Coupling

Numerical on design considerations of various hydraulic components

Unit 2: Design of Hydraulic Circuits (09Hours)

Basic Hydraulic circuits, Manual/Automatic Hydraulic Systems, Regenerative Circuits, Use of Check Valves, Standards in circuit diagram representation, Speed variation in cylinder motion, Functional Diagram and application, Electrical Control of hydraulic systems

Unit 3: Principles of Pneumatic Circuit Design (09 Hours)

Basic standards of Pneumatic circuits- Functional Diagram in Pneumatic circuit design, sequential operations, movement diagram, cascade system of pneumatic circuit design, logics in pneumatic circuit design, Binary Arithmetic, Logic and Boolean Algebra, De Morgan's Theorem, Control equation, Application of K-V map for pneumatic circuit design, K-V diagram, Control problems; Electrical controls in pneumatic circuits

Basic Control problems

Unit 4: Advanced Trends in Hydraulics and Pneumatics (09 Hours)

Advanced trends in Hydraulics- Electrohydraulic Servo System, Feedback consideration, Mechanical feedback; Servo valves; Torque Motors; Terminologies in Servo Technology; Advanced trends in Pneumatics- Introduction, Hydro pneumatics, Types of Hydro pneumatic

system, hydro pneumatic cylinders, check units, Integral type cylinders; Fluidics- Elementary concepts, Low pressure pneumatics, Basic application, Pneumatic sensors

Unit 5: Maintenance Practice in Hydraulics and Pneumatics (09 Hours)

Maintenance Practice in Hydraulics- Common faults, Repair procedure, failure due to contamination; Pump maintenance; Filter maintenance; Hydraulic system maintenance; Estimation of seal failure; faulty fitting of seals in cylinders; Fault Diagnosis, Standard Inspection Format, General Safety Measures

Maintenance Practice in Pneumatics- Maintenance needs, commonly encountered problem in pneumatics, Maintenance schedule of pneumatic system, Pressure Loss in Pneumatic Line, Seal failure, Troubleshooting standards; Maintenance of Air compressor.

Unit 6: (15 Hours)

Tutorials, Assignments, Demonstrations and Presentation based on Unit 1 to 5

References:

Text:

1. S. R. Majumdar – Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill Education Pvt. Ltd., ISBN – 0-07-463-748-7
2. S R Majumdar - Pneumatic Systems: Principal and maintenance; Tata McGraw Hill Education Pvt. Ltd., ISBN 0-07-460-231-7

Suggested reading:

1. W. Bolton – Pneumatic and Hydraulic Systems, Butterworth Heinemann, ISBN – 0-07-506-383-62
2. Anthony Esposito- Fluid Power with Application, Seventh Edition, Pearson Publication, ISBN- 97801351136904.
3. Parr – Hydraulics and Pneumatics: A Technician‘s and Engineer‘s Guide, Butterworth Heinemann, ISBN – 0-08-096-674-8

WEB

https://nptel.ac.in/courses/112105046/
https://nptel.ac.in/courses/105103021/

ATC 224 - Transmission System Design

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To understand the design procedure of various transmission elements.
2. To differentiate between various drives as per application and use.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Analyze the stresses in shaft and design the shaft for any application
CO2	Design the single plate, Multi plate and centrifugal clutch for automotive application
CO3	Analyze the gear ratio for multi stage gearbox and design of gearbox
CO4	Select Belt drive and chain drive for automotive application

Course Content:

Unit -I: Design of Shaft (08 Hours)

Pure torsion, bending moment, Compound stresses and strain, Twisting moment, Shafts, design of shaft, Material selection for shaft, Stresses in shaft, shafts in series, shaft in parallel, composite shaft

Unit -II: Design of Gearbox (10 Hours)

Gears, terminologies of gears, Material selection for gear, Spur gear, Helical gear, Bevel gear, worm and worm wheel, gear tooth failures, Simple gear train, Compound gear train, Epicyclic gear train, Lubrication of gearbox, Stages in gearbox. Performance of vehicle, total resistance to motion, traction and tractive effort, calculation of gear ratio, design of three speed gear box, design of four speed gear boxes.

Unit -III: Design of Clutch (09 Hours)

Design of single plate clutch, multi plate clutch, design of centrifugal clutch, cone clutch, energy dissipated, torque transmitting capacity of clutch, design of clutch components, uniform pressure theory, uniform wear theory

Unit –IV: Belt and Pulleys (08 Hours)

Introduction, Selection of Belt Drive, Types of Belt drive, Material used for belts, Velocity ratio, Slip, Creep of Belt, power transmitted by belt, Maximum Tension, V-Belts and pulley.

Unit –V: Rope and Chain Drive (10 Hours)

Rope drives, fibre ropes, Advantages of rope drive, wire ropes, Designation of wire ropes, wire ropes sheaves and drums, procedure for designing wire rope, Chain drive, Terms used in chain drive, Classification of chains, power transmitted by chains, Design procedure for chain drive.

Unit – VI: Tutorials, Case studies and presentation based on Unit I to V (15 Hours)

References:

1. Steeds. W -"Mechanics of Road Vehicles"- Illiffe Publisher 1960., London, ASIN: B0000CKKGV
2. Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2008, ISBN-10: 8174092161
3. Dean Averns - "Automobile Chassis Design"- Illiffe Publisher, London, ISBN-13: 978-1444600049.
4. V.B.Bhandari, “Design of Machine Elements”, Tata McGraw Hill publication, 2010, ISBN: 0070681791
5. Keith J Nisbett and Richard G Budynas, “Mechanical Engineering Design” ,Mcgraw Hill Series, 2013, ISBN 13: 9780073529288

Generic Elective-III (Anyone among ATC 225A and ATC 225B)
ATC 225A - Automobile Systems Design

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To understand the design procedure of bearing, brake, Cam and Follower.
2. To select the bearing for proper application from manufacturers catalogue.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Explain the construction and working of automobile systems.
CO2	Design automobile systems as per specifications.
CO3	Draw 2D drawings of designed components.
CO4	Prepare report on design of components and its drawings.

Course Content:

Unit –I: Basic Design Philosophy (9 Hours)

Basic Procedure for Design, Traditional Design Method, Design Synthesis, Use of standards in Design, Aesthetic consideration in Design, Ergonomic consideration in Design, Concurrent Engineering, Mechanical Properties of Materials, BIS Designation of steels, Selection of Materials, Manufacturing consideration in Design

Unit –II: Rolling Contact Bearings (09 Hours)

Introduction, Selection of Bearing type, Static load carrying capacity, Dynamic load carrying capacity, Equivalent Bearing load, Load life relationship, Selection of Bearing life, Load life, Selection of Bearing from manufacturer catalogue, Bearing Failure- Causes and Remedies, Lubrication of Rolling contact Bearing, Mounting of Bearing.

Unit –III: Sliding Contact Bearings (09 Hours)

Bearing Design- Selection of Parameters, Bearing Material, Bearing Construction, Sintered Metal Bearings, Hydrodynamic bearing, Raimondi and Boyd Method, Lubricating oils, Additives of Mineral oils, Selection of Bearings, Greases, Comparison of Rolling contact and Sliding contact bearing.

Unit –IV: Braking system: (10 Hours)

Introduction, Energy absorbed by the brake, Heat dissipated during braking, Material for Brake lining, Types of Brake, Single Block Brake, Pivoted Shoe Brake, Double shoe brake, Simple Band Brake, Differential Band Brake, Internal Expanding Brake.

Unit –V: Cam and Follower (8 Hours)

Cam Design: Types - pressure angle and under cutting base circle determination – forces and surface stresses, types of follower, Terminology of Cam, Force exerted by Cam.

Unit – VI: Tutorials, Case studies and presentation based on Unit-I to V (15 Hours)

References

1. Reimpell J., “The Automotive Chassis – Engineering Principle” – 2nd Edition, ISBN 9781493302864
2. P. Lukin, G. Gasparyarts, V. Rodionov, “Automotive Chassis – Design & Calculation”, MIR Publishing, Moscow, ISBN, 1-55623-603-4
3. P. M. Heldt, “Automotive Chassis” ,Chilton Co. NK, ISBN-13: 9781114312395
4. W. Steed, "Mechanics of Road Vehicles" , Illiffe Books Ltd., London ASIN: B0000CKKGV
5. Keith J Nisbett and Richard G Budynas, “Mechanical Engineering Design” ,Mcgraw Hill Series, 2013, ISBN 13: 9780073529288
6. R. B Gupta, “Auto design”, Satya Prakashan, ISBN-13: 9788176840101
7. V.B.Bhandari, “Design of Machine Elements”, Tata McGraw Hill publication, 2010, ISBN: 0070681791

ATC 225B: Vehicle Aerodynamics and Design

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To calculate the lift and drag forces on vehicle.
2. To explain shape optimization of cars and passenger bus bodies.

Course outcomes

The student should be able to–

CO1	Explain vehicle aerodynamics.
CO2	Analyse stability, safety and comfort of vehicles
CO3	Explain wind tunnels and testing techniques.
CO4	Analyze the lift and drag forces on vehicle.

Course Content:

Unit I: Fundamentals of Aerodynamics (09 hours)

Scope and Historical Development Trends - Fundamental of Fluid Mechanics - Flow Phenomenon Related To Vehicles - External & Internal Flow Problem - Resistance To Vehicle Motion - Performance - Fuel Consumption And Performance - Potential of Vehicle Aerodynamics.

Unit II: Aerodynamic Drag of Cars (08 hours)

Cars as a Bluff Body - Flow Field Around Car - Drag Force - Types of Drag Force - Analysis of Aerodynamic Drag -Drag Coefficient of Cars - Strategies for Aerodynamic Development - Low Drag Profiles, Lift, Body Styling.

Unit III: Wind Tunnels and Test Techniques (11 hours)

Principles of wind technology, Limitations of simulation, Simulation based optimization of geometries, Drag reduction Technologies, Surface shaping Scale models, Existing automobile wind tunnels Wind Tunnel Experiments, Measurement of Pressure Coefficient , Measurement of Drag Force .Wind Tunnel limitations & Corrections, Boundary Layer Control, Pressure Gradient , Wind Tunnel Blockages. Climatic tunnels, Measuring equipment and transducers. Pressure measurement, velocity measurements

Unit IV: Shape Optimization of Cars (09 hours)

Front End Modification - Front And Rear Wind Shield Angle - Boat Tailing - Hatch Back, Fast Back And Square Back - Dust Flow Patterns at the Rear - Effects of Gap Configuration - Effect of Fasteners. The Origin of Forces and Moments on Vehicle - Side Wind Problems - Methods to Calculate Forces and Moments - Vehicle Dynamics Under Side Winds - The Effects of Forces and Moments

Unit-V: Vehicle Handling (08 hours)

Characteristics of Forces and Moments - Dirt Accumulation on the Vehicle - Wind Noise - Drag Reduction in Commercial Vehicles, Flow visualization techniques, Road testing methods, Wind noise measurements.

Unit –VI: Tutorials, case studies and presentation based on Unit I to V (15 hours)

References:

1. W.H. Hucho, 'Aerodynamics of Road Vehicles', Butterworth and Co., 2004.
2. Schlichting, H. 'Boundary Layer Theory', McGraw Hill, New York, 1999.
3. Pope, A., Low speed Wind Tunnel Testing, John Wiley and Sons, New York, 1999.
4. Vehicle aerodynamics, SAE, 1996.
5. E.L.Houghton & P.L.Carpenter, "Aerodynamics for Engineering students", Butterworth Heinman (2003)

ATLC 226 Mini Project – Phase II

(5 Credits: 150 Marks)

Course Outcomes:

On completion of this course, students should gain-

- Critical thinking in problem solving
- Presentation and communication skills
- Report organization and writing skills
- Independent learning and information integration skills
- Project management skill
- Work as an individual, with support from a supervisor, formulating solutions to day-to-day problems by integrating knowledge and experience gained on the course and outside the course.

Activity

Students or group of students (max.02) have to prepare a comprehensive project proposal based on theory and laboratory courses they have covered in Semester – I and will be covering under Semester – II during the semester under supervision of project guide. After approval of the proposal by the Director, students will be allowed to work on the project. Working Model/ Demonstration model of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Mini Project coursework will be based on power-point presentation, demonstration and viva-voce examination.

ATR 221 Industrial Project – Phase II

(5 Credits: 150 Marks)

Experimental work to be continued with the approved project. Final evaluation will be based on power-point presentation, demonstration and viva-voce examination.

ATC 321 Autotronics (Self-Study Mode)

(04 credits – 100 marks)

Learning Objectives:

The course should enable students:

1. To Differentiate between Vehicle Motion Control and Digital powertrain control.
2. To understand working principle of various sensors and actuators used in automobile.

Course Outcomes:

After completion of the course, students are expected to be able to:

CO1	Identify various types of display device.
CO2	Carry out the instrumentation in vehicle and intelligent vehicle system.
CO3	Demonstrate Advanced cruise control and powertrain control system.
CO4	Demonstrate various sensors used in engine management system.

Unit I: Electronics Fundamentals (09 hours)

Semiconductor devices: Diodes, Rectifier Circuit, Transistors, Integrated circuits, Digital circuits, Binary number system, Logic circuits, Logic circuits with memory, Register Circuits, Buses, Memory read/write, Digital to Analog converter, Analog to digital converter,

Unit II: Vehicle Motion Control (08 hours)

Introduction, Representative Cruise control system, Digital cruise control, Cruise control electronics, Advanced cruise control, Antilock Braking System, Tire-Slip Controller, Electronic suspension system, Variable damping, Electronics steering control, Four wheel steering.

Unit III: Digital Powertrain Control (08 hours)

Digital engine control features, Control modes for fuel control, EGR control, Variable Valve timing control, Electronic Ignition Control, Integrated Engine control system, Automatic Transmission Control, Torque converter lock-up control, Differential and Traction control, Hybrid Electric Vehicle Powertrain Control

Unit IV: Sensors and Actuators (10 hours)

Automotive Control system Applications of Sensors and Actuators, Variables to be measured, Airflow rate sensor, Pressure measurements, Engine crankshaft Angular position sensor, Magnetic Reluctance Position Sensor, Hall-Effect position sensor, Optical crankshaft Position sensor, Throttle angle sensor, Temperature sensors, Typical coolant sensor, Sensors for feedback control, Exhaust gas oxygen sensor, knock sensors, Automotive engine control actuators, Fuel Injection, Exhaust gas recirculation Actuator, Variable Valve Timing, Electric Motor Actuators, Brushless DC Motor, Stepper Motors, Ignition system.

Unit V: Automotive Instrumentation and Telematics (09 hours)

Modern Automotive Instrumentation, Input and Output Signal Conversion, Multiplexing, Display devices: LED,LCD, Trans missive LCD, VFD, Flat Panel display, Fuel Quantity Measurement, Coolant Temperature measurement, Oil pressure measurement, Vehicle Speed Measurement, High-speed Digital communications (CAN), Telematics, GPS navigation, GPS system structure, Automotive Diagnostics.

Unit -VI Tutorials, case studies and presentation based on Unit I to V (15 Hours)

References:

1. William B. Ribbens, *Understanding Automotive Electronics*, 7th edition,
2. Ronald k. Jurgen, *Automotive Electronics Handbook*, 2nd edition, McGraw-Hill
3. Rajkamal, Embedded System – Architecture, Programming, Design", Tata McGraw Hill,2003.
4. Daniel W. Lewis „Fundamentals of Embedded Software", Prentice Hall of India.
5. Holman, J.P., Experimental methods for engineers, McGraw-Hill
6. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill, New Delhi

ATC-322 Mini Project with Lab course on Autotronics

(6 Credits: 200 Marks)

Course Outcomes:

On completion of this course, students should be able to –

1. Recognize elements of a powertrain control modules in Autotronics lab
2. Recognize performance and Testing of engine.
3. Conceptualize role of Autotronics in modern vehicles.

Activity

Group of students (max.03) have to undertake project on part of Autotronics. Each group should decide a specific task on the unit and get it approved by the faculty – in – charge. Demonstration of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Mini Project coursework will be based on power-point presentation, demonstration and viva-voce examination.

ATR-321 Industrial Project- Phase III

(20 Credits: 600 Marks)

Experimental work to be continued with the approved project. Final evaluation of Industrial Project -Phase III coursework will be based on power-point presentation, demonstration (if the experimental work is at requisite matured stage) and viva-voce examination.

ATC421: Intellectual Property Rights
(Self- Study Mode)

(4 Credits: 100 Marks)

Learning Objectives

This course is intended mainly to acquaint students with fundamental concepts of IPR, basics of patent law, know the requirements of patentability, learn how to read and interpret patent specifications, analyze patent office procedures and case studies for developing the basic understanding for drafting a patent specification. The course also looks forward to give fundamental ideas and procedures of other dimensions of IPR namely Copyright, Design and GI. Mostly, Indian perspectives of IPR will be discussed.

Course Outcomes

On completion of the Course, students should be able to-

1. Recognize the different dimensions of Intellectual Properties and subsequent Rights
2. Discuss basic traits pertaining to different dimensions of Intellectual Property Acts
3. Express requirements of a Patent Specification
4. Describe steps of Patent prosecution
5. Recognize practices of patent office

Course Contents:

Unit 1: Introduction to IPR and Patents (10 Hours)

Introduction to Intellectual Property, Concept of property and rights in IPR, Meaning of intellectual in IPR, Characterises of IP, Kinds of IPR, Rights granted by IP, Intangible economy, Traits of intangibility, Enforcement of IP; Patents- Introductory concepts, Subject matter, Patents in India, To file or not to file a patent, Publish or Patent, Who can file a patent, When and how to file a patent, Requirements of a patent application, Types of Patent application

Unit 2: Patents (13 Hours)

Patent law as concepts, Understanding the patent act and rules, Preliminary sections, Preliminary rules, Reading patent act and rules; Patentability of Inventions, Inventions not patentable, Novelty, Anticipations, Inventive step, Capable of Industrial Application, Person skilled in art, Prior knowledge; Drafting of patents -Complete and Provisional specifications, Contents of specifications, Structure of a patent specification, Drafting of Provisional specification, Drafting of Complete specification; Patent search; Case study

Unit 3: Patent Prosecution (13 Hours)

Powers of Controller, Patents of Addition, Priority Dates, Publication of Application, Request for Examination, Examination of Application, Expedited Examination of Application, Search for Anticipation, Procedure in case of Anticipation, Consideration of Report of Examiner, Refuse, Require Amendment, and Division of Applications, Dating of Application and Anticipation, Potential Infringement, Orders Regarding Substitution of Applicants, Putting Applications in Order for Grant, Amendments during Prosecution, Introduction to Opposition to Grant of Patents

Pre-Grant Opposition, Post-Grant Opposition, Opposition in General

Unit 4: Practices at Patent Office **(13 Hours)**

Secrecy Provisions, Grant of Patents, Rights conferred by Grant, Rights of Co-Owners of Patents and Power of Controller to give directions, Patent obtained by Fraud of True and First Inventor, Term of Patent, Restoration of Lapsed Patents, Surrender of Patents, Revocation of Patents, Register of Patents, Patent Office and its Establishment, Patent Agents, Use and Acquisition by Government, Penalties; Introduction to compulsory licensing

Unit 5: Trademark, GI, Design, Copyright **(11 Hours)**

Trade Marks, International Arrangements, Trade marks in India, What can be protected, Registration of trade mark, Rights and Defences; Geographical Indication; Design; Introduction to copyright – Copyright in India, Criteria of protection, Subject matter, Rights an infringement, Educational exceptions; Case studies

Unit 6:

Tutorials, Assignments, Demonstrations and Presentation based on Unit 1 to 5

References:

Web support:

1. Lectures of Professor Feroz Ali (Department of Humanities and Social Sciences, IIT Madras) on 'Intellectual Property' available with NPTEL; https://nptel.ac.in/courses/109/106/109106137/
2. Lectures of Professor Feroz Ali (Department of Humanities and Social Sciences, IIT Madras) on 'Patent Laws for Scientists and Engineers' available with NPTEL; https://nptel.ac.in/courses/110/106/110106081/

Suggested reading:

1. V. K. Ahuja, 'Intellectual Property Rights in India', Lexis Nexis; ISBN: 978-9351433880
2. V. K. Ahuja, 'Law Relating to Intellectual Property Rights', Lexis Nexis; ISBN: 978-8131251652
3. 'Intellectual Property Laws', Universal's Legal Manual, ISBN: 978-9350355855
4. 'Manual of Patent Office Practice and Procedure-2019', The Office of Controller General of Patents, Designs & Trademarks; IPO
5. 'The Patents Act-1970' ; IPO
6. 'Manual of Designs Practice and Procedure', The Office of Controller General of Patents,

   Designs & Trademarks; IPO
7. 'Manual of Trademarks Practice and Procedure', The Office of Controller General of Patents, Designs & Trademarks; IPO
8. 'Practice and Procedure Manual', Copyright Office

ATLC 421: Case Study Report of Any Existing Industrial Project

(6 Credits: 200 Marks)

Course Outcomes:

On completion of this course, students should be able to –

1. Recognize the underlying factors of problem identification/manufacturing support in industrial realm
2. Apprehend the procedural steps towards root cause analysis and comprehensive solution approach
3. Conceptualize financial planning issues in commissioning a project
4. Realize pay off and benefit cost analysis

Activity

1. Students (group of max 2 students) should identify one industrial project commissioned in industry - to alleviate certain problem/to support existing manufacturing facility. They are expected to study the project in depth and submit a detailed report to the department on –

    i. Problem identification process
    ii. Justification for machineries installation
    iii. Economic Considerations (elements of cost, capital cost, facility cost etc.)
    iv. Payoff and cost benefit analysis
    v. Installation aspects & safety measures installed
    vi. Co-working of the project with existing systems in the plant
    vii. Benefit factors

Final evaluation will be based on presentation, and viva-voce examination

ATR 421: Industrial Project – Phase IV

(20 Credits: 600 Marks)

Students are expected to work on concluding part of the experimental work, analyze the results, standardize the complete work with optimum aesthetic integration before submitting to the department. A neatly prepared report in soft-format (CD) should be submitted to the department along with the project. Final evaluation of Industrial Project -Phase IV coursework will be based on power-point presentation, demonstration and viva-voce examination.