2016

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Course Structure and Curriculum

Master of Vocation

(M.Voc)

In

Industrial Automation

Choice Based Credit System

(Effective from June 2016 onwards)

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

This M.Voc (Industrial Automation) program is divided in four semesters having 102credits. The distribution or credits is as per following –

Sr. No.	Category of course(s)	Type of Course (Theory/ Practical/ Research Project)	Number of Course(s)	Total Credits	Semester-wise Credit Distribution
1	Compulsory Common Component (Constitution of India)	Theory	01	02	Sem I – 02
2	Core Component	Theory	07	14	Sem I - 08 Sem II - 06
3	Foundation Component (Elective)	Theory	01	02	Sem I – 02
4	Foundation Component (Research)	Theory	01	01	Sem I – 01
5	Foundation Component (Compulsory)	Theory	05	10	Sem I - 04 Sem II - 06
6	Generic Elective	Theory	05	10	Sem III – 08 Sem IV -02
7	Open Elective[#]	Theory	02	04	Sem III – 02 Sem IV - 02
8	Laboratory courses (Core)	Practical	07	10.5	Sem I - 06 Sem II - 4.5
9	Laboratory courses (Foundation)	Practical	05	7.5	Sem I - 03 Sem II - 4.5
10	Laboratory Courses (Generic Elective)	Practical	05	7.5	Sem III -06 Sem IV- 1.5
11	Research Component				
	Part 1	Research/Industrial project	Part 1	05	Sem II - 5.0
	Part 2		Part 2	09	Sem III- 9.0
	Part 3		Part 3	19.5	Sem IV - 19.5
			Total	**102 Credits**	

The above structure exercised component wise distribution as per following –

Constitution of India = 02 Credits

Core Component = 24. 5%

Foundation Component = 20.5%

Elective Component = 21.5 %

Research component = 33.5% (Excluding theory course entitled 'Research Methodology')

#Students can opt for open electives from courses offered by Automobile Division, Deen Dayal Upadhyay KASUSHAL Kendra

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 programme is designed to produce a skilled manpower in Industrial Automation to improve the opportModuleies 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), there should be a deficit of 40 million working 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 programme 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 programme 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:

The objectives of M.Voc (Industrial Automation) program are to produce graduates who -

1. Are equipped with time advanced knowledge of mechatronics and electronics to address multi disciplinary demand of automated manufacturing, and process in modern industries in capacity of productive Senior System Developers, Senior System Integrators and Plant Supervisors.
2. Have a acute knowledge base to practice industrial automation in the areas of robotics, manufacturing, and process control in industry and Government settings meeting the growth 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. Should be sensitive to consequences of their work both ethically and professionally for productive professional career.

Program Outcomes (PO):

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 have at each exit level/at the time of graduation. These Outcomes are generic and are common to all exit levels mentioned in the programme structure. Graduates of the M.Voc program are expected to -

PO1. **Domain knowledge:** Apply advanced knowledge of the specific skill based trade for the solution of target skill sector.

PO2. **Problem Analysis:** Identify industry domain related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of domain sectors and technical literature.

PO3. **Design Development of solutions :** Design / develop solutions for specific critical problems in the target skill based trade to address changing challenges put forward by market demand/ stakeholder

PO4. **Conduct Investigation of complex problems:** Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions

PO5. **Modern tools:** Use the techniques, skills and modern tools necessary skill based trade to practice with clear understanding of limitations.

PO6. **The citizenship and society:** Apply sound understanding of ethical and professional skill based trade practice in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

PO7. **Environment and sustainability:** Apply sound understanding of impact of skill based trade in a global, economic, environmental and societal context.

PO8. **Ethics:** Apply ability to develop practical solutions for skill trade problems within positive professional and ethical boundaries.

PO9. **Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

PO10. **Communication:** Communicate effectively in oral and written format addressing specific professional/ social demands.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the first principles of skill trade 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:** Recognize the need for and have the ability to address to the changing technological demands of the target skill trade.

Program Specific Outcomes (PSO):

Graduates of the M.Voc (Industrial Automation) program are expected to -

1. Apply advance knowledge of electronics, electrical, mechatronics fundamentals and Industrial automation specialization for the solution of automated manufacturing and process related problems.

2. Identify complex industrial automation related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using advance concepts of electronics, electrical and mechatronics and technical literature.

3. Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions.

4. Use the techniques, skills and modern tools necessary for industrial automation practice with clear understanding of limitations.

Eligibility:

Those who have completed B.Voc (Industrial Automation)/ B. Sc with Physics and Electronics / B. E/ B. Tech (Electronics/Electronics and Telecommunication/ Instrumentation/ Electrical/ Mechanical/Mechatronics/Industrial Automation) from any recognized Board/Institution are eligible for registration / admission.

AND

Students having B. Sc degree with Physics and Electronics will have to complete at least 4 credits in terms of two theory courses namely – (i) Fundamentals of Hydraulics and Pneumatics (ii) Process Control and Instrumentation during First year of M.VOC apart from courses being taught in course of regular academic session.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves. Admission should be done on the basis of performance of students at Common Entrance Test(CET). The CET should 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 should 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 should 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 should 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):

(A) For 4 credit courses-

- There will be 20 marks for Continuous Internal Assessment. Two internal tests (of 20 marks each) will be conducted, after completion of 40% and 80% of the curriculum respectively. Average performance of the two sets will be considered for final marks-memo preparation. The setting of question papers and the assessment will be done by concerned teacher.

(B) For 2 credit courses-

- There will be 10 marks for Continuous Internal Assessment. Two internal tests (of 10 marks each) will be conducted, after completion of 40% and 80% of the curriculum respectively. Average performance of the two sets will be considered for final marks-memo preparation. The setting of question papers and the assessment will be done by concerned teacher.

Semester End Examination (SEE):

- The semester end theory examination for each theory course of 4 credits will be of 80 marks, whereas, for 2 credit theory course, the same will be of 40 marks. Therefore, the total marks shall be 100 for 4 credit theory course (80 marks semester end exam + 20 marks CIA) and 50 for 2 credit theory course (40 marks semester end exam + 10 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 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:

(A) For 4 credit courses-

- 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 one sentence) as compulsory questions and it should cover entire course curriculum (20 Marks)

- Part B will contain 07 questions of 12 marks each (with more or less equal weightage on every module). Students will have to attempt 05 questions out of 07 (60 Marks).

- 20 to 30% weightage can be given to problems/ numerical (wherever applicable) wherein use of non-programmable scientific calculator may be allowed.

- Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

(A) For 2 credit courses-

- The semester end examination of theory course will have two parts (10+30 = 40 Marks)

- Part A will be consisting of 10 questions having 1 marks each (multiple choice questions / fill in the blanks/ answer in one sentence) as compulsory questions and it should cover entire course curriculum (10 Marks)

- Part B will contain 05 questions of 10 marks each (with more or less equal weightage on every module). Students will have to attempt 03 questions out of 05 (30 Marks).

- 20 to 30% weightage can be given to problems/ numerical (wherever applicable) wherein use of non-programmable scientific calculator may be allowed.

- Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

- Assessment of laboratory courses and project will be carried out at the end of semester. Student must perform at least eight experiments from each laboratory course. The semester end practical examination will be conducted at the end of each semester along with the theory examination.

- At the end of each semester, the Departmental Committee will assign grades to the students.
- The Director of the Centre shall send all results to the Controller of Examination for further processing.

- Every student will have privilege for revaluation of answer sheets or recounting of marks for each semester end examination. However, students will have to submit an application within 15 days from the date of declaration of results.

- Applications received for revaluation / recounting will be discussed in the Departmental committee and examiners will be appointed accordingly.

- The results of revaluation / recounting will be approved by Departmental committee and forwarded to Controller of Examination for further processing.

Earning Credits:

At the end of every semester, a letter grade should be awarded in each course for which a student had registered. A student's performance should be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) should be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) should 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	8.00-8.90	A^{++}	Exceptional
70-79	7.00-7.90	A^{+}	Excellent
60-69	6.00-6.90	A	Very Good
55-59	5.50-5.90	B^{+}	Good
50-54	5.00-5.40	B	Fair
45-49	4.50-4.90	C^{++}	Average (Above)
41-44	4.1-4.49	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 should 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 should 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 should be announced at the end of each semester and CGPA should be given at final exit.

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

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

The computation of SGPA and CGPA should be as below

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

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

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

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

M. Voc (Industrial Automation)

Semester	Paper Code	Paper Title	Contact Hrs/Week	Credits
Semester I	**CC100**	Constitution of India	2	2
	IAC110	Electronic Systems	2	2
	IAC111	Power Electronics	2	2
	IAC112	Transducer Technology	2	2
	IAC113	Electric Drives	2	2
	IAF120	Embedded Systems Design	2	2
	IAF121	Programmable Logic Controllers	2	2
	CF101	Research Methodology	1	1
	EF1XX	Elective Foundation (Any One) ▪ Operations Management (EF130) ▪ Materials management (EF 131)	2	2
	IALC 140	Electronic Systems lab	3	1.5
	IALC 141	Power Electronics lab	3	1.5
	IALC 142	Instrumentation lab – I	3	1.5
	IALC 143	Electric Drives lab	3	1.5
	IALF 150	Embedded Systems Lab	3	1.5
	IALF 151	PLC lab	3	1.5
	Assignments/Tutorials will remain integral part of all courses			
		Total Credits for Semester – I		**26**

Semester	Paper Code	Paper Title	Contact Hrs/Week	Credits
Semester II	**IAC 210**	Communication Protocols for Instrumentation	2	2
	IAC 211	Mechatronics	2	2
	IAC 212	Advanced Transducers	2	2
	IAF 220	Robotics	2	2
	IAF 221	Process Control	2	2
	IAF 222	Industrial Automation	2	2
	IALC 230	Industrial Networking lab	3	1.5
	IALC 231	Mechatronics lab	3	1.5
	IALC 232	Instrumentation lab –II	3	1.5
	IALF 240	Robotics lab	3	1.5
	IALF 241	Process Control lab	3	1.5
	IALF 242	Industrial Automation lab	3	1.5
	IAR 250	Research/ Industrial Project – Phase I (Review of Literature/ Industrial Orientation, Formulation of Topic, Experimental Plan)	10	5
	Assignments/Tutorials will remain integral part of all courses			
		Total Credits for Semester – II		**26**

Semester	Paper Code	Paper Title	Contact Hrs/Week	Credits
Semester III	**IAGE 31X**	Generic Elective – I	2	2
	IAGE 31X	Generic Elective – II	2	2
	IAGE 31X	Generic Elective – III	2	2
	IAGE 31X	Generic Elective – IV	2	2
	IAOE 32X	Open Elective –I	2	2
	IALE 33X	Lab Course based on Generic Elective – I	3	1.5
	IALE 33X	Lab Course based on Generic Elective – II	3	1.5
	IALE 33X	Lab Course based on Generic Elective – III	3	1.5
	IALE 33X	Lab Course based on Generic Elective – IV	3	1.5
	IAR 340	Research/ Industrial Project – Phase II (Experimental Work)	18	9
	Assignments/Tutorials will remain integral part of all courses			
		Total Credits for Semester – III		**25**

Semester	Paper Code	Paper Title	Contact Hrs/Week	Credits
Semester IV	**IAGE 41X**	Generic Elective – V	2	2
	IAOE 42X	Open Elective – II	2	2
	IALE 43X	Lab Course based on Generic Elective – V	3	1.5
	IAR 440	Research/ Industrial Project – Phase III (Experimental Work Continued, Organization and Interpretation of Result, Dissertation, Presentation)	39	19.5
	Assignments/Tutorials will remain integral part of all courses			
		Total Credits for Semester – IV		**25**

Electives for Semester – III

(Any four theory paper along with corresponding lab course have to be chosen from generic electives)
(Any one theory paper have to be chosen from open electives)

	Paper Code	Paper Title		Paper Code	Paper Title
Generic	**IAGE 310**	Industrial Processes and Instrumentation	Generic(Lab)	**IALE 330**	Lab Course based on Industrial Process Control
	IAGE 311	SCADA System and Applications		**IALE 331**	Lab Course based on SCADA System and Applications
	IAGE 312	Applied Hydraulics and Pneumatics		**IALE 332**	Lab Course based on Applied Hydraulics and Pneumatics
	IAGE 313	Industrial Robotics		**IALE 333**	Lab Course based on Industrial Robotics

	IAGE 314	Advanced Sensor Technology		**IALE 334**	Lab Course based on Advanced Sensor Technology
	IAGE 315	Kinetics and Dynamics of Robotics		**IALE 335**	Lab Course based on Kinetics and Dynamics of Robotics
	IAGE 316	Mechatronics Systems Design		**IALE 336**	Lab Course based on Mechatronics Systems Design
	IAGE 317	Distributed Control System		**IALE 337**	Lab Course based on Distributed Control System
	IAGE 318	Advanced Electrical Drives		**IALE 338**	Lab Course based on Electrical Drives
	IAGE 319	Advanced Microcontrollers		**IALE 339**	Lab Course based on Advanced Microcontrollers
Open	**IAOE 321**	Automotive Engines			
	IAOE 322	Automobile Control Systems			

Electives for Semester – IV

(Any one theory paper along with corresponding lab course have to be chosen from generic electives)
(Any one theory paper have to be chosen from open electives)

	Paper Code	**Paper Title**		**Paper Code**	**Paper Title**
Generic	**IAGE 410**	Automated and Computer Integrated Manufacturing	**Generic(Lab)**	**IALE 430**	Lab Course based on Automated and Computer Integrated Manufacturing
	IAGE 411	CNC Technology		**IALE 431**	Lab Course based on CNC
	IAGE 412	Micro Mechatronic Systems		**IALE 432**	Technology Lab Course based on Micro Mechatronic Systems
Open	**IAOE 420**	Automated Manufacturing			
	IAOE 421	Industrial Robotics			
	IAOE 422	Mechatronics Fundamentals			

SEMESTER – I

IAC - 110

Electronic Systems

(02 credits – 50 marks)

Course Outcomes:

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

1	Recognize OP-AMPs for building systems to develop application oriented platforms
2	Associate with controlled oscillations and monolithic frequency synthesizers
3	Experiment analog/digital timing and counting circuits
4	Classic treatments on Phase locked loops and frequency to voltage conversion
5	Interpret active filter operations
6	Identify necessary system requirements
7	Address and resolve complex application challenges

Course Contents:

Module– I: Special Operational Amplifiers and Non-linear Function Circuits (06 Hrs)

High voltage/high current amplifiers, chopper and chopper stabilized amplifiers, instrumentation amplifierand isolation amplifier.

Nonlinear function circuits: limiter, log/anti-log, multiplier/divider, peak detector, comparator, true RMS/DC converter, square wave oscillators.

Module– II: Oscillators, Timers, Counters (06 Hrs)

Sinusoidal and relaxation oscillators:phase shift oscillator, Ring oscillator, Wien-bridge oscillator, quadrature oscillator, crystal oscillator and clock circuits, voltage controlled oscillators – sine, square and triangle, frequency synthesizers.

Timing and counting circuits :digital counters, shift register, analog and digital timers, frequency counters, PLA and PLD applications.

Module– III: Phase Locked Loops and F/V conversion (06 Hrs)

Phase locked loop, Loop response, Applications of PLL.

Frequency-to-voltage converters: diode pump integrator, frequency and RPM transducers; Phase and phase/frequency comparators – analog and digital.

Module– IV: Active Filters **(06 Hrs)**

Active filter types, Filter approximations – Butterworth and chebyshev, filter realizations, frequency and impedance, scalings, filter transformations, sensitivity, switched capacitor circuit.

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. Sende, B.S. – Introduction to System design using Integrated Circuits, New Age International (P), NewDelhi.
2. Fitchen, F.C. – Integrated Circuits and Systems,Van Nostrand, New York.

IAC - 111

Power Electronics

(02 credits – 50 marks)

Course Outcomes:

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

1	Memorize various Power Converter topologies and configurations.
2	Classify various Power devices and know their construction, working principle, how they are controlled by small power, advantages, disadvantages
3	Experiment with converter, inverter, cycloconverter
4	Construct and relate power devices with different loads
5	Assess and modify control related application of power electronics

Course Contents:

Module– I: DC – DC Converters (06 Hrs)

Principle of operation of buck, boost, buck-boost, cuk, fly back, forward, push-pull, half bridge, full bridge converters, multi output boost converters, diode rectifier based boost converters

Module– II: Inverters (06 Hrs)

Single and three phase inverters with R and RL loads, Voltage Control, Harmonic reduction, Square Wave generation, PWM inverters, modulation techniques, SPWM, Current Source Inverter

Module– III: Resonant Pulse Converters (06 Hrs)

Series and parallel resonant inverters – zero current and zero voltage switching, Frequency Response Two quadrant zero voltage switching, Resonant DC link inverters, soft switching

Module– IV: Cycloconverters and AC voltage Controllers (06 Hrs)

Single and Three phase cycloconverters with R and RL loads, Voltage control, harmonics and operation waveforms

Single and Three phase AC voltage controllers with R and RL loads, Voltage Control, harmonics, operation waveforms, PWM, Matrix converter

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. Mohan, Undeland, Robbins-Power Electronics: Converters, Application and Design, John Wiley & Sons, 1989
2. A.I. Pressman –Switching mode power supply design-MGH, 1992
3. M. H. Rashid- Power Electronics, PHI, 2004
4. Michel, D. –DC-DC Switching Regulator Analysis – MGH 1987
5. Bimal K. Bose- Modern Power Electronics and AC Drives- PHI, 1995
6. Erickson, Makgimovic – Fundamentals of Power Electronics – Springer, 1998
7. P. T. Krein – Elements of Power Electronics – OUP, 1989

IAC - 112

Transducer Technology

(02 credits – 50 marks)

Course Outcomes:

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

1	Observe, monitor, analyze and sympathy towards the instruments form the basis of measurement.
2	Distinguish between transducers, sensors and transmitters
3	Define principle behind strain gauge and pressure sensors
4	Explain working of displacement, position, motion & temperature sensors
5	Work with different sensors

Course Contents:

Module– I: Introduction to Transducers (06 Hrs)

Characteristics and choice of Transducer, Classification of Transducer: Primary & secondary, Passive & Active, Transducers & Inverse Transducers; Advantages of Electrical Transducers, Summery of factors influencing the choice of Transducers, Types of signals: Pneumatic signal, Hydraulic signal, Electric signal, Difference between sensors, transmitter and transducer.

Module– II: Displacement, Position and Motion Sensor (06 Hrs)

Principles of variable resistance, variable inductance, variable reluctance, variable capacitance type sensors, Position and Motion sensor : Limit switches, proximity sensors, optical proximity sensor, ultrasonic proximity sensor
LVDT & RVDT: Construction, working principle, Advantages and Disadvantages
Hall Sensor: Working principle, Hall Effect gear tooth sensor
Accelerometer: Definition, General Construction, Working principle, types of accelerometer

Module– III: Temperature Sensors (06 Hrs)

Mechanical and resistance type temperature sensors, Thermistors: Construction of Thermistors, resistance temperature characteristics of thermistors, voltage current and current time characteristics of thermistors, salient features of thermistors
Thermocouple: Construction of thermocouple, Measurement of thermocouple output, Compensation circuit, reference junction compensation, Optical pyrometer

Module– IV: Strain Gauge and Pressure Sensor (06 Hrs)

Strain Gauge: Working principle, construction, piezo resistance co-efficient; Types of strain gauge: bonded, unbounded, semiconductor; Strain gauge measurement: Wheatstone bridge measurement
Pressure Sensor: Classification of pressure, Pressure measurement methods: inductive type, capacitance type, strain gauge type, reluctance type, piezoelectric pressure transducer

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. A K Ghosh: Introduction to Instrumentation and Control, Prentice Hall of India, New Delhi 2004.
2. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat Raj & Co, 2005
3. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill, New Delhi 2004
4. John P.Bentley: Principles of measurement systems, 3rd edition, Addison Wesley Longman, 2000.
5. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
6. M.M.S.Anand: Electronic instruments and instrumentation Technology, Prentice-Hall of India,2004.
7. Alan S.Morris: Principles of measurement and instrumentation, 2nd edition, Prentice-Hall of India,2004.
8. Ernest O. Doebelin: Measurement systems, 4th edition, Tata-McGraw Hill, 1990.
9. H.S.Kalsi-Electronic Instrumentation,3rd edition,2011

IAC - 113

Electric Drives

(02 credits – 50 marks)

Courser Outcomes:

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

1	State starting and braking of Drives
2	Observe Speed-torque characteristics of Drives
3	Demonstrate Chopper, Inverter, Cycloconverter and PWM based Control
4	Select drive for specific application
5	Categorize speed controlling of Motors

Course Contents:

Module– I: Introduction to Electrical Drives (06 Hrs)

Electrical Drives, Advantages Of Electrical Drives, Parts Of Electrical Drives, Choice Of Electrical Drives, Status Of DC And AC Drives, Types Of Loads, Quadrantal Diagram Of Speed-Torque Characteristics, Starting and Braking of Electric Drives

Module– II: Control of Electrical Drives (06 Hrs)

Control of electric Drives: Modes of operation. Closed-loop control of drives. Current-limit control. Closed-loop torque, and speed control. Speed and current sensing. Phase-locked-loop control.

Module– III: DC Drive (06 Hrs)

DC Drive: Single phase half wave and full wave converter Drive, Three phase half wave and full wave converter Drive , Chopper fed DC Drive: Motoring Control, Two –quadrant Chopper Drives

Module– IV: AC Drive (06 Hrs)

AC Drive : Inverter fed drive, single phase and three phase cycloconverters Operations in different modes and configurations, Stator voltage control, stator frequency control, Stator Current control, PWM based control

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books :

1. Bimal.K. Bose, “Power Electronics and Variable frequency drives”, Standard Publishers Distributors, New Delhi, 2000
2. Murphy J.M.D, Turnbull, F.G, “Thyristor control of AC motor, Pergamon press, Oxford, 1988.
3. M. H. Rashid, "Power Electronics -Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994
4. N. Mohan et.al. "Power Electronics-Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., Singapore, 1996
5. Bimal K Bose, “ Modern Power Electronics and AC Drives” PHI
6. R. Krishnan, “Electric motor drives: modeling, analysis and control, Pearson
7. Dubey G.K. “Power Semiconductor controlled drives”, Prentice Hall inc, A division of Simon and Schester England cliffs, New Jersey 1989.
8. Sheperal, Wand Hully, L.N. “Power Electronic and Motor control” Cambridge University Press Cambridge 1987
9. Dewan,S. Slemon B., Straughen,A. G.R., “Power Semiconductor drives”, John Wiley and Sons, NewYork 1984.

   10.Dr. P.S. Bhimbra,”Power Electronics”, Khanna Publishers,2012

IAF – 120

Embedded Systems Design

(02 credits – 50 marks)

Course Outcomes:

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

1	State the concepts of interfacing 8051 microcontroller to real world elements
2	Recognize protocols for interfacing 8051 microcontroller to real world elements
3	Demonstrate interfacing concepts and protocols for 8051 microcontroller.
4	Develop programs for interfacing real world elements to 8051 microcontroller
5	Implement 8051 microcontroller for process automation applications

Course Contents:

Module- I: Introduction (05 Hrs)

Introduction, Microcontroller and embedded processors, Overview of 8051 family, 8051 Architecture, PSW registers, register bank and stacks, addressing modes, introduction to the use of assemblers and simulators.

Module- II: Arithmetic, Logic Instructions and Assembly language program (08 Hrs)

Jump, loop and call instructions, Addressing modes, arithmetic instructions, logical instructions, Assembly language programs, introduction to timers and counters.

Module- III: Real World Interfacing - I (06 Hrs)

Interfacing of - LCD, Keyboard, ADC (Parallel and Serial), DAC; Analog and Digital Sensor; Case Studies

Module- IV: Real world interfacing– II (06 Hrs)

Interfacing of - External Memory, RTC, Stepper Motor, DC motor, Speed control of motors; Case studies

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. Muhammad Ali Mazidi, J. G. Mazidi and Rolin D. McKinlay – The 8051 Microcontroller and Embedded Systems - Pearson, 2nd edition 2013
2. 8051 Architecture, Programming and Interfacing- K.J. Ayala; Penram International
3. John B. Peat Man- Design with Microcontroller, Pearson Edition Asia, 1998
4. Burns, Alan and Wellings, Andy, Real Time Systemand Programming Languages, 2nd edition 2013, Harlow: Addison- Wesley
5. Frank Wahid - Embedded Systems
6. Raj Kamal -Embedded Systems

IAF - 121

Programmable Logic Controllers

(02 credits – 50 marks)

Course Outcomes:

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

1	Recognize typical components of a Programmable Logic Controller.
2	Explain the basic concepts of a Programmable Logic Controller
3	Develop basic programming skills for process automation with PLC's
4	Employ Allen Bradley PLCs for industrial applications
5	Design and program basic PLC circuits for entry-level PLC applications
6	Compose and develop a small, automated Industrial production line.

Course Contents:

Module– I: PLC fundamentals (06 Hrs)

Overview of PLC systems,input/output modules, power supplies, isolators, rack assembly, PLC programming Modules, Input and Output devices for PLC based systems; Relay ladder logic Circuits, Conceptualization of ladder diagram.

Module– II: PLC Functions – I (06 Hrs)

General PLC programming procedures; Addressing, Relationship of Data File addresses to I/O modules; Language of ladder diagram, programming on-off inputs/ outputs; Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

Module- III: PLC Functions - II (06 Hrs)

Arithmetic functions, number comparison functions, Skip and MCR functions, data manipulation functions; PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions.

Module– IV: PLC Advanced Functions and Applications (06 Hrs)

PLC advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC -PID functions; PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from real time system descriptions.

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. J. W. Webb, R. A. Reis – Programmable Logic Controllers: Principles and Applications- PHI, New Delhi, 2013
2. W. Bolton – Programmable Logic Controllers – Elsevier, UK, 2006
3. J. R. Hackworth, F. D. Hackworth Jr- Programmable Logic Controllers: Programming Methods and Applications – Pearson, New Delhi, 2004
4. F. Petruzella – Programmable Logic Controllers – MGH, UK, 2014
5. G. D. Anderson – PLC programming using RSLogix 500: Ladder Logic Diagonistics and Trobleshooting (Vol 1-3)

CF 101

Research Methodology

(01 credits – 50 marks)

Course Outcomes:

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

1	Define research and describe the research process and research methods
2	Estimate qualitative research and methods used to execute and validate qualitative research
3	Relate basic aspects of the research process in order to plan and execute a research project
4	Select a suitable analytical method for a specific research approach
5	Demonstrate a good understanding of how to write a research report
6	Critically assess published quantitative research with regard to the statistical methods and approaches adopted .

Course Contents:

Module- I : Research Fundamentals (04 Hrs)

Introduction: Definition, objectives of the research, characteristics of the research, what makes people to do research, importance of research

Module- II : Identification of Research Problem (04 Hrs)

Defining the research problem: Identification of research problems, selection of research problem, facts one should know regarding selection of research problem, the process of research problem definition, some facts involved in defining research problem

Module- III : Formulation of Research Problem (04 Hrs)

Formulation of the problems: steps involved in defining a problem, formulation of the problems, Formulation of hypothesis: Concept of hypothesis, hypothesis testing, Developing the research plan: implementation, interpreting and reporting the findings, Importance of hypothesis of in decision making.

Module- IV : Research Report and Proposal Writing (04 hrs)

Introduction, research proposal writing: costing, the research proposal, rationale for the study, research objectives, research methodology, target respondents, research Centres, sample size and sample composition, sampling procedures, research project execution, research Modules; An insight into research report and proposal, research project synopsis, research report writing : types of research reports, guidelines for writing reports; Steps in writing report, report presentation, typing the report, documentation and bibliography, formatting guidelines for writing a good research report / research paper.

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

References:

1. Research Methodology by Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd (**2013),** ISBN-10: 8191064278, ISBN-13: 978-8191064278
2. Basic Research Methods-Gerard Guthrie SAGE Publications, India, Pvt Ltd, New Delhi (**2010),** ISBN-10: 8132104579, ISBN-13: 978-8132104575
3. Research Methodology-methods and techniques By C. R. Kothari, New Age International Publishers **(2011)** ISBN 978-81-224-1522-3
4. Principles of Research Methodology- Phyllis G. Supino, Jeffrey S. Borer; Springer, Verlag New York **(2012),** ISBN-ebook: 1461433592, ISBN (Hardcover): 978-1461433590
5. Research Design Qualitative, Quantitative. and Mixed Methods Approaches- John W. Creswell; SAGE Publications Ltd, UK **(2011),** ISBN-9780857023452
6. Research Methodology -A Step-by-Step Guide for Beginners- Ranjit Kumar; Sage Publications Ltd **(2010)**, ISBN- 1849203016.
7. Scientific Writing and Communication- Angelika Hofmann; Oxford University Press, US **(2010),** ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
8. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Joshua Schimel, Oxford University Press, **(2011)**, ISBN: 9780199760237
9. Handbook of Scientific Proposal Writing- A.Yavuz Oruc; CRC Press, Taylor & Francis group **(2011)**, ISBN: 9781439869185

EF 130
Operations Management

(02 credits – 50 marks)

Course Outcomes:

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

1	Define 'operations' and 'operations management'
2	Identify the roles and responsibilities of operations managers in different organizational context.
3	Apply the 'transformation model' to identify the inputs, transformation processes and outputs of an organization
4	Identify operational and administrative processes
5	Describe the boundaries of an operations system, and recognize its interfaces with other Functional areas within the organization and with its external environment

Course Contents:

Module– I:Introduction to Operations Management (06 Hrs)

Introduction to Operation Management, Operations Strategy, Role of Operations Strategy, Importance of Operation strategy, Classification of production system – Job shop, Batch, Mass, Continuous production, Competitive Advantage, Time Based Competition.

Module- II: Product Development Cycle (06 Hrs)

Product Decision and Analysis, Product Development, Process Selection, Process Design, Process Analysis, Process-Product Matrix, Evolution of Production Systems, Batch Sizing-Models-Optimization

Module- III: Layout and Management of Operation (06 Hrs)

Facility Location, Facility Layout, Capacity Planning, Capacity Decisions, Waiting Lines, Demand Management-models, Resource Planning-models, Total Quality Management, Supply Chain Management and Just-in-Time/Lean Operations

Module- IV: Planning and Management **(06 Hrs)**

Aggregate Planning, Basics of MRP / ERP**,** Basics of Scheduling**,** Basics of Project Management, Basics of Work Study, Job Design and Work Measurement**,** Basics of ISO 14000 / 9000, Basics of Value Engineering & Analysis

Module- V:

Presentation's, case studies, Assignments, Tutorials based on Module I to IV

Ref. Books:

1. Production & Operations Management -S. N. Chary
2. Operations Management – S.Anil Kumar, N.Suresh- New age International Publishers
2. Operations Management – Andrew Greasley - SAGE Publications
3. Modern Production Management -By E. S. BUFFA
4. Production and Operations Management -By Norman Gaither
5. Theory and problem in Production and operations Management -By S. N. Chary
6. Production and operation Management - By Chunawalla Patel
7. Production & operation Management – Kanishka Bedi – Oxford
8. Production & operation Management – R.C. Manocha
9. Production & operation Management – Muhlemann

EF-131

Materials Management

(02 credits – 50 marks)

Course Outcome:

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

1	Define Materials and its Management
2	Identify Integrated Approach to Materials Management
3	Understand in International procurement-Imports

Course Contents:

Module– I: Materials Management- an overview (06Hrs)

Introduction, Importance of Materials Management, Objectives of Materials Management, Costs involved in the Management of Materials, Integrated approach to Materials Management, organizing Materials Management, Organization based on Commodities, Organization based on Location, Organization based on function, Inter-departmental relationships, Centralized versus Decentralized materials management.

Module- II: Materials Planning (06Hrs)

Introduction and factors influencing materials planning, Techniques of materials planning, Bill-of-Materials, Materials Requirement Planning (MRP), Past Consumption Analysis Technique, Moving Average method, Exponential Smoothing.

Module- III: Purchasing (06Hrs)

Purchasing principles, policies, procedures and practices, Objectives, scope, responsibility and limitations, Sources of supply and Supplier selection, Vendor development-evaluation and rating, Price forecasting, Price-cost analysis, Negotiations, Reciprocity, Legal aspects of purchasing, Purchase orders/ contracts, Method of buying- under certainty, under risk, and under uncertainty

Module- IV: International procurement-Imports (06 Hrs)

International commercial terms, Import procedures and documentation, Categories of importers, Identification of foreign sources, Payment terms including Letter of credit, Types of L/Cs, Custom tariff, Custom clearance, Bill of Lading and other documents.

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV

Ref.Books:

1. Materials and Logistics Management By Prof. L.C. Jhamb (Everest Publishing House, Pune).
2. Purchasing and Materials Management By P.Gopalkrishnan (Tata McGraw Hill, New Delhi).
3. Materials Management –An integrated approach By P.Gopalkrishnan and M. Sundaresan (Prentice-Hall India, New Delhi).
4. Materials Management-Procedures, Text and Cases By A.K. Datta (Prentice-Hall India, NewDelhi).
5. Introduction to Materials Management By JR Tony Arnold and Stephan Chapman (Pearson Education, New Delhi) 2004 Fifth Edition.
6. Purchasing and Materials Management By N.K.Nair (Vikas Publishing House, New Delhi)

IALC - 140

Electronic Systems Lab

(1.5 credits – 50 marks)

Course Outcomes:

On completion of the course, students should able to –

1	Demonstrate working of different types of amplifiers, timers, counters, oscillators and filters.
2	Illustrate operation of industry standard programmable timer.
3	Apply different amplifiers/ timers/ counters/ oscillators/ filters for real time applications

List of Experiments: (Any 5 experiments are to be performed)

1. Study of Instrumentation amplifier
2. Study of log/antilog amplifier
3. Study of window comparator
4. Study of Phase shift/ Wien bridge oscillator
5. Study of typical monolithic frequency synthesizer
6. Study of voltage controlled oscillator
7. Study of fundamental digital counters
8. Study of industry standard event counter
9. Study of industry standard programmable timer (analog and digital)
10. Study of filters (any one pertinent to theory course)

IALC - 141

Power Electronics Lab

(1.5 credits – 50 marks)

Course Outcomes

On completion of the course, students should able to –

1	Demonstrate working of different types of converter/ inverter and cyclo converter.
2	Illustrate operation of zero voltage switching.
3	Apply different converter/ inverter and cyclo converter for real time applications

List of Experiments: (Any 5 experiments are to be performed)

1. Study of Buck Converter
2. Study of Boost Converter
3. Study of Flyback Converter
4. Study of Forward Converter
5. Study ofsingle phase inverter with R load
6. Study ofsingle phase inverter with RL load
7. Study of PWM converter
8. Study of series inverter
9. Study of parallel inverter
10. Study of zero voltage switching
11. Study of single phase cycloconverter with R load
12. Study of single phase cycloconverter with RL load
13. Study of single phase AC voltage control scheme (any one pertinent to theory course)

IALC - 142

Instrumentation Lab

(1.5 credits – 50 marks)

Course Outcomes

On completion of the course, students should able to –

1	Demonstrate working of different transducers.
2	Illustrate working of optical rotary/ angle encoder for speed / position measurement.
3	Apply different transducers for real time applications.

List of Experiments: (Any 5 experiments are to be performed)

1. Study of Resistive Transducer
2. Study of Inductive Transducer
3. Study of Differential Output Transducer (LVDT)
4. Study of optical rotary encoder for speed measurement
5. Study of optical angle encoder for position measurement
6. Study of Capacitive Transducer
7. Study of RTD
8. Study of Photo Electric Transducer
9. Study of Pressure Cell
10. Study of Piezo Electric Transducer
11. Study of Optical fiber Transducer

IALC - 143

Electric Drives lab

(1.5 credits – 50 marks)

Course Outcomes

On completion of the course, students should able to –

1	Demonstrate working of different comparators.
2	Illustrate working of single/ three phase cycloconverter AC Drive.
3	Apply different single/ three phase PWM/ cycloconverter AC drive for real time applications.

List of Experiments: (Any 5 experiments are to be performed)

1. To study single phase converter using RAMP Comparator
2. To study three phase converter using RAMP Comparator
3. To study operation of single phase cycloconverter AC Drive
4. To study operation of three phase cycloconverter AC Drive
5. To study single phase PWM based AC Drive
6. To study three phase PWM based AC Drive
7. To study thyristors based DC motor drive
8. Study of Industry grade VFD for motor control (ABB/Danfoss/Siemens)

IALF - 150

Embedded Systems Lab

(1.5 credits – 50 marks)

Course Outcomes

On completion of the course, students should able to –

1	Develop algorithms to perform real time operations using microcontroller
3	Apply embedded systemknowledge for real world device interfacing.

List of Experiments:

Every student should build at least 02 individual projects by implementing interface of 8051 with devices pertinent to theory course. Each project should invariably include at least two devices that should demonstrate clear operational correlation.

IALF - 151

PLC Lab

(1.5 credits – 50 marks)

Course Outcomes

On completion of the course, students should able to –

1	Develop miniprojects employing PLCs
3	Apply knowledge PLCs for real world device interfacing and applications.

List of Experiments:(Any 5 experiments are to be performed)

Allen Bradley platform to be employed

1. Develop ladder programming to implement (i)basic logic gates and (ii) sequencing operations employing timers (lamp output)

2. Develop ladder programming to implement counter operation (proximity sensor to be used as event indicator) for triggering an enunciator after a certain batch of count is over
3. Develop ladder programming to operate a conveyor based liquid vending station
4. To study operation of
5. Develop ladder programming to operate a density based traffic light arrangement
6. Develop ladder programming to operate an X-Y plotter
7. Develop ladder programming to address different sequence of operation in a real time batch process unit (should contain at least two liquid tanks as main storage, one mixing tank, stirrer, heater, liquid dispenser, conveyor based handling, liquid level indicators etc.).
8. Develop program for at least two real time industrial processes with ITS – PLC virtual platform

SEMESTER – II

IAC – 210

Communication Protocols for Instrumentation

(02 credits – 50 marks)

Course Outcomes:

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

1	Identify the issues and challenges in the architecture of computer network
2	Explain the concept of communication model, OSI reference model, Recent Industry Networks.
3	Classify the Network selection applicable for specific industrial needs.
4	Differentiate the Network Architecture and describe the concepts of Industrial protocols.
5	Classify and Compare various Wireless Networking protocols

Course Contents:

Module-I: Introduction and Communication Protocols (06 Hrs)

An Introduction to Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Introduction to Communication Protocols: Communication basics, Network Classification, Device Networks, Control Networks.

Module-II: Network Architectures (06 Hrs)

Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols (RS-232C, RS- 422, and RS-485), Ethernet, Advantages and Limitations of Open networks, IEEE 1394

Module-III: Field Bus (06 Hrs)

Field bus: Field bus Trends, Hardware selection, Field bus design, Installation, Documentation, Field bus advantages and limitations. HART: Introduction, Design, Installation, calibration, commissioning.

Module-IV:Planning and Commissioning (06 Hrs)

Foundation Field bus & Profibus: Introduction, Design, Calibration, Commissioning, Application in Hazardous and Non-Hazardous area. Introduction to wireless Protocols: WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave.

Module-V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. B.G. Liptak - Process Software and Digital Networks - CRC Press ISA-, 2002.
2. R. Bowden - HART Communications Protocol-Fisher-Rosemount, 2003.
3. A.S. Tanenbaum -Computer Networks - Pearson Education, 1996/PHI.
4. K. Kant – Computer based Process Control – New Age International, 1998

IAC - 211

Mechatronics

(02 credits – 50 marks)

Course Outcomes:

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

1	Define and Classify mechatronics system.
2	Classify and Compare different types of Transducers.
3	Define various performance terminologies in Sensors.
4	Explain different types of actuators used in mechatronics
5	Analyze various types of sensors and selection procedure for various applications.
6	Design the real time application of Mechatronics based System.

Course Contents:

Module– I: Introduction (06 Hrs)

Introduction to Mechatronics; Mechatronics Systems, Need for Mechatronics, Emerging area of Mechatronics, Classification of Mechatronics, Measurement Systems, Control Systems.

Module– II: Sensors and Transducers (06 Hrs)

Performance Terminology in sensor technology; Potentiometers, LVDT, Capacitance sensors, Strain gauges, Eddy current sensor, Hall Effect sensor, Temperature sensors, Light sensors, Selection of sensors, Signal processing.

Module– III: Actuators (06 hrs)

Actuators: Mechanical, Electrical, Fluid Power, Piezoelectric, Magnetostrictive, Shape memory alloy, applications, selection of actuators.

Module– IV: Design and Mechatronics Case Studies (06 Hrs)

Stages in mechatronics system design, Traditional and Mechatronics design concepts, Case studies of Mechatronics systems - Pick and place Robot, Conveyor based material handling system, PC based CNC drilling machine, Mechatronics Control in Automated Manufacturing

Module-V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. Bolton.W – Mechatronics - Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F - Mechatronics integrated technologies for intelligent machines - Oxford university press, 2008.
3. Devadas Shetty and Richard A.Kolk, - Mechatronics systems design - PWS Publishing Company, 2007.
4. Godfrey C. Onwubolu - Mechatronics Principles and Applications - Elsevier, 2006.
5. Nitaigour Premchand Mahalik -Mechatronics Principles, Concepts and Applications - Tata
6. McGraw-Hill Publishing Company Limited, 2003.
7. Michael B.Histand and Davis G. Alciatore - Introduction to Mechatronics and Measurement
8. Systems - McGraw Hill International edition, 1999.
9. Bradley D.A, Dawson.D, Buru N.C and Loader A.J – Mechatronics - Nelson Thornes Ltd, Eswar press, Indian print, 2004.

IAC - 212

Advanced Transducers

(02 credits – 50 marks)

Course Outcomes:

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

1	Discuss calibration protocol for test various types of sensors
2	Explain different types of errors in Sensor Systems.
3	Classify different types of Flow sensors based on flow measurements.
4	Identify techniques to measure viscosity and density
6	Discuss on different types of sensors in robotics

Course Contents:

Module– I: Testing, Calibration and Error (06 Hrs)

Testing and calibration: Traceability. Measurement reliability. Calibration experiment and evaluation of results. Primary calibration. Secondary calibration. Direct calibration. Indirect calibration. Routine calibration. Calibration of a voltmeter, ammeter and an oscilloscope.Measurement Errors. Human Error. Systematic Error. Limiting and Random Errors.

Module– II: Flow Sensors (06 Hrs)

Flow measurement: Introduction, definitions and Modules, classification of flow meters, Pitot tubes, orifice meters, venturi tubes, flow tubes, flow nozzles, positive displacement liquid meters and provers, positive displaceTesting and calibration ment gas flowmeters, variable area meters Positive displacement type: Piston; oval gear, nutating disk and rotary vane types,Velocity meters: turbine, vortex shedding, electromagnetic and sonic design; head type flow meter, electromagnetic flow meter, rotameter, anemometer, ultrasonic flow meter

Module– III: Viscosity Sensors (06 Hrs)

Measurement of viscosity: definition, Modules, Newtonian and Non-Newtonian behavior, Measurement of viscosity using laboratory viscometer, industrial viscometers,viscometer selection and application.

Measurement of density – definitions, Modules, liquid density measurement, gas densitometers – application and selection.

Module– II: Smart Sensors and Sensors in Robotics (06 Hrs)

Smart Sensors: Methods of internal compensation, information coding, integrated sensor principles, present trends Sensors in Robotics: Potentiometers, synchros and resolvers, optical encoder, tactile and proximity sensors, non-contact ranging sensors, ultrasonic transducers, opto-electronic sensors, geomagnetic sensors, gyroscopes; Different type of load cells and its application, Torque measurement.

Module- V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. A K Ghosh: Introduction to Instrumentation and Control, Prentice Hall of India, New Delhi 2004.
2. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat Raj & Co, 2005
3. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill, New Delhi 2004
4. John P.Bentley: Principles of measurement systems, 3rd edition, Addison Wesley Longman, 2000.
5. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
6. M.M.S.Anand: Electronic instruments and instrumentation Technology, Prentice-Hall of India,2004.
7. Alan S.Morris: Principles of measurement and instrumentation, 2nd edition, Prentice-Hall of India,2004.
8. Ernest O. Doebelin: Measurement systems, 4th edition, Tata-McGraw Hill, 1990.
9. H.S.Kalsi-Electronic Instrumentation,3rd edition,2011

IAF - 220

Robotics

(02 credits – 50 marks)

Course Outcomes:

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

1	Classify Robots in different categories.
2	Explain robot kinematics and dynamics.
3	Analyze forward and reverse kinematics
4	Summarize path planning by a Robot.
5	Describe robot manipulator.
6	Program Robot for various applications

Course Contents:

Module– I: Introduction (06 Hrs)

Specifications of Robots, Classifications of robots, Laws of Robotics, Flexible automation versus Robotic technology, Applications of Robots

Module– II: Robot Kinematics And Dynamics (06 Hrs)

Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations, Transformation Arithmetic, D-H Representation, Forward and inverse Kinematics, Robot Arm dynamics

Module- III: Manipulators (06 Hrs)

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators, Classification of End effectors (Tools as end effectors), Drive system for grippers(Mechanical, adhesive, vacuum, magnetic, grippers), Hooks & scoops, Gripper force analysis and gripper design, Active and passive grippers.

Module- IV: Path Planning &Programming (06 Hrs)

Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion, straight line motion, Robot Programming

Module-V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. S. R. Deb and S. Deb, ‘Robotics Technology and Flexible Automation’, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J.Craig , “Introduction to Robotics”, Pearson, 2009.
3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
4. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
5. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987

IAF - 221

Process Control

(02 credits – 50 marks)

Course Outcomes:

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

1	Define Process Modeling Fundamentals.
2	Describe various modeling techniques of process control
3	Explain the Characteristics of Controller.
4	Summarize Control System configurations.
5	Describe Control systems with multiple loops.
6	Analyze Different Process loop and tuning techniques.

Course Contents:

Module– I: Modelling of processes (08 Hrs)

Need for Process Control, Mathematical model of first order liquid and thermal processes, Processes with dead time, Processes with inverse response, Interacting and non-interacting systems, Continuous and batch processes, Servo and regulator operation

Module– II:Controller Characteristics (05 Hrs)

Basic control action, Characteristics of ON-OFF, Proportional, Integral and Derivative Control Modes, Composite Control Modes, Electronic controllers to realize various control actions

Module– III: Control Systems with Multiple Loops (07 Hrs)

Control system configurations; Cascade control, Feed forward control, Ratio Control, Selective Control system; Split Range Control, Adaptive and Inferential Control,

Module– IV: Process Loop tuning (06 Hrs)

Evaluation criteria in control systems Quality, IAE, ISE, ITAE and ¼ decay ratio,; Process loop tuning- Open loop transient Response method, Ziegler – Nichols method, Cohencoon method, Damped oscillations method

Module-V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. D. P. Eckman – Automatic Process Control – Wiley Eastern Ltd., New Delhi, 1993
2. G. Stephanopoulis – Chemical Process Control- PHI, New Delhi, 1990
3. B. G. Liptak – Process Control – Chilton Book Company, 1994
4. C. D. Johnson – Process Control Instrumentation Technology – 7^{th} edition, Pearson Education, New Delhi, 2002
5. J. G. Balchen, K. J. Mumme – Process Control Structures and Application – Van Nostrand Reinhold Co., New York, 1988

IAF - 222

Industrial Automation

(02 credits – 50 marks)

Course Outcomes:

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

1	Explain the requirements of modern day industries.
2	Classify the different types of automated techniques used.
3	Describe high volume manufacturing automation.
4	Explain various flexible manufacturing concepts.
5	Summarize Assembly Automation.
6	Analyze Performance evaluation and economics of assembly systems.

Course Contents:

Module– I: Introduction (06 Hrs)

Automated production system, Mechanization and automation, Types of automation, Automation strategies, Economics of automation, Review of actuation devices used in automated systems

Module– II: High Volume Manufacturing Automation (06 Hrs)

Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines.

Module– III: Flexible Manufacturing Concepts (04 Hrs)

Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system.

Module– IV: Flexible Manufacturing Automation (08 Hrs)

Assembly Automation: Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, AS/RS, Performance evaluation and economics of assembly systems.

Module-V:

Presentations, case studies, Assignments, Tutorials based on Module I to IV.

Ref. Books:

1. M. P. Groover- Automation, Production System & Computer Integrated Manufacturing -PHI, New Delhi, 2001
2. Malov and Ivanov - Principles of Automation & Automated Production Process - Mir Publications, Moscow
3. Oates and Georgy - Automation in Production Engineering - Newness Publications
4. Buzacott& Shanty Kumar - Stochastic Models of Manufacturing Systems – PHI, New Delhi
5. W. Bolton – Mechatronics – Pearson Education, 1999
6. J. Boothroyd, P. Dewhurst, W. A. Knight – Product Design for Manufacture and assembly –CRC press, 2011

IALC - 230

Industrial Networking Lab

(1.5 credits – 50 marks)

Course Outcomes:

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

1	Identify necessary protocol for a particular application
2	Interface real time devices to microprocessors/ computers using standard protocols
3	Design a simple fieldbus/profibus network

List of Experiments: (Any 4 protocols are to be studied)

1. Study of 7 Layer OSI reference model
2. Study of Industry open protocol – RS 232
3. Study of IEEE 1394 protocol
4. Study of Bluetooth Technology
5. Study of Zigbee Technology
6. Study of Ethernet protocol
7. Study of Fieldbus Protocol
8. Study of profibus protocol

IALC - 231

Mechatronics Lab

(1.5 credits – 50 marks)

Learning Outcomes:

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

1	Illustrate different supplementary operations of sensors and actuators in combination
2	Design simple mechatronics systems pertinent to real life operations

List of Experiments: (Any 5 experiments are to be performed)

1. Study of LVDT as displacement Sensor
2. Study of Strain Gauge as analog/digital balance
3. Study of Hall effect sensor as an event counter
4. Study of Stepper Motor
5. Study of BLDC
6. Study of Spring Mass system
7. Study of Hydraulic/Pneumatic Cylinders
8. Study of Hydraulic/Pneumatic Motors
9. Study of PC based CNC Drill Machine
10. Study of Automatic door closing and opening arrangement (PLC/PC/microcontroller based)
11. Study of user defined 2/3 floor elevator module (PLC/PC/microcontroller based)

IALC - 232

Instrumentation Lab-II

(1.5 credits – 50 marks)

Course Outcomes:

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

1	Illustrate concept of calibration of sensors
2	Apply industry grade sensors for various measurements

List of Experiments: (Any 5 experiments are to be performed)

1. Study of Calibration of Bourdon Gauge using dead weight tester
2. Determination of discharge coefficient using Orifice Meter
3. Study of Calibration of Rota-meter
4. Study and calibration of Differential pressure transmitter
5. Study of water level measurement by Capacitive method/ Bubble purge method/ Contact method
6. Instrumentation tutor for Flow meter calibration.
7. Measurement of viscosity.
8. Measurement of temperature by using Thermocouple.
9. Study of water and air flow meter
10. Study of optical encoder
11. Study of Ultrasonic transducer.
12. Study of Differential flow measurement

IALF - 240

Robotics Lab

(1.5 credits – 50 marks)

Course Outcomes:

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

1	Identify components of a robot
2	Describe different links and joints used in robots
3	Perform basic programming for simple operations with different robotic platforms

List of Experiments: (Any 5 experiments are to be performed)

1. Study of components of robots with drive system and end effectors
2. Study of different types of robots based on configuration and application
3. Study of different type of links and joints used in robots
4. Programming exercises with moving Robotic arm platform for sorting/ batching/ stacking applications
5. Robot Programming exercises for line following and obstacle avoiding applications
6. Robot programming exercises for Pick and place operation on same plane
7. Robot programming exercises for Pick and place operation on orthogonal plane

IALF - 241

Process Control Lab

(1.5 credits – 50 marks)

Course Outcomes:

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

1	Illustrate closed loop operations
2	Tune a PID controller installed in real time systems
3	Illustrate cascade control system

List Of Experiments: (Any 5 experiments are to be performed)

1. Study of interacting and non-interacting system.
2. Response of different order processes with and without transportation lag

3. Response of P+I+D Controller
4. Study of Closed loop response of flow control loop
5. Study of Closed loop response of level control loop
6. Study of Closed loop response of temperature control loop
7. Study of Closed loop response of pressure control loop
8. Tuning of PID Controller
9. Response of Cascade Control System

IALF - 242

Industrial Automation Lab

(1.5 credits – 50 marks)

Course Outcomes:

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

1	Illustrate concept of Automation in manufacturing through a modular FMS platform
2	Identify components of a modular FMS platform
3	Operate independent elements of the modular FMS platform
4	Develop PLC (Allen Bradley) based programs for performing automated steps in a modular FMS platforms

List Of Experiments: (Any 3 experiments are to be performed with expt. 7 as compulsory)

1. Study of Conveyor based material handling
2. Study of pick and place operation
3. Study of gravity based feed station
4. Study of linear transfer mechanism
5. Study of Rotary Indexing Platform
6. Study of AS/RS System
7. Study of a Modular FMS System

IAR – 250

Research/Industrial Project (Phase-I)

(5 credits – 100 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 should 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

(iv) and finally, draft a systematic experimental plan to achieve projected goal

(v) deliver regular presentations

(vi) 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/herself

SEMESTER – III

IAGE – 310

Industrial Processes and Instrumentation

(02 credits – 50 marks)

Course Outcomes:

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

1	Interpret type of controller that can be used for specific problems in chemical industry
2	Design of controllers for interacting multivariable systems
3	Work with controller tunning
4	Ability to design feed forward anf cascade control system
5	Predict multivariable system

Course Contents:

Module-I : Process characteristics (07 Hrs)

Incentives for process control, Process Variables types and selection criteria,, Process degree of freedom, Characteristics of physical System, Elements of Process Dynamics, Types of processes- Dead time, Single /multicapacity, self-Regulating /non self regulating, Interacting /noninteracting, Linear/non linear, and Selection of control action for them. Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts

Module-II : Performance of Feedback Control system (06 Hrs)

Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control. Controller tuning based on stability Control Performance via closed loop frequency Response, Control system factors influencing control Performance

Module-III : MultiLoop & Nonlinear Systems (07 Hrs)

Cascade control, Feed forward control, feedback-feedforward control, Ratio control, Selective Control , Split range control- Basic principles, Design Criteria , Performance, Controller Algorithm and Tuning, Examples and any special features of the individual loop and industrial applications. Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance,

Module-IV : Automation Multivariable Control (07 Hrs)

Concept of Multivariable Control: Interactions and its effects, Modelling and transfer functions, Influence of Interaction o the possibility of feedback control, important effects on Multivariable system behavior Relative Gain Array, effect of Interaction on stability and Multiloop Control system. Multiloop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.

Module-V : Tutorials, assignments and presentation based on Module I to IV

References:

1. S Donald Eckman – Automatic Process Control, Wiley Eastern Limited
2. Thomas E Marlin - Process Control- Designing processes and Control Systems for Dynamic Performance, McGraw-Hill International Editions
3. Process control Systems-F.G.Shinskey,TMH
4. Computer Based Industrial Control –Krishna Kant, PHI
5. Process Instrumentation and control Handbook –Considine
6. Fuzzy Logic with Engineering Applications, T.J.Ross

IAGE-311: SCADA System and Applications

(2 Credits: 50 Marks)

Course Outcomes:

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

1	State the basic features of SCADA, HMI
2	Develop architecture of SCADA and explain the importance of SCADA in critical infrastructure.
3	Analyze the theory and applications of SCADA
4	Develop projects with SCADA and HMI
5	Implementation of SCADA application.

Course Contents:

MODULE – I : SCADA System (08 Hrs)

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture),

SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution), Petroleum Refining Process, Water Purification System, Chemical Plant

MODULE – II : SCADA Protocols (07 Hrs)

Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Interfacing of SCADA with PLC

Module – IV: Project Development and HMI (08 Hrs)

Project Development: Creating Project , Screens project Configuration, Device Settings, Communication Configuration and Defining Tags

Graphic Control: Planning Graphic Design, Screen Preparation and Navigation Control, Graphic Elements and Libraries and Linking Objects with Tags

Other HMI Features: Tag Logging, On Line and Historical Trending, Alarm System – Designing and Handling and Recipes- Designing and Handling, User Administration and Transferring Project to HMI

MODULE – III : Various Case Studies on SCADA Applications (07 Hrs)

Case Study on Controlling Electrical Power System Network, Manufacturing Industries and Waste Water Treatment and Distribution Plants

Module V: Tutorials, assignments and presentation based on Module I to IV

References:

1. Ronald L. Krutz, "Securing SCADA System", Wiley Publications.
2. Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition 4. Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols", ELSEVIER
3. Scada: Supervisory Control And Data Acquisition 4th Edition by Author Stuart A. Boyer ISBN-13: 978-1936007097 ISBN-10: 1936007096
4. A Guide to Utility Automation: Amr, Scada, and: it Systems for Electric PowerPaperback – Import, 15 Jan 1999 by Author Michael Wiebe
5. Power System SCADA and Smart Grids 1st Edition by Mini S. Thomas (Author), John Douglas McDonald (Author) ISBN-13: 978-1482226744 ISBN-10: 148222674X
6. Behrouz A. Forouzan 2005, Data Communications Networking, McGraw-Hill Education [ISBN: 9780071254427]
7. David Bailey 2003, PRACTICAL SCADA FOR INDUSTRY, NEWNES [ISBN: 13: 978-0-7506-5805-8]

IAGE - 312

Applied Hydraulics and Pneumatics

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Recall the basic concepts of in hydraulic systems and fluidics and hydropneumatics
2	Describe function of hydraulic system, servo systems, torque motors, Bistable flip flop, turbulence amplifier, Pneumatic controls,
3	Illustrate area of applications of a Hydraulic transmission, fluidics and pneumatic circuit
4	Analyze the designing aspects of hydraulic system and pneumatic system
5	Discriminate hydropneumatics, hydraulic and hydropneumatc system, Types of transmission
6	Design and construct rehydraulic circuit with servo valve, hydraulic circuit with proportional valve, pneumatic sequencing circuit, pneumatic circuit with quick exhaust valve, pneumatic circuit with time delay valve, pneumatic speed control circuit, Hydraulic regenerative circuit

Course Contents:

Module-I : Hydraulic Servo Techniques and Hydrokinetics (07 HRS)

Overview of function of hydraulic system, Mechanical feedback and application of tracer valve, Feedbeck in the system, Electro-hydraulic servo systems, Torque Motors, Types of Servo valves, Special valve features, Terminologies in servo technology. Types of transmission, pump-motor combination, Applications of Hydraulic transmission

Module-II : Design of Hydraulic Systems (06 HRS)

Hydraulic circuits, Manual and automatic hydraulic systems, Regenerative ckt., use of check valves, selection of pump, Circuit Diagram standards, basic circuits functional diagram, application of functional diagram, electrical control of hydraulic systems

Module-III : Fluidics and Hydropneumatics (07 HRS)

Introduction to fluidics, Bistable flip flop, turbulence amplifier, low pressure, pneumatics sensors, application of fluidics/ low pressure pneumatics as sensors proportional devices, Hydropneumatics systems, hydraulic check Modules, hydropneumatic cylinder , parallel check Module, integral air-oil, cylinder, types of feed, intensities, comparision of hydropneumatics, hydraulic and hydropneumatc system.

Module-IV : Automation and Principle of Pneumatic circuit design (07 HRS)

Pneumatic controls, Functional diagram in pneumatic circuit design, Movement diagram, Cascade system in pneumatic circuit design, Logics in pneumatic circuit design, Logics and Boolean algebra. Demorgam's theorem of inversion. Examples of control equation , use of K-V map for pneumatic circuit design, K-V diagram, Control problem

Module-V : Tutorials, assignments and presentation based on Module I to IV

References:

1. S. R. Majumdar – Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill Education Pvt. Ltd., ISBN – 0-07-463-748-7
2. W. Bolton – Pneumatic and Hydraulic Systems, Butterworth Heinemann, ISBN – 0-07-506-383-62
3. A. Parr – Hydraulics and Pneumatics: A Technician‘s and Engineer‘s Guide, Butterworth Heinemann, ISBN – 0-08-096-674-8
4. S R Majumdar; 2006 (Sixteenth Reprint); Pneumatic Systems (Principal and maintenance); Tata McGraw - Hill Publishing Company Limited; ISBN 0-07-460231-
5. P. Joji; 2008; Pneumatic Controls; Willey India Pvt. Ltd., ISBN 978-81-265-1542-4
6. Antony Barber; 1997 (Eighth Ed.); Pneumatic Handbook; Elsevier Science Ltd.; ISBN 978-81-265
7. Andrew Parr; 2011 (Third Ed.); Hydraulics and Pneumatics-A Technician's and Engineer's Guide; Elsevier Ltd. (Butterwoth-Heinemann); ISBN-13: 978-0-08-0966748

IAGE - 313

Industrial Robotics

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Recall the fundamental aspects of automation and robotics
2	Discuss brief history of robotics, robotics market and future prospectus
3	Use the robots in various manufacturing processes
4	Explain the safety training and maintenance and quality improvement aspects; social issues and future of robotics
5	Reframe the robot programming
6	Develop simple programs to define pre-coordinated trajectory of robots, for pick and place operation with a six axis industrial robot, for stacking operation with a six axis industrial robot

Course Contents:

Module- I: Fundamentals of Robotics (04 Hrs)

Introduction, Automation and Robotics, A brief History of Robotics, Robotics Market and the Future Prospectus

Module- II: Robot Programming (07 Hrs)

Methods of Robot Programming, Lead through Programming Methods, Robot Program as path in space, Motion Interpolation, WAIT Signal and Delay Commands, Capabilities and Limitations of Lead through Methods; Robot Languages: Textual Robotic Languages, Generations of Robotic Programming Languages, Robot Language Structure, Motion Commands, Program Control and Subroutines, Monitor Mode Commands

Module- III: Robot Applications in Manufacturing (07 Hrs)

Material Transfer and Machine Loading/Unloading, Processing Operation: spot welding, arc welding, spray coating, other processing operation using Robotics, Assembly and Inspection: Assembly and Robotic Assembly Operation, Inspection Automation

Module- IV: Implementation Principles and Issues of Robotics (06 Hrs)

Implementation of Robotics; Safety Training and Maintainence and Quality Improvement; Social Issues and Future of Robotics

Module- V: Tutorials, assignments and presentation based on Module I to IV

Reference:

1. Industrial Robotics-Technology Programming and Applications by Mikell P Groover, Mitchell Weiss, Nagel and Odrey ISBN-13:978-0-07-026509-7 ISBN- 10: 0-07-026509-7
2. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
3. 3. P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995.
4. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
5. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.
6. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press. 2003.
7. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
8. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999
9. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishing company limited, 1994

IAGE – 314

Advanced Sensor Technology

(02 credits – 50 marks)

Course Outcomes:

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

1	Describe basic characteristics of measurement system
2	Discuss elements of motion and dimensional measurements
3	Explain working of basic force and torque measurement
4	Explain working of advanced temperature transducers

Course Contents:

Module-I : Characteristics Of Measurement Systems (07 Hrs)

Static characteristics - Dynamic characteristics - Mathematical model of transducer - Zero, I and II order transducers. Response to impulse, step, ramp and sinusoidal inputs. Simulation using MATLAB.

Module-II : Motion and Dimensional measurement (06 Hrs)

Fundamental standards, relative displacements- translational and rotational, Calibration, Resistive potentiometers, differential transformers, variable inductance & variable reluctance pickups, capacitance pickup, Digital displacement transducers, Mechanical fly ball angular velocity sensor, Mechanical revolution counters and timers, tachometer encoder methods, stroboscopic method, translational velocity transducer, eddy current Drag-cup tachometer, velocity sensors.

Module-III : Force, Torque, Shaft power (07 Hrs)

Standards & calibration; basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, Piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).

Module-IV : Temperature measurement (07 Hrs)

Standards & calibration; thermal expansion methodsbimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; RTD, thermister and thermocouple (comparative study); digital thermometers. Radiation Methods – radiation fundamentals, radiation detectors: thermal

and photon, monochromatic brightness radiation thermometers, two color radiation thermometers, black body tipped fiber optic radiation thermometer, Fluor optic temperature measurement, infrared imaging systems.

Module-V : Tutorials, assignments and presentation based on Module I to IV

References:

1. S E.A. Doebelin, „Measurement Systems – Applications and Design", Tata Mc Graw Hill, New York, 2012
2. John P. Bentley, „Principles of Measurement Systems", 4th Edition,Pearson Education, 2005.
3. S. Ranganathan, „Transducer Engineering", Allied Publishers Pvt. Ltd.,2003.
4. D.V.S. Murthy, „Transducers and Instrumentation", Prentice Hall of India, 2011.
5. D.Patranabis, „Sensors and Transducers", Prentice Hall of India, 2004

IAGE - 315

Kinetics and Dynamics of Robotics

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Recall the fundamental aspects of automation and robotics
2	Discuss various co-ordinate systems
3	Use the robots in various manufacturing processes
4	Explain the kinematic and Dynamic model
5	Model the Robot
6	Develop programs for pick and place operation with a six axis industrial robot, for stacking operation with a six axis industrial robot and for other industrial applications

Course Contents:

Module- I: Coordinate Frames, Mapping and Transformation of Robots (04 Hrs)

Introduction, Anantomy of Robot in brief, Co-ordinate frames: mapping ; transformation of vectors: rotation, translation and combined; Fundamentals of Rotational Matrices: principal axis rotation, fixed angle, Euler angle.

Module- II: Symbolic Modelling of Robots- Direct Kinematic Models (07 Hrs)

Mechanical Structure and Notations, Description of links and joints, Kinematic modeling of the Manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent joints, manipulator transformation matrix.

Module- III: Inverse Kinematics (05 Hrs)

Manipulator Workspace, Solvability of Inverse Kinematic Model, Solution Techniques, Closed Form Solution

Module- IV: Dynamic modeling of Robotics (06 Hrs)

Lagrangian Mechanics, Two degree of freedom manipulator-Dynamic Model, Lagrange-Euler Formulation, Newton-Euler Formulation, Comparision of Lagrange-Euler and Newton-Euler Formulation, Inverse Dynamics

Module- V: Tutorials, assignments and presentation based on Module I to IV

References:

1. Robotics: Control Sensing. Vis. By K S Fu,Ralph Gonzalez,C S G Lee Tata McGraw-Hill Education, 2008, ISBN-978-0-07-026510-3, ISBN: 0-07-026510-0
2. Industrial Robotics-Technology Programming and Applications by Mikell P Groover, Mitchell Weiss, Nagel and Odrey ISBN-13:978-0-07-026509-7 ISBN- 10: 0-07-026509-7
3. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
4. 3. P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995.
5. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
6. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.
7. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press. 2003.
8. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
9. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999
10. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishing company limited, 1994

IAGE 316: Mechatronics System Design

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the course, students should able to –

1	Explain various mechanical elements of mechatronics
2	Discuss elements of mechatronics process design
3	Explain advance control mechanisms in mechatronics

Course Contents:

Module - I: Introduction **(05 Hrs)**

Introduction to mechatronics systems. Basic building blocks of mechatronic systems. Mechatronics key elements, Mechatronics in industry automation, Scope of Mechatronics. Advantages of Mechatronics

Module - II: Machines in Mechatronics **(07 Hrs)**

Physical translation and rotational systems, Fluid systems, guideways, Mechanism used in mechatronics (High resolution scanning mechanisms, Indexing mechanisms), Assembly techniques, Hydraulic and pneumatic actuators, microactuators. Piezoelectric actuators

Module - III: Mechatronics Design Process **(07 Hrs)**

Generalized Mechatronics Design Process: Recognition of the Need, Conceptual Design and Functional Specification, First principle Modular Mathematical Modeling, Sensor and Actuator Selection, Drivers for Actuators, Detailed Modular Mathematical Modeling, Control System Design, Design Optimization, Prototyping Hardware-in-the-loop Simulation, Deployment/Life Cycle, Deployment of Embedded Software, Life Cycle Optimization.

Module -IV: Advance Approaches in Mechatronics **(05 Hrs)**

Advance Approaches in Mechatronics: Servo control, Process Control, Supervisory Control, Shop Floor Control, Plant Control.

Module – V: Tutorials, assignments and presentation based on Module I to IV

References

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc.
2. Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press.
3. Mechatronics System Design , Shetty and Kolk CENGAGE Learning, India Edition
4. Introduction to Mechatronics and Measurement Systems , Alciatore and Histand Tata McGraw-Hill
5. Mechatronics, Necsulescu, Pearson education.
6. Mechatronics - Electromechanics and Control Mechanics , Mill Springer-Verlag
7. Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton Pearson
8. Mechatronics - Electronics in products and processes , Bradley, et al.
Chapman and Hall
9. Mechatronics - Mechanical System Interfacing , Auslander and Kempf, Prentice Hall
10. Introduction to Mechatronics, Appu Kuttan K.K., OXFORD Higher Education

IAGE - 317

Distributed Control System

(Process Automation)

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Recall basics of automation , PLC, DSC and SCADA
2	Classify and compare types of plant and control, PLC and SCADA
3	Illustrate Control system architecture, Architecture and working of PLC, DCS architecture and specifications
4	Analyze the various systems of SCADA
5	Summarize advanced PLC instructions, integration of PLC and computer, integration of DCs and computer
6	Program DCS for control of remote process

Course Contents:

Module- 1: Automation Fundamentals (07 Hrs)

Automation and its importance, automation applications, expectations of automation, Types of plant and control – categories in industry, open loop and close loop control functions, continuous processes, discrete processes, and mixed processes. Automation hierarchy – large control system hierarchy, data quantity & quality and hierarchical control. Control system architecture – evolution and current trends, comparison of different architectures.

Module -II: Programmable Logic Controller (07 Hrs)

Hardware Evolution of PLC, Definition, functions of PLC, Advantages, Architecture, working of PLC, Scan time, Types & Specifications. DI-DO-AI-AO examples and ratings, I/O modules, local and remote I/O expansion, special purpose modules, wiring diagrams of different I/O modules, communication modules, Memory & addressingmemory organization (system memory and application memory), I/O addressing, hardware to software interface. Software-Development of Relay Logic Ladder Diagram, introduction to PLC Programming, programming devices, IEC standard PLC programming languages, LD programming- basic LD instructions, PLC Timers and Counters: Types and examples, data transfer & program control instructions, advanced PLC instructions, PID Control using PLC.

Module -III: Distributed Control System (07 Hrs)

Introduction to DCS – Evolution of DCS, DCS flow sheet symbols, architecture of DCS – controller, Input and output modules, communication module, data highway, local I/O bus, workstations, specifications of DCS. Introduction to Hierarchical Control and memory: Task listing, Higher & Lower Computer level tasks. Supervisory computer tasks and DCS configuration –Supervisory Computer functions, Control techniques, Supervisory Control Algorithm, DCS & Supervisory Computer displays, advanced control Strategies, Computer interface with DCS. DCS – system integration with PLCs and computer: Man machine interface-sequencing, supervisory control, and integration with PLC, personal computers and direct I/O, serial linkages, network linkages, links between networks.

Module- IV: SCADA (07 Hrs)

SCADA introduction, brief history of SCADA, elements of SCADA. Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Protocol Detail SCADA as a real time system, Communications in SCADAtypes & methods used, components, Protocol structure and Mediums used for communications, SCADA Development for any one typical application

(Additional module : Safety Instrumented System (SIS) Need for safety instrumentation- risk and risk reduction methods, hazards analysis. Process control systems and SIS. Safety Integrity Levels (SIL) and availability. Introduction to the international functional safety standard IEC61508.)

Module-V: Tutorials, assignments and presentation based on Module I to IV

Reference:

1. Samuel M. Herb, “Understanding Distributed Processor Systems for Control”, ISA Publication.
2. Thomas Hughes, “Programmable Logic Controller”, ISA Publication.
3. Stuart A. Boyer, “SCADA supervisory control and data acquisition”, ISA Publication.
4. Poppovik Bhatkar, “Distributed Computer Control for Industrial Automation”, Dekkar Publication.
5. S.K.Singh, “Computer Aided Process Control”, Prentice Hall of India.
6. Krishna Kant, “Computer Based Process Control”, Prentice Hall of India
7. N.E. Battikha, “The Management of Control System: Justification and Technical Auditing”, ISA.
8. Gary Dunning, “Introduction to Programmable Logic controller”, Thomas Learning, edition, 2001.

IAGE-318: Advanced Electrical Drives

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the course, students should able to –

1	Understand the various drive mechanisms and methods for energy conservation.
2	Apply power electronic converters to control the speed of DC motors and induction motors.
3	Evaluate the motor and power converter for a specific application.
4	Develop closed loop control strategies of drives.

Course Contents:

Module -I: Electrical Drives- An Introduction (5 Hrs)

Introduction to electric drives: Electrical Drives, Advantages of Electric drives, Parts of Electrical Drives, Electric Motors, Power Modulators, Sources, Control Module, Choice of Electric Drives and Losses.

Module –II: Dynamics of electrical drives (7 Hrs)

Dynamics of electrical drives: Fundamental torque equation, components of load torque, load characteristics, modified torque equation, speed-torque convention & multi-quadrant operation. Equivalent values of drive parameters, load with rotational motion, loads with translational motion, measurement of moment of inertia, components of load torques, Nature and classification of load torque. Calculation of time and energy loss in transient operation, steady state stability, loads equalization.

Module -III: Control of electrical drives (6 Hrs)

Control of electrical drives: Modes of operation, speed control and drive classifications, closed loop control of drives. DC Motor Drives: Starting, Braking, Speed control of DC motors using single phase fully controlled and half controlled rectifiers. Three phases fully controlled and half controlled converter fed DC motor drives. Chopper controlled DC drives.

Module – IV: Induction Motor Drives (7 Hrs)

Induction Motor Drives: Speed control using pole changing, stator voltage control, AC voltage controllers. Variable frequency and variable voltage control from inverter. Different types of braking, dynamic, regenerative and plugging.

Energy Conservation in Electric Drives: Losses in Electric drive systems, measurement of Energy conservation in Electric drives. Use of efficient converters, energy efficient operation of drives, Improvement of p.f., improvement of quality of supply, maintenance of motors

Module – V: Tutorials, assignments and presentation based on Module I to IV

References:

1. Vedam Subramanyam: Electric Drives Concepts & Applications –Tata McGraw Hill Edn. Pvt.Ltd, Second edition 2011

2. Gopal K Dubey; 2001; Fundamentals of Electrical Drives (SECOND EDITION); Narosa Publishing House; New Delhi (India)

3. Nisit K.De and Prashanta K.Sen: Electric Drives, PHI., 2001

4. V. Subrahmanyam: Thyristor Control of Electric Drives, Tata McGraw Hill Edn. Pvt.Ltd, 2010.
5. Werner Leonhard: Control of Electric Drives, Springer international edition 2001
6. Nisit K.De and Swapan K.Dutta: Electric Machines and Electric Drives, PHI learning Pvt. Ltd 2011.

IAGE – 319
Advanced Microcontrollers

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1	State configuration of ARM Microcontroller, Registers, addressing modes, interfacing methods, ISR, Timing generations and measurements
2	Classify Data types , Thumb instructions used in programming,
3	Illustrate ARM architecture and architectural support for system development & operating system
4	Explain implementation of ARM
5	Summarize instructions used for high level language
6	design an embedded hardware using ARM series of Microcontroller

Course Contents:

Module – I: The ARM architecture (**05 Hrs)**

Introduction to ARM microcontrollers. The Acorn RISC Machine, The architectural inheritance, The ARM programmer's model, ARM development tools, Basics of Assembly Language Programming.

Module – II: ARM organization and Implementation (**08 Hrs)**

3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface.ARM instruction set-Branch, branch with link(B,BL),branch, branch with link and exchange(BX,BLX),software interrupt(SWI),data processing instructions, multiply instructions, multiple register transfer instructions, Co-processor instructions. Memory Hierarchy- Memory size and speed, On-chip memory, Caches, Cache design, Memory management.

Module – III: Architectural Support for High level Language (**08 Hrs)**

Data types, floating point data types, ARM Floating point Architecture, Expressions, Conditional statements, Loops, Functions and Procedure, Use of memory, run time environment, Thumb Instruction set - The Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions ,Thumb software interrupt instruction, Thumb data processing instructions, Thumb

single register data transfer instructions ,Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb application.

Module – IV: Architectural Support for System Development & Operating System (**07 Hrs)**

The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA), The ARM reference peripheral specification Hardware system prototyping tools, The ARMulator,The JTAG boundary scan test architecture, The ARM debug architecture, ARM processor Cores-ARM7TDMI,ARM8, An introduction to operating systems, The ARM system control coprocessor,CP15 protection Moduleregisters, ARM protection Module,CP15 MMU registers, ARM-MMU architecture, Synchronization, Context switching, Input/output.

Module-V: Tutorials, assignments and presentation based on Module I to IV

References:

1. ARM System on chip Architecture- Prof. Steve Furber, 2nd Edition,Addison Wesley,2000,ISBN-0-201-67519-6.
2. RM Microcontrollers, Part 1: 35 Projects For Beginners, Bert Van Dam, Elektor International Media, ISBN-10: 0905705947, ISBN-13: 9780905705941.
3. Embedded Systems: Introduction to Arm(r) Cortex(tm)-M Microcontrollers: 1; Jonathan Valvano
4. Steave Furber, “ARM system – on – chip architecture”, Addison Wesley, 2000
5. Daniel Tabak, “Advanced Microprocessors”, McGraw Hill. Inc., 1995

Open Electives
IAOE 321
Automotive Engines

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1.	Define the key terms like Supercharging, Turbocharging
2	Differentiate the fuel dynamics for SI and CI engines
3	Acquainted with the latest technologies.

Course Content:

Module-I: Introduction to Engines (05 Hrs)

Introduction, Carnot cycle, Classification, I.C. Engines, Otto cycle, Diesel cycle, Flywheel, performance parameters, Brake Power, Indicated Power, Zeroth law of thermodynamics, First law of thermodynamics, Second law of thermodynamics, Fuel-Air cycles, numerical on performance parameters.

Module- II: Petrol Engines (07 Hrs)

Engine Construction and Operation: Constructional details of 4-stroke petrol engine. Working principle, actual indicator diagram, Firing order and its significance, Two Stroke Engines: Terminologies and definitions, Theoretical scavenging methods. Effect of operating variables: Compression Ratio, Fuel- Air Ratio, Ignition system, Combustion in petrol engine, morse test, motoring test, willans line method

Module- III: Diesel Engines (07 Hrs)

Engine construction and operation. Two stroke and four stroke diesel engines. Fuel-air and actual cycle analysis. Diesel fuel, Ignition quality, fuel injection systems, supercharging, turbo charging, Diesel Engine Testing and Performance: Automotive and stationary diesel engine testing, Performance characteristics. Variables affecting engine performance. Methods to improve engine performance. Heat balance.

Module- IV Advanced Engines (05 Hrs)

Need of advancement in engine, Common Rail Direct Injection Engine, Multi point fuel injection engine, Gasoline Direct Injection engine, Lean burn engines, Homogeneous charge compression ignition engine, variable compression ratio engine, Wankel Engine.

Module –V: Tutorials, case studies and presentation based on Module I to IV

References:

1. Internal Combustion Engines, Ganesan.V, Tata McGraw Hill Publishing Co., New York, 4 th Edition (2012), ISBN-0-07-049457-6.
2. High Speed Combustion Engines, Heldt.P.M, Oxford Publishing Co., New York, (1990).
3. Automotive Engines, William H. Crouse (Author), Donald Anglin (Author), Donald L. Anglin, McGraw-Hill Education (ISE Editions); (1994), ISBN-10: 0071138846, ISBN-13: 978-0071138840.
4. Automotive Engines, Ellinger.H.E, Prentice Hall Publishers (1992).
5. Diesel Engine Operation and Maintenance, Maleev.V.M, McGraw Hill (1974)
6. Dicksee.C.B, Diesel Engines, Blackie & Son Ltd., London (1964)

IAOE 322
Automobile Control Systems

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

1.	Define the key terms in Automotive Control System
2.	State various criteria's in components selection
3	Explain steering system, braking system and suspension system
4	Acquaint with the latest technologies

Course Content:

Module –I: Components Selection **(04 Hrs)**

Tyre selection, air resistance, rolling resistance, requirement of engine power, transmission system layout

Module –II: Steering systems **(07 Hrs)**

Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering

Module –III: Braking system **(06 Hrs)**

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

Module –IV: Suspension systems **(07 Hrs)**

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.

Module –V: Tutorials, assignments and presentation based on Module I to IV

References:

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

IALE - 330

Industrial Process Control Lab

(1.5 credits)

Course Outcomes:

On completion of the course, students should able to –

1	Explain the various loops of industrial process control.
2	Develop complex loop system.
3	Design and Implementation of Advance process controller.

List of Experiments: (Any five experiments should be performed)

1. Finding dynamic elements for any process. (TD, TS)
2. Analysis of Flow loop.
3. Analysis of Level loop.
4. Analysis of Temperature loop.
5. Analysis of Pressure loop.
6. Study of Cascade control loop.
7. Study of Ratio control/ Selective control. (any one)
8. Study of SLPC for process control.
9. Design and Implementation of Advance process controller. (ANN/Fuzzy/MPC) (May be implemented using any suitable software)
10. Study of non linear control elements.

IALE-331

SCADA System and Applications Lab

(1.5 credits)

Course Outcomes:

On completion of the course, students should able to –

1	Observe Parameter reading of PLC in SCADA.
2	Different controls using SCADA system.
3	Design complex control system using SCADA.

List of Experiments: (Any five experiments should be performed)

1. Parameter reading of PLC in SCADA
2. Alarm annunciation using SCADA
3. Pressure control by using SCADA
4. Tank Level control using SCADA System
5. Temperature monitoring using SCADA System
6. Speed control of machine by SCADA System
7. Pressure control by using SCADA
8. Controlling Electrical Power System using SCADA

IALE 332

Applied Hydraulics and Pneumatics Lab

(1.5 credits)

Course Outcomes:

On completion of the course, students should able to –

1	Construct Hydraulic and Pneumatic circuit for different valves.
2	Design Pneumatic circuit for control operations
3	Design sequential Hydraulic / Pneumatic circuit.

List of Experiments: (Any 5 experiments are to be performed)

1. Design of a rehydraulic circuit with servo valve
2. Design and construction of a hydraulic circuit with proportional valve
3. Design and construction of a pneumatic sequencing circuit
4. Design and construction of a pneumatic circuit with quick exhaust valve
5. Design and construction of a pneumatic circuit with time delay valve
6. Design and construction of a pneumatic speed control circuit
7. Design and construction of Hydraulic regenerative circuit
8. Design and construction of Hydraulic Punch and Drill circuit

IALE 333

Industrial Robotics Lab

(1.5 credits)

Course Outcomes:

On completion of the course, students should able to –

1	Develop simple programs to define pre-coordinated trajectory of robots.
2	Program a parallel kinematic robot for a palletizing application.
3	Calibrate External TCP and Moving Base / Frame Coordinate.

List of Experiments: (Any 5 experiments are to be performed)

1. Develop simple programs to define pre-coordinated trajectory of robots
2. Develop program for pick and place operation with a six axis industrial robot
3. Develop program for stacking operation with a six axis industrial robot
4. Develop program for picking an object from predefined position of ASRS and placing it in a pneumatic vice with a five axis industrial robot.
5. Develop program for emulating a welding operation with a six axis industrial robot.
6. Offline Programming: The modeled robot is programmed offline, also using the industrial robot simulation system
7. Programming a parallel kinematic robot for a palletizing application.
8. External TCP and Moving Base / Frame Coordinate Calibration
9. Program using external TCP and Moving Base / Frame
10. Loop Programming of Industrial Robot
11. Interrupt Programming of Industrial Robot

IALE - 334

Advanced Sensor Technology Lab

(1.5 credits – 50 marks)

Course Outcomes:

On completion of the course, students should able to –

1	Apply sensors pertinent to Course IAGE 314 for real time applications

Students are supposed build one project deploying more than one sensors (that have been taught in IAGE 314). A batch of three students should submit one project.

IALE - 335

Kinematics and Dynamics of Robot Lab

(1.5 credits – 50 marks)

Course Outcomes:

On completion of the course, students should able to –

1	Demonstrate different Industrial grade Robot
2	Describe various Co-ordinate system of Robot
3	Design robot for various applications.

List of Experiments: (Any five experiments should be performed)

1. Study of Robot (Industrial grade eg. KUKA/ FANUC etc)
2. Mastering of Robot
3. Study of various Co-ordinate system of Robot
4. Adjusting position of Robot
5. Programming of robot for Linear Motion
6. Programming of robot for Circular Motion
7. Programming of Robot for various applications
8. Mini Project (based on various applications of Robot)

IAGE 336 :

Mechatronics System Design Lab

(1.5 Credits)

Course Outcomes:

On completion of the course, students should able to –

1	Identify suitable sensor and actuator for a control system
2	Develop simple mechatronic systems

List Of Experiments: (Any 5 experiments are to be performed)

1. System identification for actuators
2. Stability analysis of predicted transfer function, and PID tuning and implementation on experimental setup.
3. Experimental identification of mechanisms such as flexural based systems etc.
4. Experiment on image based navigation and control of robot.
5. Experiment on control of non-linear systems.
6. Experiment on control of inverted pendulum
7. Experiment on system identification and control of scanning mechanism

IALE 337

Distributed Control System Lab

(1.5 credits)

Course Outcomes:

On completion of the course, students should able to –

1	Develop of Human Machine Interface using any SCADA package
2	Control of Pressure and flow using DCS.
3	Create interlock logic in DCS.

List of Experiments:

1. Control of a multi process batch reactor (configurable) using PLC
2. Development of Human Machine Interface using any SCADA package.
3. Level and flow control using PLC.
4. Pressure and flow control using DCS.
5. Creating an analog – open loop & Digital loop using DCS
6. Configuring DCS- System for given application.
7. Creating interlock logic in DCS.

IALE 338

Electrical Drives Lab

Course Outcomes:

On completion of the course, students should able to –

1	Apply concepts of chopper control for motoring and generating control
2	Control of AC and DC motor using suitable drive
3	Develop application of Electric Drive

List of Experiments:

1. Study chopper control of D.C. Motor for motoring and generating control.
2. Study of D.C. Motor drive using PLL.
3. Study and simulate AC voltage controller based speed control of AC motor.
4. Study and simulate Inverter based speed control of Induction/Synchronous motor.
5. Study and simulate Cycloconverter based speed control of synchronous motor.
6. Study and simulate AC voltage controller based speed control of AC motor.
7. Study of solar and battery powered drives.
8. Study of traction drives.

SEMESTER – IV

Generic Elective

Industrial Automation

IAGE – 410

Automated and Computer Integrated Manufacturing

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Identify elements of an automated manufacturing cell in modern production Module
2	Explain Fundamentals of NC Technology
3	Apply knowledge of CAM, CAD/CAM, CIM for automated manufacturing
4	Analyze various quality control systems
5	Evaluate Positioning System, NC part programming, Automated assembly systems
6	Work in a flexible manufacturing workstation

Course Contents:

Module-I: Overview of Manufacturing (06 Hrs)

Introduction, Manufacturing operations, metrics, and economics; Automated manufacturing

Module- II: CNC and CAD /CAM (08 Hrs)

Fundamental of NC Technology, Computers and numerical control, Applications of NC, Analysis of Positioning System, NC part programming

Product design and CAM, CAD/CAM, CIM

Module -III: Automated Manufacturing Systems (08 Hrs)

Overview, Single station Manufacturing Cells, Automated Production line, Automated assembly systems

Module-IV: Quality Control Systems (06 Hrs)

Inspection Principles and Practices, Automated Inspection, Analysis of Inspection Systems, Inspection Metrology, Conventional Measuring and gaging Techniques, Coordinate measuring machines, Surface measurement, Machine Vision, Optical/non optical techniques

Module-V : Tutorials, assignments and presentation based on Module I to IV

References:

Automation, Production Systems, and Computer-Integrated Manufacturing
By Mikell P. Groover; Pearson Education India

Mechatronics; HMT; Tata Mc Graw Hill

Computer-Aided Manufacturing by Tien-Chien Chang and Richard A. Wysk; Prentice Hall

IAGE- 411: CNC Technology

(2 Credits: 50 Marks)

Course Outcomes:

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

1	Define the basic of CNC machine.
2	Apply Features of CNC Machines and Retrofitting
3	Design CNC part programming.
4	Describe types of measuring systems in CNC machines.

Course Contents:

Module -I: Fundamentals of CNC Machines (05 Hrs)

Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines.

Module –II: Constructional Features of CNC Machines and Retrofitting (07 Hrs)

Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors. Retrofitting of Conventional Machine Tools: Modification to be carried out on conventional machines for retrofitting.

Module -III: Control System, Feed Back Devices and Tooling (06 Hrs)

Description of a simple CNC control system. Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices

Module – IV: CNC Part Programming (05 Hrs)

Part Program Terminology-G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements.

Module – V: Tutorials, Assignments, Demonstrations and Presentation Based On Module I to IV.

References:

1. Radhakrishnan P., Computer Numerical Control Machines, New Central Book Agency 1992.
2. Berry Leatham – Jones, Computer Numerical Control, Pitman, London, 1987.
3. Steave Krar And Arthur Gill, Cnc Technology And Programming, Mcgraw–Hill Publishing Company, 1990. 46
4. Hans B.Kief And T.Frederick Waters, Computer Numerical Control Macmillan/Mcgraw-Hill, 1992.
5. G.E.Thyer, Computer Numerical Control Of Machine Tools. Second Edition, B/H Newnes, 1993.
6. Groover, M.P., Automation, Production Systems And Computer Integrated Manufacturing, Prentice Hall, 1998.
7. Mike Mattson, "Cnc Programming Thomson Learning, 2003. Me3306
8. Yoreur Koren, "Computer Control Of Manufacturing Systems", Pitman, London, 1987

IAGE - 412

Micro Mechatronic System

(02 credits – 50 marks)

Course Outcomes:

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

1	Define Micromechatronics system.
2	Classify Piezoelectric Actuators.
3	Define various performance terminologies in Sensors.
4	Explain different types of actuators used in Micro-mechatronics.
5	Analyze Control Techniques For Piezoelectric Actuators.
6	Develop prototype of Micro-Mechatronic System.

Course Contents:

Module–I: Current trends for Actuators and Micromechatronics (06 Hrs)

The Need for New Actuators, Conventional Methods for Micropositioning, An Overview of Solid-State Actuators, Critical Design Concepts and the Structure of the Text.

Module– II: A Theoretical Description Of Field-Induced Strains (06 Hrs)

Ferroelectricity, Microscopic Origins of Electric Field Induced Strains, Tensor/Matrix Description of Piezoelectricity, Theoretical Description of Ferroelectric and Antiferroelectric Phenomena Phenomenology of Magnetostriction, Ferroelectric Domain Reorientation, Grain Size and Electric Field-Induced Strain in Ferroelectrics.

Module– III: Actuators Materials (06 Hrs)

Practical Actuator Materials, Figures of Merit for Piezoelectric Transducers, The Temperature Dependence of the Electrostrictive Strain, Response Speed, Mechanical Properties of Actuators.

Module– IV: Drive / Control Techniques For Piezoelectric Actuators (06 Hrs)

Classification of Piezoelectric Actuators, Feedback Control, Pulse Drive, Resonance Drive, Sensors and Specialized Components for Micromechatronic Systems

Module-V: Presentations, case studies, Assignments, Tutorials based on Module I to IV.

References:

1. Kenji Uchino, Jayne Giniewicz, MicroMechatronics- CRC Press, April 25, 2003, ISBN 9780824741099
2. Bolton.W – Mechatronics - Pearson education, second edition, fifth Indian Reprint, 2003, SBN, 8131762572, 9788131762578
3. Smaili.A and Mrad.F - Mechatronics integrated technologies for intelligent machines - Oxford university press, 2008. ISBN-10: 0198060165 ISBN-13: 978-0198060161
4. Devadas Shetty and Richard A.Kolk, - Mechatronics systems design - PWS Publishing Company, 2007. ISBN-13: 978-1439061985 ISBN-10: 143906198X
5. Godfrey C. Onwubolu - Mechatronics Principles and Applications - Elsevier, 2006. ISBN-13: 978-0750663793 ISBN-10: 0750663790
6. Nitaigour Premchand Mahalik -Mechatronics Principles, Concepts and Applications - Tata
7. McGraw-Hill Publishing Company Limited, 2003. ISBN 10: 0070634459 / ISBN 13: 9780070634459
8. Michael B.Histand and Davis G. Alciatore - Introduction to Mechatronics and Measurement
   Systems - McGraw Hill International edition, 1999.
9. Bradley D.A, Dawson.D, Buru N.C and Loader A.J – Mechatronics - Nelson Thornes Ltd, Eswar press, Indian print, 2004. ISBN-13: 978-0748757428 ISBN-10: 0748757422

IALE 430

Automated and Computer Integrated Manufacturing Lab

(1.5 credits)

Course Outcomes:

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

1	Perform simple automated manufacturing task of a flexible manufacturing cell
2	Analyze automated workpiece loading/unloading in CNC machining stations by articulated robot

List of Experiments (Any 5 experiments are to be performed)

1. Study of a FMS Cell
2. Study of FMS model for any industry
3. Study and demonstration on 5 axis robot in a CIM Cell
4. Programming of a 5 axis robot for AS/RS and linear transfer
5. Programming of a 5 axis robot for CNC lathe/ milling loading/unloading operation combined with any turning process.
6. Programming of a 5 axis robot for CNC lathe/ milling loading/unloading operation combined with any milling process.

IALE 431

CNC Machines Lab

(1.5 credits)

Course Outcome:

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

1	Develop basic competency to perform CNC machining operations
2	Illustrate concepts of synchronized CNC operation in a CNC based FMS cell

List of Experiments (Any 3 experiments from sub head 3 are to be performed)

1. Study of a CNC based FMS Cell
2. Study of various instructions for programming of CNC
3. Pragramming of CNC for various applications
   1) Cutting
   2) Milling
   3) Boring
   4) Spinning
   5) Gluing
   6) Routing
   7) Drilling
4. Miniproject based on combination or single CNC Application

IALE - 432

Micro Mechatronic System Lab

(1.5 credits)

Course Outcomes:

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

1	Develop basic simulation concepts for design of micromechatronic/micro-electromechanical elements

List of Experiments (Any 5 experiments are to be performed)

1. To Perform Multiphysics Analysis of a Thermal Actuator
2. Tutorial – 1 Introduction to MEMS & Microsystems.
3. Tutorial – 2 Mechanics of MEMS.
4. Tutorial – 3 Dynamics of MEMS.
5. Tutorial – 4 Fabrications processes for MEMS.
6. Design and Analysis of MEMS Pressure Sensor-I
7. Design and Analysis of MEMS Pressure Sensor-II
8. Design and Analysis of MEMS Pressure Sensor-III

Open Elective

IAGE - 420

Automated Manufacturing

(02 credits – 50 marks)

Course Outcomes:

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

1	Define Manufacuring
2	Classify schemes of manufacturing systems.
3	Define various principles and strategies of Automation.
4	Explain Production lines and Assembly ststions.
5	Analyze parts delivery systems at workstations.

Course Contents:

Module–I: Introduction to Manufacturing (06 Hrs)

Production Systems, Automation in Production System, Manual Labor in Production systems, Automation Principles and Strategies

Module– II: Components of Manufacturing System (06 Hrs)

Components of manufacturing system: production machines, material handling system, computer control system, human resources; classification scheme for manufacturing systems; types of operations performed, number of workstations, system layout, part or product variety, classification scheme

Module– III: Automated Production Lines (06 hrs)

Fundamentals of Automated Production Lines: system configurations, workpart transfer mechanisms, storage buffers, control of production lines; Applications of production lines; Analysis of transfer lines.

Module– IV: Automated Assembly Stations (06 hrs)

Fundamentals of Automated Assembly Systems: system configurations, parts delivery at workstations, applications; Quantitative analysis of Assembly stations: parts delivery systems at workstations, multistation assembly machines, single station assembly machines, partial automation

Module-V: Presentations, case studies, Assignments, Tutorials based on Module I to IV.

References:

1. Mikell P Groover- Automation Production Systems and Computer Integrated Manufacturing
   Pearson Publication ISBN: 78-93-325-4981-4
2. Bolton.W – Mechatronics - Pearson education, second edition, fifth Indian Reprint, 2003, SBN, 8131762572, 9788131762578
3. Smaili.A and Mrad.F - Mechatronics integrated technologies for intelligent machines - Oxford university press, 2008. ISBN-10: 0198060165 ISBN-13: 978-0198060161
4. Devadas Shetty and Richard A.Kolk, - Mechatronics systems design - PWS Publishing Company, 2007. ISBN-13: 978-1439061985 ISBN-10: 143906198X
5. Godfrey C. Onwubolu - Mechatronics Principles and Applications - Elsevier, 2006. ISBN-13: 978-0750663793 ISBN-10: 0750663790
6. Nitaigour Premchand Mahalik -Mechatronics Principles, Concepts and Applications - Tata
7. McGraw-Hill Publishing Company Limited, 2003. ISBN 10: 0070634459 / ISBN 13: 9780070634459
8. Michael B.Histand and Davis G. Alciatore - Introduction to Mechatronics and Measurement
   Systems - McGraw Hill International edition, 1999.
9. Bradley D.A, Dawson.D, Buru N.C and Loader A.J – Mechatronics - Nelson Thornes Ltd, Eswar press, Indian print, 2004. ISBN-13: 978-0748757428 ISBN-10: 0748757422

IAOE 421

Industrial Robotics

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the Course, students should be able to

1	Familiar with the applications of robotic systems as they are currently used in industry and research
2	Define the needs acquire necessary information
3	Select appropriate robots for various industrial applications
4	Apply the knowledge gained for the design and development of simple robotic aspects

Course Contents:

Module- I: Review of Robotics (06 Hrs)

Automation and Robotics, Robotics Market and Future Prospects, Review of Robot Anatomy and Robot Motion analysis,

Module -II: Application Engineering for Manufacturing (07 Hrs)

Robot Cell Design: Robot Cell Layouts, Multiple Robots and Machine interface, Workcell Control;

Economic Analysis for Robotics: Methods for economic analysis, Differences in Production rates, Robot project analysis form.

Module- III: Robot application in Manufacturing (07 Hrs)

Material Transfer and Machine loading/unloading: material transfer applications, machine loading and unloading ;

Processing Operations: Spot Welding, Spray coating, other processing operations using Robots;

Assembly and Inspection.

Module- IV: **Implementation Principles and Issues** (07 Hrs)

An approach for Implementing Robotics: Plant Survey, Selection of Robot, Planning and Engineering the installation;

Safety, Training, Maintenance and Quality; Social Issues and Future of Robotics.

Module V: Tutorials, assignments and presentation based on Module I to IV

References:

1. Robotics and Control by Mittal &NagrathTata McGraw-Hill Education, 2003: ISBN 10: 0070482934 / ISBN 13: 9780070482937

2. Industrial Robotics By Michel P Groover**1St Edition Edition**; ISBN-13: 978-0070249899 / ISBN- 10: 007024989X

3. Robotic Engineering By Dr. Surender Kumar, Dr.S K. Mukherjee (TMH)

4. , "Robotic Engineering - An Integrated Approach" by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice Hall India, 2002

5. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009

6. Robotics control, sensing, vision and intelligence, Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "", McGraw Hill Book co, 1987

7. Robots and Manufacturing Automation, Ray Asfahl. C., John Wiley & Sons Inc.,1985

8.. Introduction to Robotics mechanics and control, by Craig. J. J., Addison- Wesley, 1999

IAOE 422

Mechatronics Fundamentals

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the course, students should able to –

1	Explain the various Analog & Digital circuit elements.
2	Develop the program using PIC Microcontroller.
3	Differentiate the different sensor technology.
4	Describe design aspects for the mechatronics system.

Course Contents:

Module - I: Analog circuits and Digital circuits. (05 Hrs)

Analog Circuit Elements. Mechanical Switches. Circuit Analysis. Equivalent Circuits. Impedance. AC Signals. Power in Circuits. Operational Amplifiers. Grounding. Solenoids and Relays,Combinational Logic Circuits. Sequential Logic Circuits. Circuit Families. Digital Devices. H-Bridge Drives.

Module - II: Data acquisition and Microcontroller/pc interfacing (07 Hrs)

PIC Microcontroller. Programming the PIC Microcontroller,PIC MCU Devices and Features. Interrupts

Sampling Theory. Parallel Port. Data Acquisition Board Programming. USART Serial Port. Serial Peripheral Interface. Inter-Integrated Circuit Interface. USB Communication. Network Connection.

Module - III: Sensors & Actuators (06 Hrs)

Sensors Performance Terminology. Displacement Measurement. Proximity Measurement. Speed Measurement. . Force and Torque Measurement. Temperature Measurement. Signal Conditioning. Sensor Output.

DC Motors. AC Motors. Stepper Motors. Other Motor Types. Actuator Selection.

Module -IV: Mechatronics Projects (05 Hrs)

Stepper-Motor Driven Rotary Table. A Paper Dispensing System That Uses a Roller Driven by a Position Controlled DC Motor. A Temperature-Controlled Heating System That Uses a Heating Coil, a Copper Plat, and a Temperature Sensor.

Module – V: Tutorials, Assignments, Demonstrations and Presentation Based On Module I to IV

References:

1. "Fundamentals of Mechatronics," Musa Jouaneh, Cengage Learning, 2011.
2. "Mechatronics: a Foundation Course", Clarence de Silva, CRC Press, 2010.
3. "Mechatronics Systems Fundamentals", Rolf Isermann, Springer, 2005.
4. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6thEdition, Pearson Education, 2015
5. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2008).

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 June 2016 and onwards)

Deen Dayal Upadhyay KAUSHAL Kendra

INDEX

Structure and Curriculum for Master of Vocation (M. Voc)
in
Automobile

(Choice Based Credit System)

This M.Voc (Automobile Technology) program is divided in four semesters having 102 credits. The distribution or credits is as per following –

Sr. No.	Category of course(s)	Type of Course (Theory/ Practical/ Research Project)	Number of Course(s)	Total Credits	Semester-wise Credit Distribution
1	Compulsory Common Component (Constitution of India)	Theory	01	02	Sem I - 02
2	Core Component	Theory	07	14	Sem I - 08 Sem II - 06
3	Foundation Component (Elective)	Theory	01	02	Sem I – 02
4	Foundation Component (Research)	Theory	01	01	Sem I - 01
5	Foundation Component (Compulsory)	Theory	05	10	Sem I - 04 Sem II - 06
6	Generic Elective	Theory	05	10	Sem III – 08 Sem IV -02
7	Open Elective[#]	Theory	02	04	Sem III – 02 Sem IV - 02
8	Laboratory courses (Core)	Practical	07	10.5	Sem I - 06 Sem II - 4.5
9	Laboratory courses (Foundation)	Practical	05	7.5	Sem I - 03 Sem II - 4.5
10	Laboratory Courses (Generic Elective)	Practical	05	7.5	Sem III -06 Sem IV- 1.5
11	Research Component				
	Part 1	Research/Industrial project	Part 1	05	Sem II - 5.0
	Part 2		Part 2	09	Sem III- 9.0
	Part 3		Part 3	19.5	Sem IV - 19.5
			Total	**102 Credits**	

The above structure exercised component wise distribution as per following –

Constitution of India = 02 Credits

Core Component = 24. 5%

Foundation Component = 20.5%

Elective Component = 21.5 %

Research component = 33.5% (Excluding theory course entitled 'Research Methodology')

#**Students can opt for open electives from courses offered by Automation Division, Deen Dayal Upadhyay KASUSHAL Kendra**

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 Technology)/ B.Sc with Automobile / B. E/ B. Tech (Automobile/ Mechanical/) from any recognized Board/Institution are eligible for registration / admission.

AND

Students having B. E/ B. Tech (Mechanical/Production) & B. Sc degree with Automobile will have to complete at least 4 credits in terms of two theory courses namely – (i) Automobile Electricals and Electronics

(ii) Automotive Troubleshooting during First year of M.VOC apart from courses being taught in course of regular academic session.

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 10 marks for Continuous Internal Assessment. Distribution of 10 marks will be as follows- 02 marks for tutorials & assignment, 02 marks for seminar presentation and 05 marks for weekly tests. Weekly tests of 05 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 40 marks. The total marks shall be 50 for 2 credit theory course (40 marks semester end exam + 10 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 research 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 (10+30 = 40 Marks)
    - Part A will be consisting of 10 questions having 1 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 (40 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 50 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	8.00-8.90	A^{++}	Exceptional
70-79	7.00-7.90	A^{+}	Excellent
60-69	6.00-6.90	A	Very Good
55-59	5.50-5.90	B^{+}	Good
50-54	5.00-5.40	B	Fair
45-49	4.50-4.90	C^{++}	Average (Above)
41-44	4.1-4.49	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

Sum (Course Credits) X Number of Grade Points in concerned Course Gained by

$$SGPA = \frac{\text{the Student}}{\text{Sum (Course Credits)}}$$

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

Semester	Paper Code	Paper Title	Contact Hrs / Week	Credits
Semester I	**CC 100**	Constitution of India	2	2
	ATF 121	Automotive Engines	2	2
	ATF122	Automotive Transmission Systems	2	2
	ATF 123	Fuels and Combustion	2	2
	ATC 124	Automobile Control Systems	2	2
	ATC 125	Automobile Engine Components Design	2	2
	ATC 126	Automobile Air Conditioning	2	2
	CF 101	Research Methodology	1	1
	EF 1XX	Elective Foundation (Any One) ▪ Operations Management (EF 130) ▪ Materials management (EF 131)	2	2
	ATLF 127	Laboratory Coursework based on Automobile Engines and Engine Design (Auto-CAD)	6	3
	ATLF 128	Laboratory Coursework based on Automotive Transmission Systems	3	1.5
	ATLF 129	Laboratory Coursework based on Fuels and Combustion	3	1.5
	ATLC 130	Laboratory Coursework based on Automobile Control Systems	3	1.5
	ATLC 131	Laboratory Coursework based on Automobile Air Conditioning	3	1.5
	Assignments/Tutorials will remain integral part of all courses			
		Total Credits for Semester – I		**26**

Semester	Paper Code	Paper Title	Contact Hrs/Week	Credits
Semester II	**ATF 221**	Transmission System Design	2	2
	ATF 222	Automobile Systems Design	2	2
	ATF 223	Hydraulic and Pneumatic Systems	2	2
	ATF 224	Noise and Vibration	2	2
	ATC 225	Automobile Body Engineering	2	2
	ATC 226	Vehicle Dynamics	2	2
	ATLF 227	Laboratory Coursework based on Hydraulic and Pneumatic Systems	3	1.5
	ATLF 228	Laboratory Coursework based on Noise and Vibration	3	1.5
	ATLC 229	Laboratory Coursework based on Solid Modeling	6	3
	ATLC 230	Laboratory Coursework based on Automobile Body Engineering	3	1.5
	ATLC 231	Laboratory Coursework based on Automotive Electrical system diagnosis	3	1.5

	ATR 232	Research/ Industrial Project – Phase I (Review of Literature/ Industrial Orientation, Formulation of Topic, Experimental Plan)	10	5
	Assignments/Tutorials will remain integral part of all courses			
			Total Credits for Semester – II	**26**

Semester	**Paper Code**	**Paper Title**	**Contact Hrs/Week**	**Credits**
Semester III	**ATC 321**	Generic Elective – I	2	2
	ATC 322	Generic Elective – II	2	2
	ATGE 32X	Generic Elective – I	2	2
	ATGE $32X_1$	Generic Elective – II	2	2
	ATOE $32X_2$	Open Elective –I	2	2
	ATLC 332	Laboratory Coursework based on Generic Elective I	3	1.5
	ATLC 333	Laboratory Coursework based on Generic Elective – II	3	1.5
	ATLE $33X_L$	Laboratory Coursework based on Generic Elective – I	3	1.5
	ATLE $33X_{1L}$	Laboratory Coursework based on Generic Elective – II	3	1.5
	ATR 340	Research/ Industrial Project – Phase II (Experimental Work)	18	9
	Assignments/Tutorials will remain integral part of all courses			
			Total Credits for Semester – III	**25**

Semester	**Paper Code**	**Paper Title**	**Contact Hrs/Week**	**Credits**
Semester IV	**ATGE 42X**	Generic Elective – III	2	2
	ATGE $42X_1$	Open Elective – II	2	2
	ATLE $42X_2$	Laboratory Coursework based on Generic Elective - III	3	1.5
	ATR 430	Research/ Industrial Project – Phase III (Experimental Work Continued, Organization and Interpretation of Result, Dissertation, Presentation)	39	19.5
	Assignments/Tutorials will remain integral part of all courses			
			Total Credits for Semester – IV	**25**

Electives for Semester – III

(Any Two theory paper along with corresponding lab course have to be chosen from generic electives)
(Any one theory paper along with corresponding lab course have to be chosen from open electives)

	Paper Code	Paper Title		Paper Code	Paper Title
Generic Elective-I	ATC 321	Vehicle Testing	Generic Elective-I (Lab)	ATLC 332	Laboratory Coursework based on Vehicle Testing
	ATGE 323	Automotive Maintenance & Management		ATLE 334	Laboratory Coursework based on Automotive Maintenance & Management
	ATGE 324	Finite Element Methods		ATLE 335	Laboratory Coursework based on Finite Element Methods
	ATGE 325	Vehicle Aerodynamics and Design		ATLE 336	Laboratory Coursework based on Vehicle Aerodynamics and Design
Generic Elective-II	ATC 322	Transport Management	Generic Elective-II (Lab)	ATLC 333	Laboratory Coursework based on Wheel Balancing and Wheel Alignment
	ATGE 326	Autotronics		ATLE 337	Laboratory Coursework based on Autotronics
	ATGE 327	Automotive Metallurgy		ATLE 338	Laboratory Coursework based on Automotive Metallurgy
	ATGE 328	Special Purpose Vehicles		ATLE 339	Laboratory Coursework based on Special Purpose Vehicles
Open Elective-I	ATOE 329	Robotics			
	ATOE 330	CNC Technology			
	ATOE 331	Automated and Computer Integrated Manufacturing			

Electives for Semester – IV

(Any one theory paper along with corresponding lab course have to be chosen from generic electives)
(Any one theory paper along with corresponding lab course have to be chosen from open electives)

	Paper Code	Paper Title		Paper Code	Paper Title
ic Electi	ATGE 421	Automotive Emission and Controls	c Electiv e-III	ATLE 427	Laboratory Coursework based on Automotive Emission and Controls

	ATGE 422	Hybrid Vehicles		**ATLE 428**	Laboratory Coursework based on Hybrid Vehicles
	ATGE 423	Automotive Safety		**ATLE 429**	Laboratory Coursework based on Automotive Safety
Open Elective-II	**ATOE 424**	Applied Hydraulics and Pneumatics			
	ATOE 425	Industrial Robotics			
	ATOE 426	Advanced Electrical Drives			

SEMESTER – I

ATF 121 - Automotive Engines

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Distinguish between petrol engine and diesel engine by observing it.
CO2	Identify all parts and accessories of petrol and diesel engine.
CO3	Demonstrate GDI, HCCI and CRDI engine.
CO4	Perform all performance tests on engine.

Course Content:

Module-I: Introduction to Engines ***05 hours***

Introduction, Carnot cycle, Classification, I.C. Engines, Otto cycle, Diesel cycle, Flywheel, performance parameters, Brake Power, Indicated Power, Zeroth law of thermodynamics, First law of thermodynamics, Second law of thermodynamics, Fuel-Air cycles, numerical on performance parameters.

Module- II: Petrol Engines ***07 hours***

Engine Construction and Operation: Constructional details of 4-stroke petrol engine. Working principle, actual indicator diagram, Firing order and its significance, Two Stroke Engines: Terminologies and definitions, Theoretical scavenging methods. Effect of operating variables: Compression Ratio, Fuel- Air Ratio, Ignition system, Combustion in petrol engine, morse test, motoring test, willans line method

Module- III: Diesel Engines ***07 hours***

Engine construction and operation. Two stroke and four stroke diesel engines. Fuel-air and actual cycle analysis. Diesel fuel, Ignition quality, fuel injection systems, supercharging, turbo charging, Diesel Engine Testing and Performance: Automotive and stationary diesel engine testing, Performance characteristics. Variables affecting engine performance. Methods to improve engine performance. Heat balance.

Module- IV Advanced Engines ***05 hours***

Need of advancement in engine, Common Rail Direct Injection Engine, Multi point fuel injection engine, Gasoline Direct Injection engine, Lean burn engines, Homogeneous charge compression ignition engine, variable compression ratio engine, Wankel Engine.

Module -V Tutorials, case studies and presentation based on Module I to IV ***06 hours***

References:

1. Internal Combustion Engines, Ganesan.V, Tata McGraw Hill Publishing Co., New York, 4th Edition (2012), *ISBN*-0-07-049457-6.
2. High Speed Combustion Engines, Heldt.P.M, Oxford Publishing Co., New York, (1990).
3. Automotive Engines, William H. Crouse (Author), Donald Anglin (Author), Donald L. Anglin, McGraw-Hill Education (ISE Editions); (1994), ISBN-10: 0071138846, ISBN-13: 978-0071138840.
4. Automotive Engines, Ellinger.H.E, Prentice Hall Publishers (1992).
5. Diesel Engine Operation and Maintenance, Maleev.V.M, McGraw Hill (1974)
6. Dicksee.C.B, Diesel Engines, Blackie & Son Ltd., London (1964)

ATF 122 - Automotive Transmission Systems

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Differentiate various types of gearbox and its working.
CO2	Analyze gear ratios for Manual and Semi-Automatic types of gear boxes for real time applications.
CO3	Select tyre for passenger as well as heavy vehicles.
CO4	Select the proper clutch for real time applications.

Course Content:

Module-I: Clutch **05 hours**

Need for Transmission system, Tractive Effort and Resistances to Motion of a vehicle, Requirements of transmission system, Classification of Transmission systems, Multi axle drives, Clutch principle and constructional details, types of clutches, Modes of operating a clutch – mechanical, hydraulic and Electric, Automatic Clutch, Over-running clutch, numerical on power transmission of clutch.

Module – II: Gearbox **07 hours**

Determination of gear ratios for vehicles, Performance characteristics in different speeds, Different types of gear boxes – sliding, constant and synchromesh type, Need for double declutching and working of synchronizing unit, Power and economy modes in gearbox. Transfer box. Transaxles. Overdrives. Gear shifting mechanisms, Torque convertor, Automatic transmission with intelligent electronic control system.

Module – III: Propeller Shaft and Differential Drive ***05 hrs***

Introduction, propeller shaft, types of propeller shafts, Universal joint, Slip joint, Two yokes and Spider Universal joint, Final drive, Differential, Arrangements of differential, Backlash, Rear axle, Rear axle drives: Hotchkiss drive, Torque tube drive, Rear axle shaft supporting: Semi-floating axle, Full- Floating axle, Three quarter floating axle, Rear axle casing, Lubrication of rear axle.

Module – IV: Wheel and Tyres ***07 hours***

Types of wheels, Desirable tyre properties, types of tyre, Carcass type, tyre materials, tyre designation, Consideration in tread design, Wheel and tyre trouble shooting, tyre designations, tyre manufacture, factors affecting tyre life, tyre wear indicators.

Module – V: Tutorials, Case studies and presentation based on Module I to IV ***06 hours***

References:

1. *Motor Vehicle* by Garrett, T. K. *Newton*, K. and *Steeds*, W., Butterworth London, 13th Edition, (2005), *ISBN*- 10: 1560918985
2. Judge.A.W., " Modern Transmission systems ", Chapman and Hall Ltd (1969), ISBN-13: 9780412094507.
3. Crouse. W.H., Anglin., D.L., "Automotive Transmission and Power Trains construction Tata McGraw -Hill Publishing Co.
4. Design Practices, passenger Car Automotive Transmissions- SAE Hand book.
5. Kirpal Singh, "Automobile Engineering Vol-1", Standard Publications (2007), ISBN-10 8180140997.

ATF 123 - Fuels and Combustion

(02 credits – 50 marks)

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:

Module –I: Conventional Fuels ***05 hours***

Introduction, Types of Fuels – Solid, Gaseous and Liquid fuels, Chemical structure of petroleum, Petroleum refining process, Important qualities of SI and CI engine fuels, Rating of SI and CI engine fuels

Module –II: Alternate fuels ***05 hours***

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

Module –III: Combustion in SI Engines ***07 hours***

Introduction, Homogeneous mixture, Heterogeneous mixture, Stages of Combustion in SI Engines, 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.

Module –IV: Combustion in CI Engines ***07 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.

Module –V: Assignments / seminars / case studies on Module -I to Module - IV ***06 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

ATC 124 - Automobile Control Systems

(02 credits – 50 marks)

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:

Module –I: Components Selection ***04 hours***

Tyre selection, air resistance, rolling resistance, requirement of engine power, transmission system layout

Module –II: Steering systems: ***07 hours***

Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering

Module –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

Module –IV: Suspension systems ***07 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.

Module –V: Assignments / seminars / case studies on Module -I to Module - IV ***06 hours***

References:

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

ATC 125 - Automobile Engine Components Design

(02 credits – 50 marks)

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:

Module-I: Introduction to Design ***05 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.

Module-II: Design of Cylinder and Piston ***07 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.

Module – III: Design of Connecting rod, Crankshaft ***07 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.

Module –IV: Design of Valves and Flywheel ***05 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.

Module –V: Tutorials, Case studies and presentation based on Module I to IV ***06 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 126 - Automobile Air Conditioning

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Identify various HVAC systems and sub systems.
CO2	Explain working and construction of HVAC systems and sub systems.
CO3	Carry out repair and maintenance of HVAC systems and sub systems.
CO4	Carry out retrofitting and alteration of HVAC systems.
CO5	Explain environmental aspects related to HVAC systems.

Course Content:

Module –I: Introduction to Automobile Air Conditioning ***05 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

Module –II: Air Conditioning System ***07 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, 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.

Module –III: System Control Devices ***06 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.

Module –IV: Repairs and Maintenance of Air Conditioning System ***06 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

Module –V: Assignments / seminars / case studies on Module -I to Module - IV ***06 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

CF 101 - Research Methodology

(01 credits – 50 marks)

Course Outcomes:

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

CO1	Do systematic literature survey, formulation of a research topic, study design, analysis and interpretation of data.
CO2	Select a suitable analytical method for a specific research approach.
CO3	Demonstrate a good understanding of how to write a research report
CO4	Design a research approach for a specific research issue of their choice.

Course Contents:

Module I: Research Fundamentals ***03 hours***

Introduction: Definition, objectives of the research, characteristics of the research, what makes people to do research, importance of research**,**

Module II: Identification of Research Problem ***04 hours***

Defining the research problem: Identification of research problems, selection of research problem, facts one should know regarding selection of research problem, the process of research problem definition, some facts involved in defining research problem

Module III: Formulation of Research Problem ***05 hours***

Formulation of the problems: steps involved in defining a problem, formulation of the problems, Formulation of hypothesis: Concept of hypothesis, hypothesis testing, Developing the research plan: implementation, interpreting and reporting the findings, Importance of hypothesis of in decision making.

Module IV: Research Report and Proposal Writing ***04 hours***

Introduction, research proposal writing: costing, the research proposal, rationale for the study, research objectives, research methodology, target respondents, research Centres, sample size and sample composition, sampling procedures, research project execution, research units; An insight into research report and proposal, research project synopsis, research report writing : types of research reports, guidelines for writing reports; Steps in writing report, report presentation, typing the report, documentation and bibliography, formatting guidelines for writing a good research report / research paper.

References:

1. Research Methodology by Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd (2013), ISBN-10: 8191064278, ISBN-13: 978-8191064278
2. Basic Research Methods-Gerard Guthrie SAGE Publications, India, Pvt Ltd, New Delhi (2010), ISBN-10: 8132104579, ISBN-13: 978-8132104575
3. Research Methodology-methods and techniques By C. R. Kothari, New Age International Publishers (2011) ISBN 978-81-224-1522-3
4. Principles of Research Methodology- Phyllis G. Supino, Jeffrey S. Borer; Springer, Verlag New York (2012), ISBN-e book: 1461433592, ISBN (Hardcover): 978-1461433590
5. Research Design Qualitative, Quantitative. and Mixed Methods Approaches- John W. Creswell; SAGE Publications Ltd, UK (2011), ISBN-9780857023452
6. Research Methodology -A Step-by-Step Guide for Beginners- Ranjit Kumar; Sage Publications Ltd (2010), ISBN- 1849203016.
7. Scientific Writing and Communication- Angelika Hofmann; Oxford University Press, US (2010), ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
8. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Joshua Schimel, Oxford University Press, (2011), ISBN: 9780199760237
9. Handbook of Scientific Proposal Writing- A.Yavuz Oruc; CRC Press, Taylor & Francis group (2011), ISBN: 9781439869185

EF 130 - Operations Management

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Define 'operations' and 'operations management'
CO2	Identify the roles and responsibilities of operations managers in different organizational contexts
CO3	Apply the 'transformation model' to identify the inputs, transformation processes and outputs of an organization
CO4	Identify operational and administrative processes

Course Contents:

Module – I: Introduction to Operations Management ***06 hours***

Introduction to Operation Management, Operations Strategy, Role of Operations Strategy, Importance of Operation strategy, Classification of production system – Job shop, Batch, Mass, Continuous production, Competitive Advantage, Time Based Competition.

Module - II:Product Development Cycle ***06 hours***

Product Decision and Analysis, Product Development, Process Selection, Process Design, Process Analysis, Process-Product Matrix, Evolution of Production Systems, Batch Sizing-Models-Optimization

Module - III: Layout and Management of Operation ***06 hours***

Facility Location, Facility Layout, Capacity Planning, Capacity Decisions, Waiting Lines, Demand Management-models, Resource Planning-models, Total Quality Management, Supply Chain Management and Just-in-Time/Lean Operations

Module - IV: Planning and Management ***06 hours***

Aggregate Planning, Basics of MRP / ERP**,** Basics of Scheduling**,** Basics of Project Management, Basics of Work Study, Job Design and Work Measurement**,** Basics of ISO 14000 / 9000, Basics of Value Engineering & Analysis

Module - V:

Presentation's, case studies, Assignments, Tutorials based on Module I to IV ***06 hours***

References:

1. S. N. Chary, Production & Operations Management McGraw Hill ISBN:9781259005107
2. S. Anil Kumar, N.Suresh Operations Management, New age International Publishers, ISBN : 978-81-224-2587-1
3. E. S. BUFFA, Modern Production Management, 8th Edition, ISBN 9780471819059
4. Norman Gaither, Production and Operations Management, ISBN 10: 0538891084 ISBN 13: 9780538891080
5. S. N. Chary ,Theory and problem in Production and operations Management, ISBN:9780074620526

EF 131 - Materials Management

(02 credits – 50 marks)

Course Outcome

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

CO1	Define Materials and its Management
CO2	Identify Integrated Approach to Materials Management
CO3	Apply techniques for material planning and management
CO4	Prepare the procedure and documentation related to import and custom

Course Contents:

Module – I: Materials Management an overview ***06 hours***

Introduction, Importance of Materials Management, Objectives of Materials Management, Costs involved in the Management of Materials, Integrated approach to Materials Management, organizing Materials Management, Organization based on Commodities, Organization based on Location, Organization based on function, Inter-departmental relationships, Centralized versus Decentralized materials management.

Module - II: Materials Planning ***06 hours***

Introduction and factors influencing materials planning, Techniques of materials planning, Bill-of-Materials, Materials Requirement Planning (MRP), Past Consumption Analysis Technique, Moving Average method, Exponential Smoothing

Module - III: Purchasing ***06 hours***

Purchasing principles, policies, procedures and practices, Objectives, scope, responsibility and limitations, Sources of supply and Supplier selection, Vendor development-evaluation and rating, Price forecasting, Price-cost analysis, Negotiations, Reciprocity, Legal aspects of purchasing, Purchase orders/ contracts, Method of buying-under certainty, under risk, and under uncertainty

Module: International procurement-Imports ***06 hours***

International commercial terms, Import procedures and documentation, Categories of importers, Identification of foreign sources, Payment terms including Letter of credit, Types of L/Cs, Custom tariff, Custom clearance, Bill of Lading and other documents.

Module - V: Presentation's, case studies, Assignments based on Module I to IV ***06 hours***

References:

1. Prof. L.C. Jhamb , Materials and Logistics Management,Everest, Publishing House, Pune,
2. P.Gopalkrishnan ,Purchasing and Materials Management , ,Tata McGraw Hill, New Delhi, ISBN-13: 978-0074516508
3. P.Gopalkrishnan and M. Sundaresan ,Materials Management –An integrated approach, Prentice-Hall India, New Delhi, ISBN : 8120300270.
4. A.K. Datta,Materials Management-Procedures, Text and Cases ,Prentice-Hall India, New Delhi, ISBN: 978-81-203-1251-7
5. JR Tony Arnold and Stephan Chapman ,Introduction to Materials Management , Pearson Education, New Delhi,2004 Fifth Edition, ISBN: 0131 128744

ATLF 127 - Laboratory Coursework based on Automobiles Engines and Engine Design (Auto-CAD)

(03 credits – 100 marks)

Course Outcomes:

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

CO1	Draw Orthographic projection of drawings (Front, Top and side) of machine part in AutoCAD.
CO2	Draw Isometric dimensioned drawing of engine parts
CO3	Apply various commands and used 3D primitives to draw 3D model of machine component
CO4	Perform morse, retardation test on engine for its performance.

List of Practical's: (Any 08 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
7. Trial on Multi point fuel injection engine.
8. Trial on Common Rail direct injection engine
9. Trial on willians line method to calculate frictional power
10. Trial on Motoring Test.
11. Trial on Retardation test.
12. Fuel injector cleaning and perform various tests on injector.

ATLF 128 - Laboratory Coursework based on Automotive Transmission Systems

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Identify the parts of clutches, gear box, transmission system
CO2	Distinguish between types of gear boxes.
CO3	Calculate the gear ratios for single stage gear box.
CO4	Perform demonstration on automatic transmission system

List of Practical's: (Any 05 Practical can be performed)

1. Assembly and Disassembly of Multi plate clutch from transmission unit.
2. Assembly and Disassembly of Sliding Mesh gear box.
3. Assembly and Disassembly of Synchromesh Gear box.
4. Assembly and Disassembly of Differential Gear box
5. Calculation of gear ratios of respective assemblies.
6. Demonstration of Automatic Transmission system
7. Demonstration of Torque Convertor.

ATLF 129 - Laboratory Coursework based on Fuels and Combustion

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Explain construction of combustion chambers in SI and CI engines.
CO2	Assemble various components of LPG and CNG fuel supply system.
CO3	Prepare Heat Balance for engine after trial.
CO4	Conduct performance test on SI and CI engine.
CO5	Perform exhaust gas analysis using exhaust gas analyzer.

List of Practical's: (Any Five experiments can be performed)

1. Identify Combustion chamber of multi cylinder S.I. and C. I. Engine and single cylinder 2/4 stroke engine.
2. Observe and draw layout of LPG or CNG Fuel supply system.
3. Perform exhaust gas analysis of an engine exhaust using 4-gas analyzer. Diagnose engine condition from exhaust gas analysis.
4. Prepare Heat Balance Sheet And Plot Performance Characteristics Curve of An Engine After Trial.
5. Conduct Morse Test on Multi-cylinder Engine & Calculate Frictional Power & Mechanical Efficiency.
6. Conduct performance test on single cylinder diesel engine test rig by varying various engine parameters to study effects of engine variables on performance of CI engine.
7. Conduct performance test petrol engine test rig by varying various engine parameters to study effects of engine variables on performance of SI engine.

ATLC 130 - Laboratory Coursework based on Automobile Control Systems

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	State various parts and its working of automobile control system
CO2	Draw layout of Front Axles, hydraulic braking system, air suspension system, air brakes, power steering system
CO3	Dismantle hydraulically operated air/vacuum assisted braking system, suspension system, power steering system
CO4	Reassemble hydraulically operated air/vacuum assisted braking system, suspension system, power steering system

List of Practical's: (Any Five experiments can be performed)

1. Observe the steering linkages, draw its layout. Dismantle the steering gear box, identify its type, sketch its components and assemble it.
2. Observe and sketch different types of Front Axles. Dismantle the various Front Axles to study its construction.
3. Observe and draw the layout of hydraulic braking system. Dismantle master cylinder, wheel cylinder and remove brake drum, identify and sketch the components and assemble it.
4. Observe and draw the layout of hydraulically operated air/vacuum assisted braking system
5. 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.
6. Dismantle telescopic shock absorber, identify components and draw sketches of components with labels and understand it's working.
7. Observe air suspension system, air brakes, power steering system and draw layout.

ATLC 131 - Laboratory Coursework based on Automobile Air Conditioning

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Explain working of Automobile Air Conditioning system and sub system.
CO2	Describe procedure for evacuation and charging of refrigerant in AC system.
CO3	Perform test on vapor compression AC system to determine its COP.
CO4	Diagnose control system faults; write its causes and remedies.
CO5	Prepare report of troubleshooting of AC system.

List of Practical's: (Any Five)

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. Diagnoses of control systems faults and write causes and remedies.
6. Diagnosis of various running faults in car HVAC and write causes and remedies.
7. Perform trial on A.C. test rig and report the performance.

SEMESTER – II

ATF 221 Transmission System Design

(02 credits – 50 marks)

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, analyze and design the spring for automotive application

Course Content:

Module-I: Design of Shaft (6 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

Module-II: Design of Gearbox (8 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.

Module-III: Design of Clutch (6 Hours)

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

Module –IV: Design of Spring (4 Hours)

Coil Spring, leaf spring, Load on springs, Stresses in spring, Design of Leaf Spring, Spring Index, Stiffness of spring, Springs in series, springs in parallel, Materials for springs, Shot peening of springs.

Module – V: Tutorials, Case studies and presentation based on Module I to IV (06 Hrs)

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

ATF 222 - Automobile Systems Design

(02 credits – 50 marks)

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.
CO5	Prepare the design report in power point.

Course Content:

Module –I: Components Selection (4 Hours)

Tyre selection, air resistance, rolling resistance, requirement of engine power, transmission system layout, four wheel drive, transfer case

Module –II: Transmission systems (8 Hours)

Clutch, types of clutch, clutch design, Gear box, types of gear boxes, gear box design, overdrive gears, Fluid flywheel & torque converter, Epicyclic gear box, semi-automatic & automatic transmission, Propeller shaft, design of propeller shaft, slip joint, universal joint, Final drive, differential, Dead & live axle, axle design, Constant velocity joints

Module –III: Braking system: (6 Hours)

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

Module –IV: Steering systems: (6 Hours)

Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering,

Module – V: Tutorials, Case studies and presentation based on Module I to IV (06 Hrs)

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

ATF 223 - Hydraulic and Pneumatic Systems

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Identify the conditions of fittings, oil, pipes, seals & packing of hydraulic systems in automobile vehicles.
CO2	Carry out troubleshooting and maintenance of Hydraulic & Pneumatic Systems
CO3	Construct the Hydraulic circuits for various applications.
CO4	Construct the Pneumatic circuits for various applications.

Course Content:

Module –I: Introduction to fluid power (06 Hours)

Classification, application in various fluids of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, Types of hydraulic fluids and their properties, effect of temperature on fluids.

Module –II: Hydraulic system elements (07 Hours)

Control of fluid power elements- Pressure control, direction control, flow control valves, pilot operated, relief, pressure reducing, quick exhaust, sequence valves, flow control valves and their types, meter-in and meter-out circuit and flow through circuit. Types of direction control valves, Actuators – linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings. Hydraulic servo-system for rotary and linear motion

Module –III: Pneumatic Systems: (07 Hours)

Application of pneumatics, physical principles, basic requirement of pneumatic system, Comparison with hydraulic systems, Elements of Pneumatics, Air compressors, Pneumatic control valves, Pneumatic actuators - types and the mountings, Air motors – types, Pneumatic circuits – Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuits and their applications. Pneumatic servo-system for linear and rotary motion

Module –IV: Automotive Applications, Maintenance and troubleshooting: **(06 Hours)**

Hydraulic tipping mechanism, power steering, fork lift hydraulic gear, hydro-pneumatic suspension Maintenance and trouble shooting of hydraulic & pneumatic circuits, Introduction to fluidics-study of simple logic gates, turbulence, amplifiers, pneumatic sensors and applications.

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (06 Hours)

References:

1. Industrial Hydraulic & pneumatics – J.J. Pippenger - McGraw Hill, ISBN-13: 978-0070501409
2. Fluid with applications – A. Esposito- PHI Publishers, ISBN: 9781292023878
3. Industrial Hydraulic Manual by Vicker Sperry, ISBN 10: 0963416200
4. Practical guide to Fluid Power by H.S. Stewart
5. ISO 1219 Fluid systems and components
6. Hydraulic and Pneumatic Controls, K. Shanmuga Sundaram, S. Chand Publication, ISBN : 81-219-2635-1
7. Introduction to Hydraulics and Pneumatics, S. Ilango and V. Soundararajan, PHI Learning Private Limited, New Delhi, ISBN: 9788120330795
8. Hydraulic and Fluid Mechanics, Dr. P N Modi Dr. SM Seth, Standard Book House, Delhi, ISBN No, 978-81-89401-26-9
9. Hydraulic & pneumatics- Andrew Parr-Jaico Publishing House, ISBN-9780080966748

ATF 224 - Noise and Vibration

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Demonstrate vehicle noise and vibration level measurement techniques.
CO2	Identify causes and remedies for noise and its environmental impact.
CO3	Identify causes and remedies for vibrations.
CO4	Carry out troubleshooting and maintenance to control noise and vibration in a vehicle.

Course Content:

Module –I: Noise: (04 Hours)

Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Module –II: Noise Testing & Noise Control: **(04 Hours)**

Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management. Road vehicle noise standards

Module –III: Vibration: (09 Hours)

Introduction, Single degree of freedom, damped, forced vibration, Multi degree of freedom vibration, modes, nodes, Holzer's method. Multi degree of freedom of vibration, matrix method, eigen values and vectors, natural frequencies & modes, model analysis, numerical methods for solution, Lagrange's equation for problem formulation, Two degree of freedom system, co-ordinate, coupling, solution Vibration under periodic force, use of Fourier series, Vibration of continuous systems, transverse vibration of cable, bar, torsion vibration of shaft, Rayliegh's method, Reyliegh-Ritz method

Module –IV: Vibration control (07 Hours)

Balancing of reciprocating & rotating masses, controlling natural frequencies, vibration isolation, vibration absorbers, Basics of non-linear vibration, causes of non-linearity, formulation, solution methods, iterative, graphical, methods of isoclines, stability of equilibrium state, types of singularity, limits cycle. Basic vibration measuring set up, brief introduction to experimental model analysis

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (6 Hours)

References:

1. Mechanical Vibration – S. S. Rao, New Age International (P) Ltd., New Delhi, ISBN: 9780201065510
2. Engineering Mechanics Static & Dynamics – I. H. Shames, ISBN-10 8177581236
3. Mechanical Vibration Analysis, P. Srinivasan, Tata McGraw Hill Pub. New Delhi, ISBN: 9780074519332
4. Non-linear Mechanical Vibration – P. Srinivasan, Tata McGraw Hill Pub. New Delhi, ISBN: 978-0-470-23439-6
5. Fundamental of Mechanical Vibration – S. Graham Kelly, Tata McGraw Hill Pub., ISBN-10: 1577666917
6. Mechanical Vibration – Grover G. K., Nem Chand & Brothers, Roorkee, ISBN-13:9788185240565
7. Engineering Vibration – Daniel J. Inman, Prentice Hall, NJ, 4th Edition, ISBN: 9780132871693
8. Theory of Vibrations – W. T. Thomson, CBS Publishers, New Delhi, ISBN 13: 9780136510680
9. Noise, Pollution & Control – S. P. Singal, Narosa Publishing House, New Delhi, ISBN: 9788173193637

ATC 225 - Automobile Body Engineering

(02 credits – 50 marks)

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:

Module –I: Vehicle Aerodynamics: (05 Hours)

Objects- vehicle drag and types, various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, principle of wind tunnel technology, flow visualization techniques, tests with scale models.

Module –II: Car Body Details: (04 Hours)

Types of car bodies, visibility, regulations, driver's visibility, methods of improving visibility, safety design, constructional details of roof, under floor, bonnet, boot, wings etc, Classification of coach work,

Module –III: Design of Vehicle Bodies: (08 Hours)

Vehicle body materials, Layout of the design, preliminary design, safety, Idealized structure- structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads, different loading situations- load distribution on vehicle structure, Calculation of loading cases Stress analysis of bus body structure under bending and torsion, stress analysis in integral bus body, Design of chassis frame, Rules and regulations for body, Recent safety measures, Testing of body.

Module –IV Frame and Body repair (07 Hours)

Frame repairs (for cracks, loose rivets, and skewness in frames) and alignments, Body repairs- Procedure to remove dent, denting tools and equipments, Adjustment of doors and locks, Repainting procedure, patch work, Painting defects

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (6 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 226 - Vehicle Dynamics

(02 credits – 50 marks)

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:

Module –I: Introduction of Vehicle Dynamics (04 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,

Module –II: Steady State and Transient Operation (08 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.

Module –III: Acceleration and Braking Characteristics: (06 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.

Module –IV: Handling Mode and Ride Mode: (06 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. 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

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (6 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

ATLF 227 - Laboratory Coursework based on Hydraulic and Pneumatic Systems

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Identify various pumps and its parts used in hydraulics application.
CO2	Build the meter in and meter out circuit.
CO3	Find faults, probable causes and remedial action to trouble shoot problems in hydraulic circuits.
CO4	Demonstrate Bernoulli's principle and its application

List of Practicals: (Any Five experiments can be performed)

1. Understand and Verify Bernoulli's theorem by using Bernoulli's Apparatus.
2. Calculate the coefficient of discharge (Cd) of Venturimeter by using setup of convergent - divergent section.
3. Determine overall efficiency of Centrifugal Pump & plot its operating characteristics by using Centrifugal pump test rig.
4. Dismantling and assembly of reciprocating pump to identify components, functions of each component and prepare trouble shooting chart.
5. Understand operation of Hydraulic trainer having simple circuit actuation with single acting cylinder.
6. Understand functions of various components in pneumatic trainer with simple circuit actuation of double acting cylinder.
7. Construct and operate speed control Hydraulic circuit for speed control of Double Acting Cylinder by Meter in, Meter out, By pass methods.
8. Understand faults, probable causes and remedial action that can be taken to trouble shoot problems in hydraulic circuits
9. Perform mini project on practical application of hydraulic and pneumatics

ATLF 228 - Laboratory Coursework based on Noise and Vibration

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Perform pass by noise test
CO2	Find fault for creation of engine noise, transmission noise and their remedies.
CO3	Do Vibration measurement in passenger compartment.
CO4	Handle vibration measurement instruments like vibrometer.

List of Practicals: (Any Five experiments can be performed)

1. Pass- by noise test.
2. Vibration measurement in passenger compartment
3. Use of vibration measurement instruments like vibrometer, velocity pick-ups, frequency measurement instrument.
4. Noise control at source – along the path – isolation, damping, balancing, resonators, absorption, barriers and enclosures
5. Methods for control of engine noise, transmission noise.
6. Methods for control of intake and exhaust noise
7. Methods for control of aerodynamic noise, tyre noise, brake noise

ATLC 229 - Laboratory Coursework based on Solid Modeling

(3 credits – 100 marks)

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

CO1	Explain commands used in solid modelling.
CO2	Design and Drawing of Piston, Piston pin, and Piston rings.
CO3	Design and drawing of connecting rod, inlet and exhaust valves.
CO4	Design and drawing of crankshaft, camshaft and gears.
CO5	Assemble drawn components with major components of engines.

List of Practical's: (Any 08 Practical can be performed)

1. Introduction to solid modeling their commands
2. Design and drawing of Piston
3. Design and drawing of Piston pin and piston rings
4. Design and drawing of Connecting rod
5. Design and drawing of Inlet and Exhaust valves
6. Design and drawing Crankshaft
7. Design and drawing of Camshaft
8. Design and drawing of Gear.
9. Design and drawing of Spring
10. Design and drawing of pin.
11. Engine complete assembly with cylinder block, cylinder head, crankcase, valve ports, water jackets, front and rear end details.

Software Used: PRO-E/ Solidworks /CATIA

ATLC 230 - Laboratory Coursework based on Automobile Body Engineering

(1.5 credits – 50 marks)

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

CO1	Analyze effect of drag force on various automobile body parts.
CO2	Calculate Aerodynamic forces during pitching, rolling and yawing.
CO3	Demonstrate various painting techniques used in automobile.
CO4	Use denting tools for minor repairs and denting process.

List of Practicals: (Any Five experiments can be performed)

1. Study of effect of different shapes, styles and exterior objects on drag force.
2. Calculation of aerodynamic forces and pitching, rolling, yawing moments.
3. Measurement of drag, lift force of a scaled model in wind tunnel.
4. Use of denting tools and denting process.
5. Vehicle surface preparation and masking
6. Painting techniques- use of paint booth.
7. Painting defects- Probable causes and remedies for Spray pattern

ATLC 231 - Laboratory Coursework based on Automotive Electrical System Diagnosis

(1.5 credits – 50 marks)

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

CO1	Use oscilloscope to test vehicle components like sensors and actuators
CO2	Demonstrate Engine analyzer in vehicle engine management system.
CO3	Diagnose the lighting and auxiliary system in vehicle.
CO4	Diagnose battery faults and perform battery testing.

List of Practicals: (Any Five)

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 232 - Research / Industrial Project (Phase-I)

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

(5 credits – 100 marks)

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.

SEMESTER-III

ATC 321 - Vehicle Testing

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Classify various vehicle approval methods.
CO2	Describe vehicle testing procedures.
CO3	Measure engine pollution using exhaust gas analyzer.
CO4	Describe Automobile Testing Standards.

Module:I Engine Testing and Diagnosis (05 hours)

Need of vehicle testing and homologation, Vehicle testing organizations, Hierarchy of testing: Individual component approval, System level approval and Whole vehicle approval. Type Approval & Conformity of Production tests.

Module:II Vehicle System Testing (7 hours)

Brake Test, Acceleration Test, Retardation Test, Chassis Dynamometers, Two wheeler chassis dynamometer, Ultrasonic fuel injector test, gradient test, crash worthiness test simulation, Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, Gradability test, Turning circle diameter test, Steering Impact test, Steering effort test

Module:III Emission and Pollution Testing (5 hours)

Pollution due to exhaust gases, gas analyzer, 4 gas analyzer, Diesel smoke meter, Orsat apparatus, performance, emission and fuel economy, Operation of full load and part load conditions, effect of vehicle condition

Module: IVAutomobile Testing standards (7 hours)

Introduction, overview and study of testing standards like; Bharat Stage, AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles.

Module -V Tutorials, case studies and presentation based on Module I to IV (6 hours)

References:

1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. J. G. Giles – Vehicle operation and performance, Wildlife Publications, London,
3. W. H. Crouse and L. Anglin – Motor vehicle inspection, McGraw Hill Book Co.
4. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
5. Ulrich Seiffert and LotharWech, "Automotive Safety Handbook", SAE International, 2007
6. ISO Standards, ICS: 43.020, 43.040, 43.100

ATC 322 Transport Management

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Explain the evolution of transport management.
CO2	Administer the organization, personal, and operational requirement for successful transportation department.
CO3	Prepare model of traffic flow, transportation demand and supply.
CO4	Perform analysis of transport and logistic strategy.
CO5	Practice road safety activities.

Module - I: Motor Vehicle Act (05 hours)

Short titles and definitions, laws governing, use of motor vehicle licensing and registration, taxation structure, insurance type, traffic rules, signals and control, different types of forms , government administrative structure

Module - II: Road Transportation and Cost of service (04 hours)

Road transportation, Advantages, significance, transport planning, transport terminology, Capital cost, operating cost, fixed cost, variable cost, direct cost and indirect cost.

Module - III: Infrastructure, productivity and efficiency (08 hours)

Garages, essential requirement, fleet maintenance record, bus station, bus shelter, bus stops, staffing, management of transport organization, structure of organization, motivation, productivity of road transportation organization, environment, fleet and vehicle utilization, fuel and oil economy, control of breakdown, effective traffic operation.

Module - IV: Road safety (07 hours)

Driving in comfort, avoiding fatigue, poisonous car fumes, drugs and driving first aid for motorist, first aid kits, braking and stopping, mist care and precaution, ice show skidding, emergencies and road observations. Definition of accident, legal obligation, causes of road accidents, analysis and prevention, insurance documentation, road safety, driver selection test, driver training, security devices

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. Road transport in india, P.G.Patankar (C.I.T.T. Publication)

2. Productivity in road transportation, Santosh Sharma (A.S.R.T.V. publication)

2. Motor Vehicle Act. 1989

4. Compendum of transport Term- (C.I.R.T publication)

ATGE 323 - Automotive Maintenance & Management

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Carry out the complete maintenance and management of automotive system.
CO2	Do the critical analysis of breakdown and preventive maintenance.
CO3	Inspect engine components to ensure proper performance.
CO4	Design layout of garage.

Module I:Introduction to maintenance Management (06 hours)

Importance of maintenance, scheduled and unscheduled maintenance, preparation of check lists, analysis of breakdown, preventive measures, unit replacement system, maintenance schedule, chassis lubrication schedule, component retrieval, estimating repair cost, warranty period, servicing, Inspection forms, Log books, Trip sheets, Other maintenance record forms, Garage practice: Types of service station/garage, layout of garage, Factors affecting layout, transport service undertakings, design a layout for different garage

Module II: Engine Maintenance (07 hours)

Dismantling of engine components, cleaning methods, visual inspection and dimensional check of various engine components, minor and major tune up, reconditioning and repairing methods of engine components. Assembly procedure, special tools used for maintenance, repair and overhauling. Cooling Systems-Anti corrosion and antifreeze solutions, radiator, and thermostat. Lubrication oil topping up, oil change, oil relief valve; fuel feed systems, FIP adjustment and testing, Ultrasonic fuel injector testing

Module III: Chassis and Drive line Maintenance (05 hours)

Chassis and drive line maintenance: Mechanical automotive type gear box, synchromesh gear box, Universal joint, propeller shaft, Automatic Transmission, front and rear suspension systems, brake systems-hydraulic, servo, Air bleeding, Steering system, Axles, wheel alignment-tyres

Module IV: Electric System Maintenance (06 hours)

Battery testing method, starter motor, charging system - a DC generator, AC alternator, regulator, ignition system- coil ignition, transistor assisted ignition, capacitor discharge ignition, Alternator Testing, Electric horn, wiper motor, flasher, electric fuel pump, gauges. Lighting system- head lights focusing.Wiring harness testing.

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. John Doke "Fleet Management", McGraw-Hill Co.
2. Maleev. V.L., "Diesel Engine operation and Maintenance", Maintenance, McGraw Hill book Co., New York
3. Judge. A.N., "Motor vehicle engine servicing, 3rd, Edition", Pitman Paperpack, London,
4. Judge. A.W., "Maintenance of High speed diesel engines", Chapman Hall Ltd., London,
5. John. W.Vale.J.R., "ModernAut Body and Finder repair".
6. Venk. Spicer. "Automotive Maintenance and Trouble shooting"
7. "Vehicle Service Manuals of reputed manufactures."

ATGE 324: Finite Element Methods

(02 credits – 50 marks)

Course outcomes

The student should be able to–

CO1	Formulate numerical model for a given system.
CO2	Obtain numerical Solutions for boundary value problems.
CO3	Solve mechanical engineering problems using Finite Element Method
CO4	Explain the weighted residual methods

Course Content:

Module-I: Introduction to Finite Element Methods (5 hours)
Introduction, Basic concept of Finite Element methods, Discretization of continuum, Stiffness Matrix and Boundary Conditions, Introduction to elasticity, Plane Stress and Plain strain Problem.

Module II: Finite Element Formulation Techniques (6 hours)
Virtual Work and variational principle, Variational Formulation of Boundary Value problem, Variational Method: Ritz and weighted Residual methods. Galerkin Method, Potential Energy Approach, Displacement Approach

Module III: Element Properties (7 hours)
Natural coordinates, Triangular Elements Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements Isoparametric Formulation Stiffness Matrix for Isoparametric Elements, Numerical Integration

Module IV: Displacement Models (06 hours)
Convergence requirements, Shape functions, Element stresses and strains Strain—Displacement Matrix for Bar Element, Strain Displacement Matrix for CST Element, Strain Displacement Relation for Beam Element

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (06 hours)

References:

1. S.S.Bhavikatti, ―Finite Element Analysis‖, New Age International Publication, 2nd Edition.

2. Desai and Abel, ―Introduction to FEM‖, 2nd Edition.

3. Zienkiewicz & Taylor, ―The Finite Element Method for Solid and Structural Mechanics Elsevier Publications‖, 6th Edition, 2005.

4. J. N. Reddy, ―Finite Element Analysis‖, McGraw Hill Book Co.6th Edition 2010.

5. S. S. Rao, ―Finite Element Method in Engineering‖, 4th Edition, Dec. 2004Pergamon Press.

ATGE 325: Vehicle Aerodynamics and Design

(02 credits – 50 marks)

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	Apply CFD for aerodynamic design of vehicle.

Course Content:

Module I: Fundamentals of Aerodynamics (5 hours)

Scope – Concept of bluff body, Generic shapes, Relevance of these shapes to ground vehicles, Pressure drag & viscous drag. Flow phenomena related to vehicles, External and Internal flow problems, Performance of cars and light vans, Resistance to vehicle motion, Flow field around car, Aerodynamic development of cars, Optimization of car bodies for low drag.

Module II: Stability, Safety and Comfort (6 hours)

The origin of forces and moments, vehicle dynamics under side wind, Force and Moment Coefficients, Safety limit Design stage measures, Modifications of other details & their effect, Important factors affecting Aerodynamics , Rear slant, Engine cooling air drag, Crosswinds, Underside flows, Wheel Rotation, dirt accumulation on vehicle , wind noise,

Module II: Wind Tunnels and Test Techniques (7 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, Flow visualization techniques, Road testing methods, Wind noise measurements.

Module IV: Application of CFD and Aerodynamic Design (6 hours)

Methods to solve Navier–Stokes equation, Forces acting in a fluid element, Compressibility effects in a flow field, Inviscid flow, Governing equations, Irrotational flow field and consequences, Potential flows, Boundary layer methods Important requirements of CFD solver, Geometric / Dynamic similarity, Robust Flow solver / Numerical scheme, Convergence level, Transition prediction, Turbulence models. Numerical modelling of fluid flow around vehicle body. Development and simulation methods –cars, buses, trucks. Surface Motion, Surface permeability, Mass addition, Energizing the external flow

Module –V: Assignments / seminars / case studies on Module -I to Module – IV (6 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)

ATGE 326 Autotronics

(02 credits – 50 marks)

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	Elaborate embedded system application in automotive.
CO4	Demonstrate the working of serial communication using I2C, CAN, USB buses and parallel communication using ISA, PCI.

Module I: Instrumentation application in Vehicles (06 hours)

Analysis of Fuel and Emitted particles CO_2, NOx, Hydro carbons, Modern automotive instrumentation – computerized instrumentation system,multiplexing,sampling and advantages – Measurements – fuel quality, coolant temperature, oil pressure vehicles speed, Display devices – LED, LCD, VFD, CRT and types, CAN network, the glass cockpit andinformation system.

Module II: Embedded application in motor vehicles (05 hours)

Introduction to functional building blocks of embedded systems – Register, memory devices,ports, timer, interrupt controllers using circuit block diagram representation for each categories –Devices & buses for devices network

Module III: Communication Protocols (06 hours)

Serial bus, CAN bus, GPS tracking Systems, serial communication using I2C, CAN, USB buses – parallelcommunication using ISA, PCI - device drivers in a system – Serial port & parallel portMicroprocessor based front panel Indicators Ignition Systems – Engine Controls – RTOS applications.

Module IV: Intelligent Sensors (07 hours)

Sensors for intelligent transport systems,Supplementary Restraint System, wipers, climate control and electronic displays, Sensors for occupant safety, The digital vehicle, Intelligent vehicle systems, Sensors and interfacing techniques for Engine control, adaptive cruise control, braking control, traction control, steering and stability, ABS system, Electronic power steering.

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. William B. Ribbens, *Understanding Automotive Electronics*, 5th edition, Newnes
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, TataMcGraw Hill, New Delhi

ATGE -327 Automotive Metallurgy

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Define Selection criteria for various components and importance
CO2	Sate different class of materials and their applications
CO3	Select heat treatment and surface modification technique for specific component
CO4	Select material for automotive component

Module I: Metallic Materials (04 hours)

Effect of alloying additions, classifications of steels and cast irons, High Strength Low Alloy Steels (HSLA), copper base alloys, aluminum base alloys, zinc base alloys, titanium alloys, typical properties of alloy grades, methods of identification of alloy grades steel melting practices,

Module II: Heat Treatment and Surface Modification of Materials (07 hours)

Hear treatment- Definitions, Techniques of Heat treatment, Isothermal transformation diagrams, cooling curves, Hardenability, importance of heat treatment in design of components.

Mechanical surface treatment and coating - Case hardening and hard facing - thermal spraying – vapour deposition- - Diffusion coating - Electroplating and Electro-less - Conversion coating - Ceramic coatings – laser based surface modification, Diamond coating.

Module III: Non-metallic materials, Composites & Other Materials (06 hours)

Types of polymer, Properties and auto applications, Types of elastomers**,** properties and auto applications, Fiber reinforced plastics (FRP), engineering ceramics, metal matrix composites, nano composites, Automotive glasses, Electrical insulating materials. Sound insulating materials, Protective coating materials, Sealant and adhesives, Smart & Refractory materials

Module IV: Automotive Fluids & Selection of Materials (07 hours)

Type of fluids, its properties, importance and effects on vehicle performance
Selection criteria for auto components – cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel, clutch plate, axle, bearings, chassis, spring, shock absorber, propeller shaft, body panel, radiator, brake liners and brake pads, batteries, fuel tank, seats, application of non-metallic materials such as plastics, composites, ceramics, etc.

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. Raghavan.V.Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 1999.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw-Hill Book Company, 1994.
4. C. Daniel Yesudian, D. G. Harris Samuel "Material Science and Metallurgy", SPI Publication, 2006
5. Donald R Askeland, P. P. Phule "Essentials of Materials Science and Engineering, Cengage Learning, 2008

ATGE -328 Special Purpose Vehicles

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Describe the combat vehicles
CO2	Describe the working of stratified charged/lean burn engines
CO3	Describe the working of drive line in combat vehicles and earth moving vehicles compared with commercial vehicles
CO4	Describe the construction of farm equipments
CO5	Describe the working of power trains in heavy vehicles and able to analyze the ride characteristics of tractors

Module I: Tractors and Farm Equipments (05 hours)

Classification and power required - Design consideration - Ride and stability characteristics power plants and transmission - Farm equipments.

Module II: Earth Moving Machines (07 hours)

Construction and operation aspects of Bull dozers, Scrapers, Dumpers, Loaders, Mobile cranes, Road rollers, Elevators and Elevating graders. Selection criteria of prime movers for dumpers and front end rollers based on vehicle performance characteristics.

Module III: Military and Combat Vehicles (06 hours)

Special requirements like power, fuel strength and impact resistance tanker, Gun carrier and transport vehicle.

Module IV: Heavy Vehicles & Other Special Vehicles (06 hours)

Power plants - Converter match curves, chassis and transmission (epicyclic). Selection criteria for universal joints. Harbor and Airport Vehicles, Fire Station Vehicles, Jib cranes, Vibratory compactors, Borewell Machines, Concrete mixtures - Constructional Details

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. Construction planning, Equipment and Methods - Robert L. Peurifoy, William B. Ledbrtter, Clifford J. Schexnayder - McGrawHill, Fifth Edition.
2. Y. Pokras and M. Tushnyakov, “Construction Equipment Operation & Maintenance”, MIR, Moscow.
3. A. Astskhov, “Truck Cranes”, MIR, Moscow.
4. E.G. Poninson, “Motor Graders”, MIR, Moscow
5. Hand book of Earth Moving Machinery - Central Water & Power Commission (Govt. of India)
6. N. Rudenko, “Material Handling Equipment”, M.R. Publishers
7. Sheldon, R.Shacket, “Electric Vehicles”, Domus Books, New York
8. David A. Day, Neal B. H. Benjamin, “Construction Equipment Guide”, Wiley; 8. C.P. Nakra, “Farm Machines and Equipment”, Dhanpat Rai Publications, New Delhi
9. Donnell hunt and L .W.garver - Farm machinery and mechanism - Lowa state university press
10. J.Y Wong - Theory of Ground vehicles - John Wiley and Sons
11. Motor cycle - M. Michaeal Griffer
12. A. Gurevich and E.Soreking, Tractors Mir Publishers, Moscow, 1967.
13. V. Rodichev & G. Rodicheva, Tractors and automobiles, MIR Publishers, Moscow.

ATOE -329 Robotics

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Configure robots with components and devices.
CO2	Make automation module based on sensor inputs.
CO3	Demonstrate the working of actuators, feedback components, and position sensors.
CO4	Find the scope of robotics in material handling in manufacturing.

Module I: Components of the Industrial Robotics (06 hours)

Introduction,An over view of Robotics – present and future applications – classification by coordinate system and control system, Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom –requirements and challenges of end effectors, determination of the end effectors

Module II:Motion Analysis (06 hours)

Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems

Module III:Robot Actuators and Feedback Components (05hours)

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

Module IV:Robot Application in Manufacturing (07hours)

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection, Automated Guided Vehicle (AGV), Automated Retrieval System

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. Industrial Robotics / Groover M P /Pearson Education
2. Robotics and Control / Mittal R K &Nagrath I J / Tata Macgraw Hill
3. Robotics / Fu K S/ McGraw Hill.
4. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd.
5. Robotic Engineering / Richard D. Klafter, Prentice Hall
6. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
7. Introduction to Robotics / John J Craig / Pearson Education
8. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons

ATOE 330: CNC Technology

(02 credits – 50 marks)

Course Outcomes:
On completion of the course, students should be able to –

CO1	1 Define the basic of CNC machine.
CO2	2 Apply Features of CNC Machines and Retrofitting
CO3	3 Design CNC part programming.
CO4	4 Describe types of measuring systems in CNC machines.

Course Contents:

Module -I: Fundamentals of CNC Machines (5 Hours)

Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines.

Module –II: Constructional Features of CNC Machines and Retrofitting (7 Hours)

Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors. Retrofitting of Conventional Machine Tools: Modification to be carried out on conventional machines for retrofitting.

Module -III: Control System, Feed Back Devices and Tooling (6 Hours)

Description of a simple CNC control system. Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices

Module – IV: CNC Part Programming (5 Hours)

Part Program Terminology-G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming. Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements.

Module – V: (6 Hours)

Tutorials, Assignments, Demonstrations and Presentation Based On Module I to IV.

References:

1. Radhakrishnan P., Computer Numerical Control Machines, New Central Book Agency 1992.
2. Berry Leatham – Jones, Computer Numerical Control, Pitman, London, 1987.
3. Steave Krar And Arthur Gill, Cnc Technology And Programming, Mcgraw–Hill Publishing Company, 1990. 46
4. Hans B.Kief And T.Frederick Waters, Computer Numerical Control Macmillan/Mcgraw-Hill, 1992.
5. G.E.Thyer, Computer Numerical Control Of Machine Tools. Second Edition, B/H Newnes, 1993.
6. Groover, M.P., Automation, Production Systems And Computer Integrated Manufacturing, Prentice Hall, 1998.
7. Mike Mattson, "Cnc Programming Thomson Learning, 2003. Me3306
8. Yoreur Koren, "Computer Control Of Manufacturing Systems", Pitman, London, 1987

ATOE 331: Automated and Computer Integrated Manufacturing (CIM)

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Develop an understanding of CAD systems and graphical modeling.
CO2	Explain data bases and numerical analysis related to CIM
CO3	Describe Computer Aided Process Planning (CAPP) Systems, Robotic Systems, Group Technology and Cellular Manufacturing Systems
CO4	Analyse Automated Material Handling Systems, Automated Inspection Systems, and Flexible Manufacturing Systems.

Course Content:

Module –I: Concept Of CIM **5 hours**

Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking.

Module –II: CIM Database Introduction **7 hours**

Database requirements of CIM, Database, Database management, Database Models, EDM, Product Data Management (PDM), Advantage of PDM., Collaboration Engineering.

Module –III: Work Cell & Flexible Manufacturing System **7 hours**

Manufacturing cell, Group Technology, Cellular Manufacturing. DNC system and transfer of program from PC to machine. Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing-Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated stations, allied operation centers.

Module –IV: Integrative Manufacturing Planning **5 hours**

Over view of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy.

Module –V: Tutorials, case studies and presentation based on Module I to IV **6 hours**

References:

1. Paul G. Ranky, The Design and Operation of FMS, I.F.S. Publications 1983 ISBN 10, 0903608448.
2. Harrington J, Computer Integrated Manufacturing Krieger Publications 1979 ISBN 10: 0831110961
3. David Bedworth et.al Computer Integrated Design and Manufacturing McGraw hill 1991 ISBN-10: 0071008462
4. David L. Goetsch, Fundamental of CIM Technology, Delmar Publication 1988 ISBN-10: 0827328443
5. Groover, M.P., (2004), Automation, Production Systems & Computer Integrated Manufacturing second edition, Pearson Education ISBN: 81-7808-511-9

ATLC 332 Laboratory Coursework based on Vehicle Testing

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Demonstrate Morse Test on Petrol Engine.
CO2	Measure performance of two wheeler using two wheeler chassis dynamometer.
CO3	Perform cleaning and Testing of fuel injectors.
CO4	Measure Indicated Power, Brake Power of single cylinder engines.
CO5	Perform exhaust gas analysis using exhaust gas analyzer.

List of Practical: (Any 05 practical can be performed)

1. Performance Test of Petrol Engine by using Morse Test
2. Performance Test of Single cylinder engine on Diesel and petrol mode
3. Ultrasonic Injector Cleaning and Testing
4. Acceleration test on two wheeler chassis dynamometer.
5. Brake Test on two wheeler chassis dynamometer.
6. Gradient Test of Vehicle
7. Exhaust gas analysis by Exhaust gas Analyzer

ATLC 333 Laboratory Coursework based on Wheel Balancing and Wheel Alignment

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Explain the use of wheel alignment and balancing machine.
CO2	Demonstrate the wheel geometry and different wheel angles.
CO3	Diagnose various faults in wheel geometry and wheel angles.
CO4	Design wheel geometry and wheel angles for different working condition.
CO5	Prepare a report on performance of vehicle using particular wheel geometry and wheel angle.

List of Practical: (Any 05 practical can be performed)

1. Introduction of wheel alignment machine.
2. Introduction of wheel balancing machine.
3. Study on Interpreting wheel alignment readings and charts.
4. Study of Static wheel balancing.
5. Study of dynamic wheel balancing.
6. Study of Caster angle alignment effects.
7. Study of Camber angle alignment effects.
8. Study of Toe in, Toe out alignment effects.
9. Study of Steering Axis Inclination.

ATLE 334 Laboratory Coursework based on Automotive Maintenance & Management
(Generic Elective – I) (1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Distinguished between preventive and breakdown maintenance
CO2	Prepare Automotive Maintenance chart.
CO3	Analyze Automotive Maintenance Standard of a vehicle.
CO4	Use various devices to test wiring harness.

List of Practical: (Any 05 practical can be performed)

1. Study of Automobile preventive Maintenance chart.
2. Study of Schedule Maintenance Chart.
3. Study of Pre-Trip and Post Trip Inspection chart.
4. Study of Mechanic service chart.
5. Study of Maintenance log for year.
6. Study of Heavy Vehicle Maintenance Management Standard.
7. Study of wiring harness testing.

ATLE 335: Laboratory Coursework based on Finite Element Methods

(1.5 credits – 50 marks)

Course outcomes:

After completion of the course, The student should be able to:

CO1	Solve 1-D Element Problems on structural analysis.
CO2	Solve 2-D Element Problems on structural analysis
CO3	Solve 3-D Element Problems on structural analysis
CO4	Solve problems on thermal analysis

List of Practical: (Any 05 practical can be performed)

1) 1-D Element Problems –Linear Static Analysis. (Structural Analysis)
2) 2-D Element Problems – Linear Static Analysis. (Structural Analysis)
3) 3-D Element Problems – Linear Static Analysis. (Structural Analysis)
4) 1-D Element Problems-Steady state And Transient Analysis. (Thermal Analysis)
5) 2-D Element Problems of Homogeneous and Composite Slap in Steady State and Transient Analysis. (Thermal Analysis)
6) 3-D Element Problems of Homogeneous and Composite Slap in Steady State and Transient Analysis. (Thermal Analysis)

Reputed FEA software like **Hyper Mesh /ANSYS** will be used for above mentioned Assignments.

ATLE 336: Laboratory Coursework based on Vehicle Aerodynamics and Design

(1.5 credits – 50 marks)

Course outcomes

After completion of the course, The student should be able to:

CO1	Explain wind tunnels and testing techniques
CO2	Apply CFD for aerodynamic design of vehicle
CO3	Solve problems using commercial CFD software.

List of Practical:

1. Measurement of Pressure Distribution on an aerofoil using wind tunnel.
2. Measurement of lift and drag force for an Aerofoil using wind tunnel.
3. Exposure to CFD software for solving problems on Laminar Pipe Flow.
4. Exposure to CFD software for solving problems on turbulent pipe flow.
5. Exposure to CFD software for solving problems on Flow over a flat plate.
6. Exposure to CFD software for solving problems on Flow over an aerofoil.

ATLE 337 Laboratory Coursework based on Autotronics (Generic Elective – II)

(1.5 credits – 50 marks)

Course Outcomes:

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

CO1	Carry out Addressing in TCP/IP and Ping Command
CO2	Demonstrate the working of Microcontrollers
CO3	Analyze networking in vehicle system
CO4	Interface Stepper Motor using 8051 microcontroller

List of Practical:

1. Study of Addressing in TCP/IP and Ping Command
2. Study & Implementation of cable designs in Networking.
3. Implementation of Peer to Peer Network and Client- Server Network.
4. Study on a interfacing of DC Motor with PIC microcontroller.
5. Study on a interfacing of LCD using 8051 microcontroller.
6. Study on a interfacing of Stepper Motor using 8051 microcontroller.
7. Measure speed of motor using non contact type photo electric / Inductive pick up/Tachogenerator.
8. Study of AC/ DC motor

ATLC 338 Laboratory Coursework based on Automotive Metallurgy

(1.5 credits – 50 marks)

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

CO1	Define basic concept of Material Science and Metallurgy
CO2	Know about the ferrous and nonferrous metals and alloys and their applications
CO3	State different non-destructive testing methods
CO4	Find the causes and prevention of metallic corrosion
CO5	Judge the Scope and limitations of different materials

List of Practical: (Any 05 practical can be performed)

1. To identify the different types of material available for design, manufacturing and processing of various components based on structure-property-performance-processing relationships.
2. To show the effect of different quenching media (Oil, Water and Brine) on the hardness of medium carbon steel.
3. To understand the concept of hardenability and its relevance to heat treatment procedure to be adopted in practice.
4. To find out the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section.
5. Study of different heat treatment processes- annealing, normalizing, hardening and tempering, surface and casehardening to improve properties of steel during processes and applications.
6. To understand the procedure of testing, nature of indication, the capability and sensitivity of the liquid penetrant test and the magnetic particle test.
7. To understand the procedure of testing, nature of indication, the capability and sensitivity of the Eddy current test and the Ultrasound test.

ATLC 339 Laboratory Coursework based on Special Purpose Vehicles

(1.5 credits – 50 marks)

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

CO1	State special type of vehicles based on the need and purpose
CO2	Describe the working principles of individual SPV
CO3	Describe both technical and operational features of SPV
CO4	Design considerations and features of SPV.

List of Practical: (Any 05 practical can be performed)

1. Study of tipping mechanism of a dumper
2. Study of forklift truck
3. Study of operation of a truck crane
4. Study of technical & operational features of a tractor
5. Study of technical & operational features of a power scraper
6. Study of technical & operational features of a power hoe and shovel
7. Study of an extinguishing vehicle

ATR 340

Research/ Industrial Project – Phase II

(Experimental Work)

(09 credits)

SEMESTER -IV

ATGE 421- Automotive Emission and controls

(2 credits – 50 marks)

Course Outcomes:

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

CO1	Explain the formation mechanism of various types of pollutants from SI and CI engines.
CO2	Analyze the effect of vehicle population and emitted pollutant on human health environment.
CO3	Explain emission control techniques.
CO4	Explain emission standards and test procedure.

Course Content:

Module I: Emissions from Spark Ignition Engine Vehicles and their Control

Emission formation in S.I. engines - Hydrocarbons, Carbon monoxide, Oxides of Nitrogen, Polyneculear Aromatic Hydrocarbon. Effects of design and operating variables on emission formation in Spark Ignition engines Controlling of pollutant formation in engines Exhaust after treatment, Charcoal Canister Control for Evaporative Emission Control, emissions and drivability, Positive crank case ventilation system for UBHC emission reduction.

Module II: Emissions from Compression Ignition Engine Vehicles and their Control

Chemical delay, intermediate compound formation, Pollutant formation on incomplete combustion, Effect of design and operating variables on pollutant formation, Controlling of emissions, emissions and drivability, Exhaust gas recirculation, exhaust after treatment.

Module III: Emission Measurement and Test procedure

Measurement of CO, CO2, by NDIR. Hydrocarbon by FID – Chemiluminescent detector for NOx measurement, Smoke meters – Dilution tunnel technique for particulate measurement. Procedures on Engine and Chassis Constant Volume Sampling procedures –Emission Test– Sampling probes and valves – Quantifying emissions – Dynamometers.

Module IV: Health effects of Emissions from Automobiles and Emission Norms

Emission effects on health and environment. Emission inventory, ambient air quality monitoring As per Bharat Standard up to BS – IV and procedures for confirmation on production.

Module -V Tutorials, case studies and presentation based on Module I to IV

Reference Books

1. Ganesan.V, Internal Combustion Engines, Tata McGraw Hill, 1994.
2. Crouse.W.M, Anglin.A.L., Automotive Emission Control, McGraw Hill 1995.
3. Springer.G.S, Patterson.D.J, Engine Emissions, pollutant formation, Plenum Press, 1986
4. Patterson, D.J, Henin.N.A, Emissions from Combustion engines and their Control, Anna Arbor Science,
1985. Linden.D, Handbook of Batteries and Fuel Cells, McGraw Hill, 1995.
5. Maxwell et al, Alternative Fuel: Emission, Economic and Performance, SAE, 1995
6. Watson, E.B., Alternative fuels for the combustion engine, ASME, 1990
7. Bechtold, R., Alternative fuels guidebook, 1998.
8. Joseph, N., Hydrogen fuel for structure transportation, SAE, 1996.

ATGE 422- Hybrid Vehicles

(02 credits 50 Marks)

Course Outcomes:

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

CO1	Explain the fundamentals of hybrid Electric vehicle.
CO2	Select the powertrain for hybrid vehicle.
CO3	Identify the architecture of Hybrid Vehicles.
CO4	Elaborate Fuel Cell Energy system and Diagnostics of HEV

Module I: Fundamentals of Hybrid Electric Vehicles (06 hours)

Introduction, History of Hybrid Vehicles, Basics of Electric Vehicle, Architecture of Hybrid electric vehicle, Series HEV, Parallel HEV, Hybridization ratio, Constituents of HEV

Module II: HEV architecture and powertrain (07 hours)

Principle of Planetary Gears, Two-Mode Hybrid Transmission, Dual-Clutch Hybrid Transmissions, Hybrid Transmission with Both Speed and Torque Coupling Mechanism

Module III: Special Hybrid Vehicles (05 hours)

Hydraulic Hybrid Vehicles, Off-road HEVs, Diesel HEVs, Electric or Hybrid Ships, Aircraft, Locomotives, Other Industrial Utility Application Vehicles

Module IV: Fuel Cell Energy system and Diagnostics of HEV (06 hours)

Introduction to Fuel Cells, Hybrid Fuel Cell Energy Storage Systems, Diagnostics and Prognostics in HEVs, Onboard Diagnostics, Prognostics Issues, EMC Issues

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. "Hybrid Electric Vehicles", Chris Mi, M. Abul Masrur, David Wenzhong Gao, John Wiley and sons Ltd. Publications, ISBN: 978-1-119-99890-7, 2011.
2. "Fuel Cell Hybrid Electric Vehicles", Nicola Briguglio, Laura Andaloro, Marco Ferraro and Vincenzo Antonucci (2011), ISBN: 978-953-307-287-6.
3. "Control of Hybrid Electrical Vehicles - Modelling and Simulations", Gheorghe Livinț , Vasile Horga, Marcel Ratoi and Mihai Albu (2011), ISBN: 978-953-307-477-1.
4. "Electric and Hybrid Vehicles", Robin Hardy- Iqbal Husain- CRC Press.
5. "Modern Vehicle Technology", Heinz, Second Edition.

ATGE 423- Automotive Safety

(02 credits 50 Marks)

Course Outcomes:

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

CO1	Identify different safety systems and its role in automobiles
CO2	Determine vehicle structural crashworthiness.
CO3	Analyze pedestrian safety by use of pedestrian simulator.
CO4	Analyze and simulate vehicle in barrier impacts.

Course Content:

Module I: Introduction to safety (05 hours)

Automotive Safety-Active and passive safety, Driver assistance systems in automobiles, Definitions and terminology, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle.

Module II: Vehicle structural crashworthiness & Crash testing (07 hours)

Balance of stiffness and toughness characteristics and energy absorption characteristics of vehicle structures, Design of crash crumple zones, Modeling and simulation studies, Optimization of vehicle structures for crash worthiness, Types of impacts, and Impact with rebound, movable barrier tests, Analysis and simulation of vehicle in barrier impacts, Roll over crash tests, Behavior of specific body structures in crash testing, Photographic analysis of impact tests, Regulatory requirements for crash testing. Side and Frontal Pole Impact, Pedestrian Impact.

Module III: Ergonomics and Human response to Impact (06 hours)

Importance of Ergonomics in Automotive safety, Locations of controls, Anthropometry, Human impact tolerance, Determination of Injury thresholds, Severity Index, Study of comparative tolerance, Application of Trauma for analysis of crash injuries. Injury criteria's and relation with crash and modeling and simulation studies in dummy.

Module IV: Vehicle safety systems (06 hours)

Survival space requirements, Restraints systems used automobiles, Types of safety belts, Head restraints, Air bags used in automobiles, Use of energy absorbing systems in automobiles, Impact protection from steering controls, Design of seats for safety, types of seats used in automobiles. Importance of Bumpers in automobiles, Damageability criteria in bumper designs. Introduction to the types of safety glass and their requirements and rearward field of vision in automobiles, Types of rear view mirrors and their assessment. Warning devices, Hinges and latches etc. Active safety.

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. Watts, A. J., et al "Low speed Automobile Accidents" Lawyers and Judges 1996
2. Jullian Happian-Smith 'An Introduction to Modern Vehicle Design' SAE, 2002
3. Bosch-"Automotive Handbook"-5th edition- SAE publication-2000.
4. Johnson, W., and Mamalis, A.G., "Crashworthiness of Vehicles, MEP, London, 1995
5. Olson L. P, Forensic aspects of driver perception and response, Lawyers and Judges 1996.
6. Matthew Huang, "Vehicle Crash Mechanics".
7. David C. Viano, "Role of the Seat in Rear Crash Safety".
8. Jeffrey A. Pike, "Neck Injury".
9. Ching-Yao Chan, "Fundamentals of Crash Sensing in Automotive Air Bag Systems".
10. Rollover Prevention, Crash Avoidance, Crashworthiness, Ergonomics and Human Factors", SAE Special Publication, November 2003.

ATOE 424: Applied Hydraulics and Pneumatics

(02 credits – 50 marks)

Course Outcomes:

On completion of the Course, students should be able to

CO1	Recall the basic concepts of in hydraulic systems and fluidics and hydropneumatics
CO2	Describe function of hydraulic system, servo systems, torque motors, Bistable flip flop, turbulence amplifier, Pneumatic controls,
CO3	Illustrate area of applications of a Hydraulic transmission, fluidics and pneumatic circuit
CO4	Analyze the designing aspects of hydraulic system and pneumatic system
CO5	Discriminate hydropneumatics, hydraulic and hydropneumatc system, Types of transmission
CO6	Design and construct hydraulic circuit with servo valve, hydraulic circuit with proportional valve, pneumatic sequencing circuit, pneumatic circuit with quick exhaust valve, pneumatic circuit with time delay valve, pneumatic speed control circuit, Hydraulic regenerative circuit

Module-I : Hydraulic Servo Techniques and Hydrokinetics (07 hours)

Overview of function of hydraulic system, Mechanical feedback and application of tracer valve, Feedbeck in the system, Electro-hydraulic servo systems, Torque Motors, Types of Servo valves, Special valve features, Terminologies in servo technology. Types of transmission, pump-motor combination, Applications of Hydraulic transmission

Module-II : Design of Hydraulic Systems (06 hours)

Hydraulic circuits, Manual and automatic hydraulic systems, Regenerative ckt., use of check valves, selection of pump, Circuit Diagram standards, basic circuits functional diagram, application of functional diagram, electrical control of hydraulic systems

Module-III : Fluidics and Hydropneumatics (07 hours)

Introduction to fluidics, Bistable flip flop, turbulence amplifier, low pressure, pneumatics sensors, application of fluidics/ low pressure pneumatics as sensors proportional devices, Hydropneumatics systems, hydraulic check Modules, hydropneumatic cylinder , parallel check Module, integral air-oil, cylinder, types of feed, intensities, comparision of hydropneumatics, hydraulic and hydropneumatc system.

Module-IV : Automation and Principle of Pneumatic circuit design (04 hours)

Pneumatic controls, Functional diagram in pneumatic circuit design, Movement diagram, Cascade system in pneumatic circuit design, Logics in pneumatic circuit design, Logics and Boolean algebra. Demorgam's theorem of inversion. Examples of control equation , use of K-V map for pneumatic circuit design, K-V diagram, Control problem

Module-V : Assignments, Tutorials, case studies and presentation based on Module I to IV **06 hours**

Reference

1. P. Joji; 2008; Pneumatic Controls; Willey India Pvt. Ltd., ISBN 978-81-265-1542-4
2. Antony Barber; 1997 (Eighth Ed.); Pneumatic Handbook; Elsevier Science Ltd.; ISBN 978-81-265
3. Andrew Parr; 2011 (Third Ed.); Hydraulics and Pneumatics-A Technician's and Engineer's Guide; Elsevier Ltd. (Butterwoth-Heinemann); ISBN-13: 978-0-08-0966748
4.S. R. Majumdar – Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill Education Pvt. Ltd., ISBN – 0-07-463-748-7
5. W. Bolton – Pneumatic and Hydraulic Systems, Butterworth Heinemann, ISBN – 0-07-506-383-62
6. A. Parr – Hydraulics and Pneumatics: A Technician's and Engineer's Guide, Butterworth Heinemann, ISBN – 0-08-096-674-8
7. S R Majumdar; 2006 (Sixteenth Reprint); Pneumatic Systems (Principal and maintenance); Tata McGraw - Hill Publishing Company Limited; ISBN 0-07-460231-

ATOE -425 Industrial Robotics

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the Course, students should be able to

CO1	1 Familiar with the applications of robotic systems as they are currently used in industry and research
CO2	2 Define the needs acquire necessary information
CO3	3 Select appropriate robots for various industrial applications
CO4	4 Apply the knowledge gained for the design and development of simple robotic Aspects

Module I: Review of Robotics (06 hours)

Automation and Robotics, Robotics Market and Future Prospects, Review of Robot Anatomy and Robot Motion analysis,

Module II: Application engineering for manufacturing (07 hours)

Robot Cell Design: Robot Cell Layouts, Multiple Robots and Machine interface, Work cell Control; Economic Analysis for Robotics: Methods for economic analysis, Differences in Production rates, Robot project analysis form.

Module III: Robot application in Manufacturing (07 hours)

Material Transfer and Machine loading/unloading: material transfer applications, machine loading and unloading ; Processing Operations: Spot Welding, Spray coating, other processing operations using Robots; Assembly and Inspection.

Module IV: Implementation Principles and Issues (04 hours)

An approach for Implementing Robotics: Plant Survey, Selection of Robot, Planning and Engineering the installation; Safety, Training, Maintenance and Quality; Social Issues and Future of Robotics.

Module V: Tutorials, assignments and presentation based on Module I to IV (06 hours)

References:

1. Robotics and Control by Mittal &NagrathTata McGraw-Hill Education, 2003: ISBN 10: 0070482934 / ISBN 13: 9780070482937
2. Industrial Robotics By Michel P Groover 1St Edition Edition; ISBN-13: 978-0070249899 / ISBN- 10: 007024989X
3. Robotic Engineering By Dr. Surender Kumar, Dr.S K. Mukherjee (TMH)
4. "Robotic Engineering - An Integrated Approach" by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice Hall India, 2002
5. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
6. Robotics control, sensing, vision and intelligence, Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “”, McGraw Hill Book co, 1987
7. Robots and Manufacturing Automation, Ray Asfahl. C., John Wiley & Sons Inc.,1985
8. Introduction to Robotics mechanics and control, by Craig. J. J., Addison- Wesley,1999

ATOE 426 Advanced Electrical Drives

(02 credits 50 marks)

Course Outcomes:

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

CO1	Select the drive for appropriate application.
CO2	Explain the speed control characteristics of drives.
CO3	Select the size of magnets in Permanent magnet motors.
CO4	Calculate eddy current losses in the magnets.

Module I: Drive Fundamentals (05 hours)

Electrical Drives, advantages, elements of drive system, drive characteristics, criteria for selection of drive components, steady-state stability

Module II: Induction Motor Drives (06 hours)

Principle of Induction Motors, Speed Control of Induction Machine, Variable Frequency, Variable Voltage Control of Induction Motors, Efficiency and Losses of Induction Machine, Field-Oriented Control of Induction Machine

Module III: Permanent Magnet Motor Drives (07 hours)

Basic Configuration of Permanent magnet motors, Basic Principle and Operation of Permanent magnet Motors, Sizing of Magnets in Permanent magnet Motors, Eddy Current Losses in the Magnets of Permanent magnet Machines

Module IV: Control of Drives (06 hours)

Direct torque and flux control of induction motor, Sensor less control and flux observers, Permanent magnet synchronous motor, Brush less dc motor, Switched reluctance motor

Module -V Tutorials, case studies and presentation based on Module I to IV (06 hours)

References:

1. "Electric Motor drives- Modelling, Analysis & Control", R.Krishnan, PHI India,Ltd.
2. "Hybrid Electric Vehicles", Chris Mi, M. Abul Masrur, David Wenzhong Gao, John Wiley and sons Ltd. Publications, ISBN: 978-1-119-99890-7, 2011.
3. "Electric machines", D.P.Kothari and I.J.Nagrath, Tata McGraw hill publishing company, New Delhi, Fourth Edition, ISBN: 9780070699670
4. https://www.nptel.ac.in
5. "Permanent magnet and Brushless DC motors", T.Kenjo and S.Nagamori, Clarendon press, London

ATLE 427 Laboratory Coursework based on Automotive Emission and controls

Course Outcomes:

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

CO1	Perform the emission test on Heavy duty diesel engine and on Tractor.
CO2	Compare the performance of Heavy duty diesel engine and Tractor / Genset diesel engine.
CO3	Analyze carbonyl compound from exhaust emission.
CO4	Measure and analyze various exhaust gases.

List of Experiments:

1. Performance & emission test on Heavy duty diesel engine (Transient Dynamometer)
2. Performance & emission test on Tractor / Genset diesel engine (Eddy Dynamometer)
3. Study of emission test for SI engine 2/3/4 wheels on chassis dynamometer
4. Analysis of carbonyl compound from exhaust emission using HPLC.
5. Measurement of CO, CO2, by NDIR, Hydrocarbon by FID.

ATLE 428 Laboratory Coursework based on Hybrid Vehicles

(1.5 credits)

(Any 5 practical)

Course Outcomes:

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

CO1	Select DC motor for various applications.
CO2	Analyze different types of DC motor's speed control characteristics
CO3	Explain V-I Characteristics of Buck and Boost converters.
CO4	Demonstrate speed-torque characteristics of DC motor.

1. Study of speed control characteristics of Series DC motor.
2. Study of speed control characteristics of Shunt DC motor.
3. Study of speed control characteristics of Compound DC motor
4. V-I Characteristics of buck convertor.
5. V-I Characteristics of boost convertor.
6. Study of Fuel cell storage system.
7. Study of speed-torque characteristics of DC motor using open loop armature voltage variation.
8. Study of efficiency of series DC motor.
9. Case study of Toyota Prius and Ford Escape (or equivalent brand) Hybrid Powertrain.

ATLE 429 Laboratory Coursework based on Automotive Safety

Course Outcomes:

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

CO1	Explain working and importance of air bags.
CO2	Perform a proper rear mirror view setting and testing.
CO3	Perform a G lock testing of seat belt and explain seat belt anchorage.
CO4	Perform an impact testing of bumpers.

List of Experiments:

1. Study on air bags
2. Rear view mirror testing
3. Study of signaling devices and performance evaluation
4. G lock testing of seat belt
5. Impact testing of bumpers
6. Study of seat belt anchorage

ATR 430
Research/ Industrial Project – Phase III

(Experimental Work Continued, Organization and Interpretation of Result, Dissertation, Presentation)

(19.5 credits)