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Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS) - 431004

Outcome Based Curricula

[DEEN DAYAL UPADHYAY KAUSHAL KENDRA]

Effective from July 2017 onwards

PREFACE

Outcome Based Education (OBE) is the educational approach which focuses on student centric education in the context of development of personal, social, professional and knowledge (KSA) requirements in one's career and life. It is the decade ago curriculum development methodology. The educational triangle of *LEARNING-ASSESSMENT-TEACHING* is the unique nature of the OBE approach. The curriculum practices such as Competency Based Curriculum, Taylor's Model of Curriculum Development, Spadys' Curriculum principles, Blooms taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models/approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidenced Based Education, Systems' Approach, etc as the scientific and systematic approaches in curriculum design.

The authorities of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) in-lieu of accreditation standards of National Assessment and Accreditation Council, decided to opt for Outcomes Based Education (OBE). As the part of the decision, different meetings, workshops and presentations were held at the campus of university.

This document is the outcome of different meetings and workshops held at university level and department level. The detailed document is designed and the existing curriculum of the department is transformed in to the framework of OBE. This is the first step towards the implementation of OBE in the department. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the graduates/Post-graduates of the university department.

Director,

DDUKK

INDUSTRIAL AUTOMATION

Faculty of Science & Technology

Deen Dayal Upadhyay KAUSHAL Kendra

1. Vision:

- To educate and empower students for global entrepreneurship and workforce requirement by imparting time relevant skill oriented education and training

2. Mission:

- To continue with our prospective response to the changing development needs, employment opportunities, realities of the region and aim at increasing our contribution towards skill training needs for competent human resource development,
- To empower students to maximize their career opportunities and academic pathways in India and overseas.
- To catalyze a comprehensive value added learning culture for assuring best possible outcomes for every student at an affordable cost.
- To promote effective partnership with industries, academia to identify lacunae areas in training, to address changing societal needs
- To continue with expansion of the Institute's range of time responsive training provisions to cater all stakeholders
- To ensure successful achievement of qualifications for students, their progression to the higher level of study, and a positive destination for every alumni.

3. Title of the Program (s):

A. Bachelor of Vocation Industrial Automation
B. Master of Vocation Industrial Automation

4. Bachelor of Vocation (Industrial Automation)

This Bachelor in Vocation programme is divided into six semester shaving 180 credits. Each semester will have courses based on General Education Components and Skill Development Components. In each Semester, there will be four theory components of skill development with their corresponding laboratory coursework, apart from general education components. Moreover, each semester will contain dedicated Project and/or Industrial Training/Internship. The program offers following **General Education Components** viz. Linguistic Proficiency, Computer Science, Environment Management, Business & Accounting, Industrial Ethics and Safety Management, Statistical Tools, Commerce & Management Fundamentals and **Skill Development Components** in Industrial Automation.

Preamble:

Dr. Babasaheb Ambedkar Marathwada University proposes to offer a three year Bachelor programme invocation (B. 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 skilled manpower so that wide variety of options in automobiles, industrial automation and travel &tourism would be available and it will 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 C ommerce and Industry of India (ASSOCHAM), there will 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. The end result of this programme is to enable an individual to at train self-employment.

Program Educational Objectives:

The objectives of B.Voc (Industrial automation) program are to produce graduates who -

1. Are equipped with time relevant knowledge of mechatronics and electronics to address multi disciplinary demand of automated manufacturing, and process in modern industries in capacity of productive System Developers and System Integrators.
2. Have a broad-based background 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 succed 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 (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 B.Voc program are expected to -

PO1. **Domain knowledge:** Apply broad based fundamental 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 broad based 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 broad 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 broad 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 B.Voc (Industrial Automation) program are expected to -

1. Apply broad based fundamental 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 first principles 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 clear understanding of limitations.

Course Outcomes (for all courses):

Course outcomes for all courses have been framed as statements that describe the knowledge & abilities to be developed in the student by the end of course (subject) teaching. The focus is on development of abilities rather than mere content. There can be 5 to 7 course outcomes of any course. These have written in the specific terms and not in general. Course Outcomes has been presented at the beginning of syllabus of respective course.

Exit Options:

The course allows exit of a student from the course on successful employment. Scopes will be there for further continuation of study. The other wise exit options will be as follows-

Exit Point	***Duration***	***Diploma / Degree to be Offered***
First exit	After 6 months	Certificate in Vocation
Second exit	After 1 yr.	Diploma in Vocation(D. Voc.)
Third exit	After 2 yrs.	Advanced Diploma in Vocation(Adv. D. Voc.)
Fourth exit	After 3 yrs.	Bachelor in Vocation (B. Voc.)

Eligibility:

Automobile, Industrial Automation:

Those who have completed XII Science OR equivalent/ MCVC / ITI (Two Years) with relevant / equivalent trade from any recognized Board/Institution are eligible for registration / admission to first year (Semester I) of B. Voc degree program.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves for a Common Entrance Test (CET). 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.

A candidate who has sought admission to Semester – I shall be admitted to Semester – II automatically (provided, he submits an application to that effect). A candidate who has passed 75% of the papers at First Year (First and Second Semesters together) examinations shall be allowed to take admissions in third semester. Similarly, a candidate who has passed 75% of the papers at the Second Year (Third and Fourth Semesters together) examinations shall be allowed to take admission in the Fifth semester. However, if a candidate has not passed the First and Second Semester examinations, he shall not be allowed to take admission in the Fifth Semester. Appearance in the First, Third and Fifth semester is compulsory to get promoted to next semester.

Dropout students will be allowed to register for second or third year as and when the concerned courses are offered by the Centre, however he/she should not exceed more than twice the duration of the course from the date of first registration at the Centre. Therefore, for obtaining B. Voc. degree a student will have to complete all semesters successfully within 6 years/12 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 30 credits for the award of Six Month Certificate in Vocation
- Students will have to earn 60 credits for the award of one year Diploma in Vocation(D. Voc.)
- Students will have to earn 120 credits for the award of two year Advance Diploma in Vocation (Adv. D. Voc.)
- Students will have to earn 180 credits for the award of three year Bachelor Degree in Vocation (B. 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 not be strictly allowed for appearing the examination of each course.

Departmental Committee:

The Departmental Committee (DC) of DDU-KK will monitor the smooth functioning of the programme.

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 Director of DDU-KK, 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 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 respective exit point.

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 respective exit point.

<u>Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)</u>

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

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

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.

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

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

<u>Grade Card</u>

Results will be declared by the Centre and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will 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 respective exit point).

<u>Cumulative Grade Card:</u>

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

<u>Attainment Assessment Mechanism:</u>

a) Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

b) Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

c) Course Attainment Levels:

a. CO attainment is defined/set at three levels;
b. The CO attainment is based on end term examination assessment and internal assessment;
c. The Co attainment is defined at three levels in ascending order-
    i. e.g. For end term and internal examination;
    ii. Level-1: 40% students scored more than class average
    iii. Level-2: 50% students score more than class average;
    iv. Level-3: 60% students score more than class average.
d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 50% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.
e. CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

d) Program Attainment Level:

a. PO attainment is defined at five levels in ascending order;
b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);
c. The PO attainment levels are defined / set as stated below;
    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1)- Poor
    ii. Level-2: 1.0>1.5-Average
    iii. Level-3: 1.5>2.0-Good
    iv. Level-4: 2.0>2.5-Very Good
    v. Level-5: 2.5>3.0 -Excellent
d. The PO attainment target level is set/defined (say, Level-4). It implies that, the department is aiming at minimum level-4 (very good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;
e. PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

The **CO-PO MATRIX** is provided in the below table.

Bachelor of Vocation (Industrial Automation)

Paper Code	Paper Name		a	b	c	d	e	f	g	h	i	j	k	l
VOC 101	Functional English & Marathi	2									*			
VOC 102	Basic Computing	3	*	*	*	*								
VOC 103	UPS Repairing-Theory	3	*	*	*	*	*							
VOC 104	UPS repairing	2	*	*	*	*	*							
VOC 105	Occupational Practice Essentials	2	*	*	*	*	*							
VOC 111	Analog and Digital Electronics	1	*	*	*	*	*							
VOC 112	Electrical Systems	0	*	*	*	*	*							
VOC 113	Industrial Electronics	2	*	*	*	*	*							
VOC 114	Industrial Instrumentation	2	*	*	*	*	*							
VOC 115	Laboratory Coursework – I (IA)(Analog and Digital Electronics)2	2	*	*	*	*	*		*	*				
VOC 116	Laboratory C3oursework – II (IA) (Electrical Systems)	2	*	*	*	*			*	*				
VOC 117	Laboratory Coursework – III (IA) (Industrial Electronics)	3	*	*	*	*			*	*				
VOC 118	Laboratory Coursework – IV (IA) (Industrial Instrumentation)	1	*	*	*	*			*	*				
VOC 201	Communicative English and Hindi	2	*	*	*	*					*			
VOC 202	Basic Computer Hardware System : Theory	1	*	*	*	*								
VOC 203	Basic Computer Hardware System : Lab- Course	1	*	*	*	*			*	*				
VOC 204	Environment Management	1	*	*	*	*								
VOC 211	Interfacing and Signal	0	*	*	*	*								

	Conditioning													
VOC 212	Control Systems Fundamentals	0	*	*	*	*								
VOC 213	Fundamentals of Drives	0	*	*	*	*								
VOC 214	PLC Fundamentals	0	*	*	*	*								
VOC 215	Laboratory Coursework–V (IA)(Interfacing and Signal Conditioning)	0	*	*	*	*			*	*				
VOC 216	Laboratory Coursework – VI(IA) (Control Systems Fundamentals)	0	*	*	*	*	*		*	*				
VOC 217	Laboratory Coursework – VII (IA) (Fundamentals of Drives)	0	*	*	*	*	*		*	*				
VOC 218	Laboratory Coursework – VIII (IA) (PLC Fundamentals)	0	*	*	*	*	*		*	*				
VOC-239	In-plant Training – I (IA)	0	*	*	*	*	*		*	*				
VOC-301	Linguistic Proficiency-III	2	*	*	*	*	*				*			
VOC-302	Business Software Tools –I	3	*	*	*	*	*							
VOC-303	Statistical Tools (Probability and Statistics)	1	*	*	*	*								
VOC 311	Analog and Digital Circuit Design	2	*	*	*	*								
VOC 312	Mechanical Power Transmission	1	*	*	*	*								
VOC 313	Fundamentals of Hydraulics	1	*	*	*	*								
VOC 314	Embedded System Concepts	2	*	*	*	*								
VOC 315	Laboratory Coursework–IX (IA)(Analog and Digital Circuit Design)	2	*	*	*	*			*	*				
VOC 316	Laboratory Coursework–X(IA) (Mechanical Power Transmission)	2	*	*	*	*			*	*				
VOC 317	Laboratory Coursework – XI (IA)	2	*	*	*	*			*	*				

	(Fundamentals of Hydraulics)													
VOC 318	Laboratory Coursework – XII (IA)(Embedded Systems Concepts)	2	*	*	*	*			*	*				
VOC 401	Industrial Ethics and Safety Management(for Industrial Automation and Automobile) / Ethical, Legal and Regulatory Aspects of Tourism(for Travel & Tourism)	1						*	*	*	*	*	*	*
VOC 402	Business Software Tools-II	2						*	*	*	*	*	*	*
VOC 403	Fundamentals of Business and Accounting	2	*	*	*	*	*	*						
VOC 411	PLC based Automation	1	*	*	*	*	*	*						
VOC 412	Process Control	2	*	*	*	*	*	*						
VOC 413	Fundamentals of Pneumatics	2	*	*	*	*	*	*						
VOC 414	Embedded System Applications	1	*	*	*	*	*	*						
VOC 415	Laboratory Coursework–XIII (IA)(PLC based Automation)	2	*	*	*	*	*	*						
VOC 416	Laboratory Coursework–XIV(IA) (Process Control)	2	*	*	*	*	*	*						
VOC 417	Laboratory Coursework – XV (IA) (Fundamentals of Pneumatics)	2	*	*	*	*	*	*		*	*			
VOC 418	Laboratory Coursework – XVI(IA)(Embedded System App.)	1	*	*	*	*	*	*		*	*			
VOC 419	In-plant Training/Field work/Mini Project – II (IA)	2	*	*	*	*	*	*		*	*			
VOC 501	Personality Development and Stress Management	2			*	*	*	*	*	*	*	*		

VOC 502	Operations Management	1	*	*	*	*	*	*						
VOC 503	Business Communication	1	*	*	*	*	*	*						
VOC 504	Production Engineering	1	*	*	*	*	*	*						
VOC 511	Workshop Technology	2	*	*	*	*	*	*						
VOC 512	Introduction to Robotics	2	*	*	*	*	*						*	*
VOC 513	Networking Essentials	2	*	*	*	*	*							
VOC 514	Advance Microcontrollers	2	*	*	*	*	*							
VOC 515	Laboratory Coursework – XVII (IA)(Pertaining to VOC 511 and VOC 512)	3	*	*	*	*	*		*	*				
VOC 516	Laboratory Coursework – XVIII(IA)(Pertaining to VOC 513 and VOC 514)	2	*	*	*	*	*		*	*				
VOC-517	Major Project – Phase I	1	*	*	*	*	*		*	*				
VOC 601	Foreign Language(German/Chinese/Japanese/Russian)	3	*	*	*	*	*		*	*				
VOC 602	Entrepreneurship Development	1									*			
VOC 603	Production Management	1									*		*	*
VOC 611	Flexible Manufacturing System	1	*	*	*	*	*	*						
VOC 612	Industrial Robotics	3	*	*	*	*	*	*					*	*
VOC 613	Introduction to SCADA	2	*	*	*	*	*	*					*	*
VOC 614	Introduction to IOT	0	*	*	*	*	*	*						
VOC 615	Laboratory Coursework – XVII (IA)(Pertaining to VOC 611 and VOC 612)	2	*	*	*	*	*	*						

VOC 616	Lab. Coursework – XVIII (IA)(Pertaining to VOC 613 and VOC 614)	1	*	*	*	*	*	*		*	*			
VOC 617	Major Project – Phase II	1	*	*	*	*	*	*		*	*	*	*	*
VOC 618	In-plant Training/Field work/Mini Project – IV (IA)	3						*	*	*	*	*	*	*

Course Structure

Paper No	Paper Title	Credits
Semester - I		
General Education Components		
VOC 101	Functional English and Marathi	4
VOC 102	Basic Computing	2
VOC 103	UPS Repairing (Theory)	2
VOC 104	UPS Repairing (Practical)	2
VOC 105	Occupational Practice Essentials	2
Skill Development Components - Industrial Automation (A)		
VOC 111	Analog and Digital Electronics	2
VOC 112	Electrical Systems	2
VOC 113	Industrial Electronics	2
VOC 114	Industrial Instrumentation	2
VOC 115	Laboratory Coursework – I (IA)(Analog and Digital Electronics)	2
VOC 116	Laboratory Coursework – II (IA) (Electrical Systems)	2
VOC 117	Laboratory Coursework – III (IA) (Industrial Electronics)	2
VOC 118	Laboratory Coursework – IV (IA) (Industrial Instrumentation)	2
Total Credits = General Education Components + Skill Development Components		12+16= 28
Semester - II		
General Education Components		
VOC 201	Communicative English and Hindi	4
VOC 202	Basic Computer Hardware System : Theory	2
VOC 203	Basic Computer Hardware System : Lab- Course	2
VOC 204	Environment Management	4
Skill Development Components - Industrial Automation (A)		
VOC 211	Interfacing and Signal Conditioning	2
VOC 212	Control Systems Fundamentals	2
VOC 213	Fundamentals of Drives	2
VOC 214	PLC Fundamentals	2
VOC 215	Laboratory Coursework–V (IA)(Interfacing and Signal Conditioning)	2
VOC 216	Laboratory Coursework – VI(IA) (Control Systems Fundamentals)	2
VOC 217	Laboratory Coursework – VII (IA) (Fundamentals of Drives)	2
VOC 218	Laboratory Coursework – VIII (IA) (PLC Fundamentals)	2
VOC 219	In-plant Training – I (IA)	4
Total Credits = General Education Components + Skill Development Components		12+20= 32

Semester – III		
General Education Components		
VOC 301	Linguistic Proficiency-III	4
VOC 302	Business Software Tools –I	4
VOC 303	Statistical Tools (Probability and Statistics)	4
Skill Development Components - Industrial Automation (A)		
VOC 311	Analog and Digital Circuit Design	2
VOC 312	Mechanical Power Transmission	2
VOC 313	Fundamentals of Hydraulics	2
VOC 314	Embedded System Concepts	2
VOC 315	Laboratory Coursework–IX (IA)(Analog and Digital Circuit Design)	2
VOC 316	Laboratory Coursework–X(IA) (Mechanical Power Transmission)	2
VOC 317	Laboratory Coursework – XI (IA) (Fundamentals of Hydraulics)	2
VOC 318	Laboratory Coursework – XII (IA)(Embedded Systems Concepts)	2
Total Credits = General Education Components + Skill Development Components		12+16=28

Semester – IV		
General Education Components		
VOC 401	Industrial Ethics and Safety Management(for Industrial Automation and Automobile) / Ethical, Legal and Regulatory Aspects of Tourism(for Travel & Tourism)	4
VOC 402	Business Software Tools-II	4
VOC 403	Fundamentals of Business and Accounting	4
Skill Development Components - Industrial Automation (A)		
VOC 411	PLC based Automation	2
VOC 412	Process Control	2
VOC 413	Fundamentals of Pneumatics	2
VOC 414	Embedded System Applications	2
VOC 415	Laboratory Coursework–XIII (IA)(PLC based Automation)	2
VOC 416	Laboratory Coursework–XIV(IA) (Process Control)	2
VOC 417	Laboratory Coursework – XV (IA) (Fundamentals of Pneumatics)	2
VOC 418	Laboratory Coursework – XVI(IA)(Embedded System App.)	2
VOC 419	In-plant Training/Field work/Mini Project – II (IA)	4
Total Credits = General Education Components + Skill Development Components		12+20=32

Semester – V		
General Education Components		
VOC 501	Personality Development and Stress Management	4
VOC 502	Operations Management	4
VOC 503	Business Communication	2
VOC 504	Production Engineering	2

Skill Development Components - Industrial Automation (A)		
VOC 511	Workshop Technology	2
VOC 512	Introduction to Robotics	2
VOC 513	Networking Essentials	2
VOC 514	Advance Microcontrollers	2
VOC 511A	Fundamentals of Microprocessor 8086	2
VOC 512A	Interfacing with Microprocessor 8086	2
VOC 515	Laboratory Coursework – XVII (IA)(Pertaining to VOC 511 and VOC 512)	3
VOC 516	Laboratory Coursework – XVIII(IA)(Pertaining to VOC 513 and VOC 514)	3
VOC 515A	Lab. Coursework – XVIV(IA)(Pertaining to VOC 511A and VOC 512A)	3
VOC 517	Major Project – Phase I	2
VOC 518	In-plant Training/Field work/Mini Project – III (IA)	2
Total Credits = General Education Components + Skill Development Components		12+ 18= 30
Semester – VI		
General Education Components		
VOC 601	Foreign Language(German/Chinese/Japanese/Russian)	4
VOC 602	Entrepreneurship Development	4
VOC 603	Production Management	4
Skill Development Components - Industrial Automation (A)		
VOC 611	Flexible Manufacturing System	2
VOC 612	Industrial Robotics	2
VOC 613	Introduction to SCADA	2
VOC 614	Introduction to IOT	2
VOC 611A	Numerical Controls	2
VOC 612A	Single manufacturing Cells	2
VOC 615	Laboratory Coursework – XVII (IA)(Pertaining to VOC 611 and VOC 612)	3
VOC 616	Lab. Coursework – XVIII (IA)(Pertaining to VOC 613 and VOC 614)	3
VOC 615A	Lab. Coursework – XVIV(IA)(Pertaining to VOC 611A and VOC 612A)	3
VOC 617	Major Project – Phase II	2
VOC 618	In-plant Training/Field work/Mini Project – IV (IA)	2
Total Credits = General Education Components + Skill Development Components		12+ 18= 30
	Total Credits (Semester I to VI)	180

In Semester V, students have to opt for either course group I- (VOC 511, VOC 512, VOC 515) or course group II- (VOC 511A, VOC 512A , VOC 515A)
In Semester VI, students have to opt for either course group I- (VOC 611, VOC 612, VOC 615) or course group II- (VOC 611A, VOC 612A , VOC 615A)

Paper Code Description:

Each course will be identified by a unique three digit code.

The first digit refers to Semester.

The second digit refers to General academic component or Skill Development Component (according to specialization / trade) as per following scheme of nomenclature

0 - Refers to General paper / course

1 - Refers to Industrial Automation

Third digit refers to incremental number for paper / course of respective semester.

Semester – I

General Academic Components

Semester – I

General Education Components

VOC-101: Linguistic Proficiency-I (English and Marathi) with language lab training

(4 Credits: 100 Marks)

Learning Objectives

1. To facilitate the students to understand the fundamental of communicative English and Marathi
2. To facilitate the students to develop skills of communication in English and Marathi.

Learning Outcomes

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

1	Compare between different tenses in English. Explain different types of linguistic expressions in Marathi
2	Apply concept of tenses to formulate correct sentences in English Apply proper linguistic expression in Marathi to address situational demand
3	Describe basic rules of Pronounciations and phonetic subscriptions in English
4	Formulate different types of dialogues, expression of ideas/informations in English and Marathi to address situational demand
5	Compose applications, reports, requests, responses, summary and comprehensions in English and Marathi

Course Contents:

Part A: BASIC STRUCTURE OF THE ENGLISH LANGUAGE

Module I Tenses **(10 Hrs)**

1.Present tense(includes all four types of tenses each)
2. Past tense
3. Future tense

Module II Spoken English: **(14 Hrs)**

1. Basic of pronunciation : Vowels, diphthongs,
2. Certain basic sounds including th, dh, gh sounds, fricatives etc.
3. Differences in the sounds of the letters, especially, w/v, f/ph etc.
4. Phonetic transcriptions.

Module III **(14 Hrs)**

1. Introducing yourself (The communicator)
2. Introducing people to others
3. Giving personal information
4. Getting people's attention and interrupting
5. Giving instructions and seeking clarifications
6. Making requests and responding to requests

References:

1. Business Communicator – V.K. Jain, O. P. Biyani, S. Chand, New Delhi.
2. The Communicator – Board of Editors , Orient Blackswan Pvt. Ltd
3. The Art of Powerful Communication – Dinesh K. Vohra, Are Maria Publications, Pune

Part B : BASIC STRUCTURE OF THE MARATHI LANGUAGE

(ON NEXT PAGE….)

उद्दिष्टे -

१) संज्ञापनाचे स्वरूप आणि प्रकार, संज्ञापन व्यवहारातील भाषेचे महत्त्व आणि कार्य यांचे महत्त्व समजावून देणे.

२) भाषा व्यवहाराची अपारंपरिक आणि अनौपचारिक क्षेत्रे, औपचारिक भाषा व्यवहाराची क्षेत्रे आणि त्याचे क्षेत्रनिहाय स्वरूप समजावून देणे.

३) विविध स्तरावरील भाषिक कौशल्ये आणि क्षमता विकसित करणे.

४) प्रसार माध्यमांचे स्वरूप आणि त्यासाठी आवश्यक असलेल्या भाषा व्यवहाराचे स्वरूप समजावून देणे.

५) कार्यालयीन / लेखन व्यवहारातील भाषेचे स्वरूप समजावून घेणे.

६) परिभाषानिष्ठ भाषाव्यवहार म्हणजेच निरनिराळ्या शास्त्रीय विषयांवरील लेखना करिता

७) भाषाव्यवहारातील आधुनिक तंत्रोपकरणांची (व तंत्रांची) माहिती करून देणे, मराठीतून व्यवहार करणाऱ्या संस्थांना भेटी देणे इत्यादी.

घटक४

संज्ञापन व भाषिक कौशल्ये

अ) संज्ञापन म्हणजे काय ? संज्ञापनाचे प्रकार - संज्ञापनातील भाषेचे, महत्त्व आणि कार्य भाषेचे औपचारिक व अनौपचारिक उपयोग.

आ) भाषेची प्राथमिक कौशल्ये (श्रवण, भाषण, वाचन, लेखन)

इ) भाषेची प्रगत कौशल्ये -

१) वर्णन, कथन, निवेदन, संभाषण, सूत्रसंचालनइ.
२) आकलन, संक्षेप, विस्तार, भाषांतर, गद्य रूपांतर, संवादलेखन इ.

औपचारिक भाषाव्यवहाराचे विविध प्रकार

अ) इतिवृत्त, टिप्पणी, अर्जलेखन, कार्यालयीन पत्रलेखन, निवेदन प्रसिध्दीपत्रक, निविदा इ.
ब) मुलाखत लेखन

स्मरणिका / गौरविका / संस्थापत्रिका / वार्षिक अहवाल इत्यादींचे संपादन

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

संदर्भ पुस्तके:

१) मराठी शुध्दलेखन प्रदीप - मो. रा. वाळंबे, गो. य. राणे प्रकाशन

२) मुद्रित शोधन - य. ए. धायगुडे - वि. पूना प्रेस ऑनर्स असो.

३) मराठी शुध्दलेखनविवेक - द. न. गोखले - सोऽहं प्रकाशन

४) शुध्दशब्दसूची - स्नेहल तावरे - स्नेहवर्धन

५) राजभाषापरिचय -

६) व्यावहारिक मराठी - पुणेविद्यापीठ

७) व्यावहारिक मराठी - ल. रा. नसिराबादकर -फडके बुकसेलर्स,कोल्हापूर

८) व्यावहारिक मराठी - प्रकाश परब

९) वार्तासंकलन - चंद्रकांत ताम्हणे

१०) व्यावहारिक मराठी - (संपादकडॉ. स्नेहल सावरे) स्नेहवर्धन प्रकाशन, पुणे

VOC-102: Basic Computing

(2 Credits: 50 Marks)

Learning Objectives

1. To facilitate the students to study Instructional Designing theories, basic IT skills using application software tools,
2. To facilitate the students to make functional use of IT skills in teaching – learning process.

Learning Outcomes

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

1	Extend the knowledge of basic and advanced tools of Word Processing, Spreadsheet, Presentation Graphics, DBMS, and Internet in MS-Office for specific tasks
2	Apply Word Processing tools to create Notice, Application
3	Use Spreadsheet tools to create and manage attendance sheets
4	Demonstrate Presentation Graphic tools to create, modify and refine presentation
5	Implement DBMS tools to create/modify tables/forms, reports
6	Apply search engines and write e-mails

Software for Hands-on:

- Windows Vista
- MS Office 2007
- Internet Explorer
- Online collaboration tools

Course Contents:

Module - I: Word Processing **(6 Hrs)**

- Overview of Word Processing
- Creating and Editing a Document (Exercise 1 - Creating Notice)
- Revising and Refining a Document (Exercise 2 - Revise your notice)
- Using Additional Word Features (Exercise 3 – Creating notice for different classes)
- Changing the Display of the Document (Exercise 4 - Changing the display of your notice)
- Using Mail Merge (Exercise 5 – Sending notice using Mail Merge)
- Using Standard Templates (Exercise 6–Create notice using standard templates)
- Word Processing in Other Languages (Exercise 7 - Creating a notice in Marathi)

Module - II: Spreadsheet and Presentation Graphics **(8 Hrs)**

- Overview of Excel
- Creating and Editing (Exercise 1 – Creating attendance sheet)
- Using Charts (Exercise 2 – Creating a chart)
- Managing a Workbook (Exercise 3 – Managing Attendance Sheet)
- Overview of Presentation Graphics

- Creating a Presentation (Exercise 1 – Creating a Annual Day Presentation)
- Modifying and Refining a Presentation (Exercise 2 – Modifying and Refining Presentation)
- Using Advanced Presentation Features (Exercise 3 – Advanced Features for Presentation)

Module - III: Database Management Systems **(8 Hrs)**

- Overview
- Creating a Database (Exercise 1 – Creating a Student Database)
- Modifying a Table (Exercise 2 – Modifying a Student Database)
- Creating Forms (Exercise 3 – Creating Form for Student Database)
- Queries and Reports (Exercise 4 – Creating Report)
- Protecting the Database (Exercise 5 – Protecting a Student Database)

Module - IV: Internet **(8 Hrs)**

- Internet Basics
- Navigating the Web (Exercise 1 – Navigating the web site)
- Finding Information on the Web (Exercise 2 – Searching result on the web)
- Communication Using E-Mail (Exercise 3 – Communicate result to your friends)

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

References:

1. Microsoft Office Word 2007 a Beginners Guide: A Training Book of Microsoft Word 2007, By W.R. Mills, United States of America, Bloomington, Indiana.
2. Microsoft Office Word 2007: Illustrated Co: Illustrated Complete, By Jennifer A. Duffy, Carol M. Cram
3. Sams Teach Yourself Microsoft Office 2007 All in One, By Greg Perry
4. Microsoft Office Excel 2007: Comprehensive Concepts and Techniques, By Greg B. Shelly, Thomas J. Cashman, Jeffrey J. Quasney.
5. Microsoft Office Power Point 2007: Illustrated Introductory: Introductory, By David Beskeen
6. Microsoft Office Power Point 2007: Top 100 Simplified Tips & Tricks, By Paul McFedries.
7. Microsoft Office Access 2007: Comprehensive Concepts and Techniques, By Thomas J. Cashman, Philip J. Pratt
8. New Perspectives on Microsoft Office Access 2007, Comprehensive, Joseph J. Adamski, Kathleen T. Finnegan
9. Basic Internet, By O.H.U. Heathcote
10. Microsoft Office 2007 Power Point: A Training Book for Microsoft Power Point 2007, By W. R. Mills

Industrial Automation

VOC-103 : UPS Repairing

(2 Credits: 50 Marks)

Learning Objectives

1. To provide basic concepts of UPS working
2. To equip students with basic troubleshooting skills with UPS

Learning Outcomes

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

1	Classify Electrical circuit. Voltage, current, resistance, series and parallel circuit with help of ohm's law
2	Identify Active & passive Electronic components & Explain Characteristics of PN junction diode
3	Explain basic term logy of single phase HWR, Full Wave, Bridge Rectification Circuits
4	Select Inverter for particular application and compare VSI & CSI inverter operation

Course Contents:

Module I: Introduction & Engaging With Customers **(8 Hrs)**

Qualifications Pack -Occupational Standards For Electronics Industry by Electronic Sector Skill Council (Field Technician: UPS and Inverter Corresponding NOPS ELE/N0061)

Module II: Install The UPS/Inverter **(6 Hrs)**

Qualifications Pack -Occupational Standards For Electronics Industry by Electronic Sector Skill Council (Field Technician: UPS and Inverter Corresponding NOPS ELE/N7201)

Module III: Repair dysfunctional UPS/Inverter **(8 Hrs)**

Qualifications Pack -Occupational Standards For Electronics Industry by Electronic Sector Skill Council (Field Technician: UPS and Inverter Corresponding NOPS ELE/N7202)

Module IV: Interaction with Co-workers and Colleagues **(8 Hrs)**

Qualifications Pack -Occupational Standards For Electronics Industry by Electronic Sector Skill Council (Field Technician: UPS and Inverter Corresponding NOPS ELE/N9962)

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

References:

1. Basic Electronics - Repair & Maintenance of Power supply, Invertor & UPS –NIMI Published by National Instructional Media Institute, Chennai
2. Switching Power Supply Design, 3rd Ed. by Abraham Pressman (Author),
3. Uninterruptible Power Supplies Alexander King, William Knight McGraw HillProfessional

Industrial Automation

VOC 104 : UPS Repairing(Practical)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Identify broad based components and circuit cards inside an UPS
3	Fault find and solve problems UPS & Inverter circuit
4	Design Battery charging circuit With help of Bridge controlled rectification circuit

As Per Field Technician: UPS and Inverter Corresponding NOPS ELE/N0061, ELE/N7201, ELE/N7202, NOPS ELE/N9962

Industrial Automation

VOC-105: Occupational Practice Essentials

(2 Credits: 50 Marks)

Learning Objective:

1. Understand the role of Inventory management in organizations
2. Describe the key operations management decisions faced by managers
3. Understand practices like Quality Management, and Just-in-Time/Lean Operations
4. Understand the quantitative analysis of critical path method and review technique.

Learning Outcomes:

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

1	State the Inventory Management, quality management, recognize Manufacturing practices, Define of Project, Jobs, Events - Arrow Diagrams - Time Analysis and Derivation of the Critical Path.
2	Explain the effect of demand uncertainty, Risk pooling, A single warehouse inventory example
3	Apply Kaizen, T.P.M., S.M.E.D., 5-S Principles, Housekeeping, Kanban, Poka -Yoke, JIT as tools for better productivity
4	Compare centralized versus decentralized systems, plan JIT manufacturing and Lean manufacturing through waste elimination.
5	Test Problem solving tools such as- seven Tools for quality control such as Pareto charts, Check sheets, Cause and effect diagram, Scatter diagrams, Histogram, Graphs or flow charts, Control charts
6	Prepare Shortest Route Problem, develop Project Planning & Control by use of CPM/PERT Concepts

Course Contents:

Module 1 - Inventory Management (8 Hrs)

Introduction, A single warehouse inventory example, The economic lot size model, The effect of demand uncertainty, Risk pooling, Centralized versus decentralized systems, Managing inventory in the supply chain.

Module 2 – Manufacturing Tools (6 Hrs)

Total productivity through such practices- Kaizen, T.P.M., S.M.E.D., 5-S Principles, Housekeeping, Kanban, Poka -Yoke, JIT, JIT manufacturing and Lean manufacturing through waste elimination.

Module 3 – Quality Management **(6 Hrs)**

Introduction and evolution of quality movement, Problem solving tools such as- TQC Tools – problem solving, TQC Tools – Management, Quality Improvement and Total Employee Involvement

Module 4 - Network Analysis **(8 Hrs)**

Minimal Spanning Tree Problem - Shortest Route Problem, Maximal Flow in Capacitated Network - Concepts and Solution Algorithm as Applied to Problem, Project Planning & Control by use of CPM/PERT Concepts. Definitions of Project, Jobs, Events - Arrow Diagrams - Time Analysis and Derivation of the Critical Path.

Module V-

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

References :

1 Toyota Production Systems - Taichi Ohno, Kaizen , Masaki Imai
2 Chronicles of a Quality Detective - Dr Shrinivas Gondhalekar, Payal Sheth
3 Beyond T.Q.M - By Robert L. Flood
4 T.Q.M Process - By Gopal Kanji, Mike Asher
5 Operation Research - Taha
6 Quantitative Techniques in Management – N.D.Vohra
7 Quantitative Techniques in Management – J.K.Sharma

Semester – I

Industrial Automation

(Skill Development Components)

Skill Development Components

Industrial Automation

VOC-111: Analog and Digital Electronics

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce students with basic concepts of electronics components, semiconductor devices, power supply and digital electronics
2. To introduce students with the scopes of above components/concepts in practical applications.

Learning Outcomes

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

1	Identify Analog and Digital Electronics Components like diodes, transistors, Various digital ICs, etc.
2	Explain basic operation of Analog and Digital Electronics Components like diodes, transistors ,Various digital ICs, etc.
3	Explain role of various components in different types of DC voltage regulated power supplies
4	Demonstrate inter-conversions between number systems , operation of simple and combinational logic gates
5	Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
6	Design basic circuits using analog and/or digital electronic components for simple applications that include (but not limited to) power supply, water level control etc.

Course Contents:

Module -1: Basic Electronic Components **(8 Hrs)**

Basic Electronic Components - Resistor – Study of Resistor, Types of resistor, construction, and Color Coding of resistor; Capacitor - Study of capacitor, Types of capacitor and their construction; Inductor - Study of inductor & their types

Semiconductor Devices – P-N Junction Diode, Zener Diode, Light Emitting Diode, Photodiode, Transistor (CE,CB, CC modes), Phototransistor, Field Effect Transistor

Module -2: Power Supply Fundamentals **(8 Hrs)**

Power supply building blocks**,** Rectifier, Need of rectifier, Types of Rectifier, Filter and their types, Zener Diode as voltage regulator, Transistorized voltage regulator, Three terminal voltage regulator such as IC 78XX and IC 79 XX, Adjustable voltage regulator using LM-317

Module -3: Number system and Logic gates **(6 Hrs)**

Number System – Decimal, Binary, Octal, Hexadecimal and their conversion. Binary addition, subtractions

Logic Gates – Basic logic gates – AND, OR, NOT; Basic Circuit, Symbol, Truth table, universal gates & their truth table

Boolean Algebra – Basic Laws, De Morgan‘s Theorem, Conversion of Boolean expression to logic diagram, Simplification Techniques

Module – 4: Combinational Logic **(8 Hrs)**

Combination of Logic Gates: Converting a Boolean Expression to a Logic Diagram, Converting a Truth Table to a Boolean Expression, Converting a logic diagram to a truth table, AND-OR logic, Minterm, OR-AND logic, Maxterm, EX-OR gate, EX-NOR Gate, NAND and NOR gate, Universal Property of NAND and NOR gate

Module – 5:

Tutorials, assignments, demonstrations and presentation based on Module I to IV

References:

1. Electronic Devices- Thomas l. Floyd; Pearson Education, Ninth Edition, 2012, New Jersey
2. Principles of Electronics- V. K. Mehta, Rohit Mehta; S. Chand Publishers, Twelfth Edition, 2008, New Delhi
3. Semiconductor Electronics – A. K. Sharma; New Age International publishers, 2001 Reprint, New Delhi
4. Electronic Principles- A. P. Malvino, D. J Bates; Mc. Graw Hill (India Pvt. Ltd), Seventh Indian Edition, 2007, New Delhi
5. Digital Fundamental- Thomas L. Floyd; Third Edition, 1987, Universal Book Stall, New Delhi/ Tenth Edition, 2008, Pearson
6. Digital Design: Principles and Practices- John F. Walkerly; Fourth Edition, Second Impression, 2009,Prentice Hall of India, New Delhi
7. Modern Digital Electronics- R. P. Jain; Fourth Edition,2010, Tata Mc. Graw Hill, New Delhi

VOC-112: Electrical Systems

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce students with basic concepts of single and three phase AC and electrical machines.

Learning Outcomes

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

1	Analyze simple DC circuits by applying DC network theorems
2	Explain various parameters of Single phase AC signal and interconnection of phases for Three phase AC signal
3	Describe basic construction and working principle of Single Phase and three phase transformers
4	Describe basic construction and operation of AC and DC motors and select requisite motor for application specific demand
5	Compare between renewable and non-renewable sources, describe basic working of solar and wind power plant and apply modular solar/ wind power generators for basic applications

Course Contents:

Module -1: Basic Circuit Elements and D.C. Network Analysis (8 Hrs)

Basic Circuit Elements -Idea of Electric Potential and Current, Resistance -Unit, Law, Conductance and Conductivity, Effect Of Temperature on Resistance, Temperature Coefficient of Resistance, Ohms Law, Resistance and Parallel, Voltage Divider Rule, Short and Open Circuits, Equivalent Resistance. Inductance- Self inductance, mutually induced EMF, Capacitance – Charging & Discharging, Time Constant

D.C. Network Analysis- Introduction (Circuit, Parameters, Types of Circuits, Types of Networks, Node, Branch, loops, Mesh), Kirchoff's Volatage and Current Law, Thevenin Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Delta /Star and Star /Delta Transformation.

Module -2: Electrical Fundamentals and Transformer (8 Hrs)

Single Phase AC - Generation of Alternating Voltage and Current, Equation of Alternating Voltage & Current, Simple Waveform, Complex waveform, Cycle, Time Period, Frequency,

Amplitude Different form of EMF Equations, Phase, Phase Difference, Root mean Square Value(RMS) , Representation of Alternating Quantities.
Three Phase AC - Generation of Three phase voltage, Phase Sequence, Phase sequence at load, Numbering of phases, Interconnection of phases (Star and delta Connection), Concept of balance and unbalanced Load

Single Phase Transformers- Construction, Working Principle, EMF Equations, Transformation Ratio, Working of Transformer On no load and with load, losses, efficiency

Three Phase Transformers- Construction, Working Principle, Three phase transformer connections; Instrument transformers (Current and Potential transformer)

Module -3: Electric Motors (8 Hrs)

AC motors – Principle, Stator construction and operation (two and three phase), Single Phase Induction motors, Motor characteristics, Resistance-start-induction-run motor,
capacitor start- induction run motor, Three phase motors, Induction motor, Synchronous motor, parameters on motor nameplate

DC motors - Principle, Basic motor Construction, Motor classifications, Significance of back e.m.f., Rotary Motion, control of field flux, Counterelectromotive force, Armature reaction, Armature torque and shaft torque, Torque and speed of a DC motor, DC motor characteristics Speed control of DC motor

Module -4: Energy Sources (7 Hrs)

Energy Sources – Renewable and non-renewable, Thermal & Nuclear Power Plant - Working principle, application, advantages & limitations, Solar & Wind Power plant – Working principle, application, advantages & limitations

Module – 5:

Tutorials, assignments, demonstrations and presentation based on Module I to IV

References:

1. Electrical Technology (Vol 1 and 2)- B.L.Thereja, A. K. Thereja; S. Chand Publishers; First multicolour edition, 2005; New Delhi
2. Network Analysis and Synthesis- Ravish R. Singh; Mc. Graw Hill Education (India) Pvt. Ltd. First Edition, 2013, New Delhi
3. Grob's Basic Electronics- M.E. Schultz; Mc.Graw Hill Pvt. Ltd., Special Indian Edition (Tenth) 2007, New Delhi
4. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
5. Non Conventional Energy Resources- B.H. Khan; Mc. Graw Hill Education, Second Edition, 2009, New Delhi.

VOC 113: Industrial Electronics

(2 Credits: 50 Marks)

Learning Objectives:

1) To introduce students with concept of Industrial Electronic system. Why it is needed, What are various parts in it, how they work.

2) Understand classifications of various Power devices and know their construction, working principle, how they are controlled by small power, advantages, disadvantages.

3) Understand how the Power devices are used to make various industrial electronic systems like controlled rectifier, chopper, inverter etc.

Learning Outcomes:

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

1	Describe Silicon Controlled Rectifier (SCR) characteristics, protection circuits for thyristors and basic principles of various members of thyristor family, and triggering devices
2	Explain turn on and turn off mechanism for SCRs and compare between various triggering techniques for SCR
3	Design basic gate trigger circuits for SCR and implement them in projects/experiments
4	Explain concept of phase control and contrast between different phase control rectifier circuits
5	Explain the concept of Chopper and develop basic chopper circuits
6	Explain the concept of inverters, classify inveters and compare among various categories of inverters

Course Contents:

Module- 1: Power Electronic Devices **(8 Hrs)**

Introduction – Concept, Applications, Power electronic devices

Silicon Controlled Rectifiers (SCRs) – Static I-V characteristics, Switching on and off of SCR, SCR protection (Snubber circuits, overvoltage protection, overcurrent protection, gate protection), Heating, cooling and mounting

Members of Thyristor Family- LASCR, DIAC, TRIAC, ASCR, RCT; Triggering Devices- UJT, PUT

Module- 2: Turn ON and Turn OFF methods of SCR **(7 Hrs)**

Turn ON mechanism of SCR- High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering.

Gate trigger circuits - R triggering circuit, RC triggering circuit, UJT triggering circuit (Operation, applications and limitations). Use of Pulse transformer in triggering circuit,

Turn OFF Circuits - Concept of Turn OFF / commutation mechanism of SCR through various methods

Module -3: Phase Controlled Rectifiers **(8 Hrs)**

Phase control – Basic concept (Firing Angle α and conduction angle θ)

Phase Control Rectifiers - Single phase half wave controlled rectifier with R, RL load, Effect of freewheeling diode; Single phase centre tapped full wave controlled rectifier with R, RL load; Effect of freewheeling diode; Single phase Bridge type full wave controlled rectifier with R, RL load; Effect of freewheeling diode (operation and waveforms). (Basic three phase half wave uncontrolled and controlled rectifier; Need and Uses of Poly phase rectifier.

Understand need and use of Isolation transformer and Power scope.

Module - 4: Choppers & Inverters **(8 Hrs)**

Choppers- Fundamental Concept, basic circuit and its operation using SCR and MOSFET Step Up and Step down Chopper

Inverters- Fundamental Concept, Need of an inverter, Classification of inverters, Important applications of inverter, Working principle of Series, Parallel, bridge inverter, Performance parameters of inverter.

Block diagram and working principle of SMPS and UPS.

Module – 5: **(6 Hrs)**

Tutorials, assignments, demonstrations and presentation based on Module I to IV

References:

1. Power Electronics - Dr. P.S. Bhimbra, Khanna Publishers, Fifth Edition, 2014 Reprint, New Delhi
2. Power Electronics - M.D. Singh, K. Khanchandani, Tata Mc. Graw Hill Publishers, Second Edition, 2008 Third Reprint, New Delhi
3. Industrial and Power Electronics - Deodatta Shingare, Electrotech Publication, Second Edition, 2004, Pune

4. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
5. Power Electronics Circuits Devices and Applications - Muhammad H. Rashid; Prentice Hall of India; Third Edition, Seventh Impression, 2009, New Delhi
6. Power Electronics and Its Applications - Alok Jain; Penram International Publishing (India) Pvt. Ltd., Second Edition, 2004, Mumbai

VOC-114: Industrial Measurements and Instrumentation

(2 Credits: 50 Marks)

Learning Objectives

1) To introduce students with concept of Instrumentation system. Why it is needed, what are various parts in it, how they work.

2) Understand classifications of various transducers and know there construction, working principle, advantages, disadvantages.

3) Understand how the transducer output is conditioned, processed, displayed and controlled.

4) Study the various systems for measurement of different physical parameters.

Learning Outcomes

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

1	Discuss primary blocks of an Instrumentation System and describe basic selection criteria for transducers as per application demand
2	Describe and classify displacement and position detection sensors, and apply them for real time measurements
3	Describe and classify temperature and pressure sensors, and apply them for real time measurements
3	Explain and compare flow and level measurement sensors accordance to application demands
4	Discuss humidity measurement devices, speed measurement methods, weight measurement principle and principle of vibration and thickness sensing

Course Contents:

Module - 1: Displacement and Detection Sensors (8Hrs)

Instrumentation System- Block diagram, Function of each block
Sensors and Transducers- Definition, Needs, Classification, Selection criteria
Measurement of Linear and Angular Displacement - Linear and Angular Potentiometers, Capacitive Transducers, LVDT
Detection Sensors – Limit Switches, Proximity Detectors, Hall Effect Sensor, Photoelectric sensors, Ultrasonic Sensors

Module – 2: Temperature and Pressure Sensors **(8 Hrs)**

Temperature measurement - Temperature: Definition and units, Different temperature scales & their conversions; Classification of temperature measuring transducers: Gas Filled thermometer, Bimetallic thermometer, Thermistors, RTD – (PT-100) , 2 wire systems (circuit diagram only), Thermocouple – Seeback & Peltier effect, Types J, K, R , S, T(Based on material, temperature ranges)

Pressure measurement - Pressure: Definition, Types - Absolute, Gauge, Atmospheric, Vacuum (Definition, Units), Classification of Pressure measuring devices; Non elastic pressure transducer: U tube, Inclined Tube, Well type manometer; Elastic pressure transducer: Bourdon Tube, Bellows, Diaphragm, Capsule, Electronic pressure transducers- Bourdon tube with LVDT Diaphragm with Strain gauge

Module – 3 : Flow and Level Sensors **(6 Hrs)**

Flow measurement - Flow: Definition, Types of Flow – Laminar, turbulent , Reynolds number Classification of flow measuring transducers : Variable head flow meter- Venturimeter, orifice plate meter, Variable area flow meter – Rota meter, Electromagnetic Flow meter, Ultrasonic flow meter-Doppler Type, Solid flow measurement, Flow measurement

Level Measurement - Classification of level measurement methods: Float type – linear & rotary potentiometer (Contact type), Capacitive type (Contact type), Ultrasonic type (Non-contact type) Radiation type (Non-contact type), RADAR type (Non-contact type)

Module – 4 : Special Purpose Sensors **(8 Hrs)**

Humidity: Definition, unit, Types - Absolute, relative

Humidity measurement devices: Psychrometer - Dry & wet Bulb thermometer type, Hygrometer-hair type ,Speed : Definition, unit, Classification of speed measurement methods. Photoelectric pick-up & Proximity sensor (Non contact type)

Weight: Definition, unit, Classification of weight measurement methods.
Load cells. Vibration Sensor, Thickness Sensor

Module – 5: **(6 Hrs)**

Tutorials, assignments, demonstrations and presentation based on Module I to IV

References:

1. Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney; Dhanpat Rai & Sons.
2. Industrial Instrumentation & Control - S.K.Singh; Tata McGraw Hill Publishing Co. Ltd;

2006, Second Edition, New Delhi

3. Principles of Industrial Instrumentation - D. Patranabis; Tata McGraw Hill Publishing Co. Ltd; Third Edition, 1995, New
4. Electronics Instrumentation – H. S. Kalsi; Second Edition, 2004, Tata McGraw Hill Publishing Co. Ltd; N. Delhi
5. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
6. Mechatronics- M.D.Singh, B.Joshi; First Edition, 2006,Prentice Hall of India, New Delhi

VOC 115: Laboratory Coursework – I
(Analog and Digital Electronics)

(2 Credits: 50Marks)

Learning Outcomes

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

1	Demonstrate operation of diodes, transistors ,various digital ICs, etc.
2	Construct circuits deploying operation of simple and combinational logic gates
3	Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
4	Design basic circuits using analog and/or digital electronic components for simple applications that include (but not limited to) power supply, water level control etc

List of Experiments:

1. Study of P-N junction diode characteristics.
2. Study of characteristics of CE configuration of transistor.
3. Study of transistor as small signal amplifier (CE configuration) and Switching Device.
4. Study of SCR characteristics.
5. Study of Zener diode characteristics.
6. Study of rectifiers (half wave, full wave, bridge rectifier)
7. Study of Series and shunt Voltage regulator using transistor
8. Study of Zener diode as voltage regulator
9. Study of Voltage regulator IC-78XX & IC-79Xx
10. Study of adjustable voltage regulator using IC-317
11. Study of digital logic gates and De‘morgans theorem using logic gates
12. Study of discreet components (diodes and transistors) as logic gates
13. Study of universal logic gates NAND & NOR gates

VOC 116: Laboratory Coursework – II
(Electrical Systems)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Analyze DC circuits by employing network theorems
2	Verify working of single phase transformer
3	Explain working of AC induction motor and DC shunt/series motor
4	Explain working of a solar and wind power generator

List of Experiments:

1. Study of Series and parallel resistive circuit, KCL and KVL
2. Study of Charging and discharging of Capacitor
3. Study of Superposition Theorem and Maximum Power Transfer Theorem
4. Study of Norton‘s Theorem & Thevenins theorem
5. Study of Single Phase Transformer
6. Study of voltages and currents in passive loads in Three phase star Configuration
7. Study of voltages and currents in passive loads in Three phase star Configuration
8. Study of three phase circuits with balanced load
9. Study of three phase circuit with unbalanced load
10. Study and verify Load Characteristics of DC Shunt Motor
11. Study and verify Load Characteristics of DC Series Motor
12. Study of single Phase Induction motor
13. Study of three phase squirrel cage motor
14. Study of V-I characteristics of solar cell and dusk to dawn switch
15. Study of various modes of constant voltage charging technique.
16. Study of Wind Power generation

VOC 117: Laboratory Coursework – III

(Industrial Electronics)

(2 Credits: 50 Marks)

<u>Learning Outcomes:</u>

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

1	Demonstrate operation of Silicon Controlled Rectifier
2	Demonstrate Resistance and Resistance Capacitor triggering for SCR
3	Demonstrate phase control using Silicon Controlled Rectifier
4	Demonstrate operation of Choppers

List of Experiments:

1. Study of DC characteristics of SCR
2. Study of switching characteristics of SCR
3. Study of firing circuits for SCR
4. Study of SCR Commutation Techniques (Any two)
5. Study of DIAC
6. Study of TRIAC
7. Study of the effects of variation of R, C in R and RC triggering circuits on firing angle and output voltage of SCR.
8. Study of the output waveforms of single phase full wave controlled rectifier with R, RL load, freewheeling diode and measure load voltage.
9. Study of the output voltage waveform of three phase half - wave controlled rectifier with resistive load and measure load voltage.
10. Study of the effect of firing angle on output voltage in DIAC - TRIAC phase control circuit.
11. Study of Step UP chopper (with SCR/MOSFET/Transistor)
12. Study of Step Down chopper (with SCR/MOSFET/Transistor)

VOC 118: Laboratory Coursework – IV
(Industrial Instrumentation)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Demonstrate characteristics of different sensors/detectors (pertinent to theory course VOC 114)
2	Apply different sensors/detectors (pertinent to theory course VOC 114) for real time applications

List of Experiments:

1. Study of proximity sensors
2. Study of Hall effect switch
3. Study of photoelectric sensors
4. Study of temperature of liquid using Resistance Temperature Detector (PT 100)
5. Study of temperature of liquid using thermocouple
6. Displacement measurement using LVDT
7. Weight Measurement using strain gauge transducer with cantilever setup
8. Pressure Measurement using Bourdon tube pressure gauge
9. Determine the rate of flow of liquid in pipe using orifice, ventury, Rotameter
10. Level measurement using by capacitive/float/conductive probe method
11. Observe and interpret humidity of air using wet and dry bulb Hygrometer
12. Measure speed of motor using non contact type photo electric / Inductive pick up/Tachogenerator

Semester – II

General Academic Components

Semester II

General Education Components

VOC - 201: Linguistic Proficiency-II

(4 Credits: 100 Marks)

Part - A: English

Learning Objectives

To improve the writing skills of students in English and Hindi

Learning Outcomes

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

1	Write notices, agendas, minutes of meetings in English and Hindi
2	Write applications for jobs, and business related letters in English and Hindi
3	Develop effective listening skills and prepare speeches, proposals and reports in English and Hindi
4	Prepare Surveys, Proposals and Projects reports in English and Hindi

Course Contents:

Module –I: Introducing written communication **(10 Hrs)**

1. Writing Notices
2. Drafting Agendas (Synergy)
3. Writing minutes
4. Note taking
5. Basic of spoken English

Module-II: Writing applications, letters and business CORRESPONDENCE **(12 Hrs)**

(Introducing Business Correspondence):

1. Writing applications for various jobs, referring to the ads.

2. Writing letters:

   a. Letters of inquiry
   b. Letters of order
   c. Letters of complaint
   d. Letters of indent
   e. Letters of credit

f. Bills of lading
(Exercises from Synergy) Orient Longman

Module- III: Introducing listening skills **(12Hrs)**

1. Approaches to listening skills
2. Barriers to effective listening
3. Tips for effective listening
4. Preparing for interview, Interview facing techniques
5. Preparing -
   a. Speeches
   b. Presentations
   c. Meetings
   d. Surveys
   e. Report writing
   f. Making Project reports
   g. Preparing Proposals
   h. Seeking financial assistance / loan for your proposal

References:

1) Synergy: Communication in English and study skills (Orient Blackswan) – (2008)
2) Macmillan foundation English – R. K. Dwivedi, A. Kumar: Macmillan India Ltd. 2001
3) Mastring Communication – Nicky Stanlon: Palgrave Macmillan (2009)
4) Scientists must write – Robert Barrass: Routledge Publication, London
5) Functional Grammar and Spoken and Communication in English – Bikram K. Das: Orient Longman Publication (2006)

PART-B: BASIC STRUCTURE OF THE HINDI LANGUAGE

(ON NEXT PAGE…………..)

Part-B: Hindi

संप्रेषणमूलक व्यावसायिक हिंदीः

Module- IV:

वाणिज्य व्यवसाय और हिंदीः

- वाणिज्य व्यापार से तात्पर्य एंव व्यावसायिक व्यापार के साधन

- वाणिज्य व्यापार और भाषिक प्रकार्य

- वाणिज्य-व्ह्यावसायिक संरचनात्मक विशेषताएँ

- भाषा कौशल्यः

  श्रवण, भाषण, वाचन, लेखन

व्यावसायिक - संप्रेषणः

- संप्रेषण के तात्पर्य एवं स्वरुप
- संप्रेषण के प्रमुख प्रकारः भाषिक तथा भाषेतर
- व्यावसयिक पत्राचार

क) व्यापारिक- व्ह्यावहारिक सामाण्यपत्रा, आवेदनपत्र, यासाखपत्रा, संदर्भ तथा साखपत्रा के जॉचपत्रा, मुल्य ज्ञापनपत्र, आदेशोके निरसन सम्बंधीपत्रा, शिकायतपत्रा, समायोजनपत्र, तगादायावसूलीपत्र, विक्रय प्रतिनिधत्व संबंधीपत्र,

ख) विशेष व्यावहारिकपत्रः

-बीमातथाबीमा - पत्र

-रेल तथा जहाज द्वारा माल परिवहन से संबंधितपत्र

ग) प्रकल्प / सर्वेक्षण / प्रात्यक्षिकः

- भाषिक कौशल्य अभ्यास

- वाणिज्य - व्ह्यावसायके भाषिक प्रकार्या कासर्वेक्षण

- व्यापरिक संप्रेषण - पत्रलेखन का अभ्यास

सहायक ग्रंथः-

१. व्यावसयिक संप्रेषणः डॉ. अनूपचंद्र मायानी, राजपाल एण्ड संस, नईदिल्ली

२. भाषाशिक्षणःसिध्दांतऔरप्रक्रिया - मनोरमागुप्त, केंद्रियहिंदीसंस्थान, आगरा

३.मीडियालेखनः सिध्दांतऔरव्यवहार - डॉ. चंद्रप्रकाश

४. व्यावसायिकहिंदी - डॉ. दिलीपसिंह, वाणीप्रकाशन, काशन, नईदिल्ली.

५. संप्रेषणमूलक व्यावसायिक हिंदी - डॉ. माधवसोनटक्केः ओरियण्ट ब्लैक स्वाईन, दिल्ली.

VOC – 202: Computer Hardware System: Theory

(2 Credits: 50 Marks)

Learning Objectives

To introduce students with computer hardware system, troubleshooting techniques

Learning Outcomes

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

1	Illustrate Basic architecture, hardware aspects, peripherals (memory, input/ output devices) of Computers
2	Explain step by step hardware assembly of Computers
3	Compare printer categories, describe printing principles and types of scanners
4	Describe hardware features, maintenance basics and develop wi-fi network related troubleshooting skill with laptops
5	Assemble a desktop computer and install operating system/ softwares , while identifying components in Bios set-up and address problems related to installation

Course Contents:

Module-I: **(9Hrs)**

Computer Architecture, Mother Board and its all components, Computer Components (Input/ Output Devices, Primary and Secondary Memory, Power Supply, Monitor).

Observation of all parts of Floppy drives, HDD, CD, and SMPS. Identification of cables and computers. Mounting Motherboard in cabinet, Installation of cards, devices and then connecting cables. Fitting of cabinet. CMOS – Setup, Troubleshooting.

Module-II: **(10 Hrs)**

Computer Assembling, Make your own Computer, Operating System Installation, Windows Vista, Software Installation, Trouble Shooting, Bios Setups, Identifications of Components. Advanced Trouble Shooting and Maintenance.

Module-III: **(9Hrs)**

Types of printers and printing mechanism, How printer works, Inject printer, working of laser printer, Fonts/Type faces, Trouble shooting printers. Types of Scanners and its used.

Module-IV **(8 Hrs)**

Introduction to Laptops, Portable System background, System Features, Processors, Mother Boards, Memory, Power, Expansion Bus, Hard Disk & Removable Storage Devices, Laptop Components, Laptop Maintenance & Assembling, Linux, Multimedia, Internet, Computer VIRUS, Wi-Fi Network Trouble Shooting.

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

References:

1. Hardware bible By : Winn L Rosch, Techmedia publications
2. Trouble shooting, maintaining and repairing PCs By : Stephon J Bigelow Tata McGraw Hill Publication
3. Modern All about printers By :Manohar Lotia, Pradeep Nair, BijalLotia BPB publications.
4. The complete PC upgrade and maintenance guide By : Mark Minasi, BPB Publications.

VOC – 203: Computer Hardware System : Lab- Course

(2 Credits: 50 Marks)

Laboratory Coursework

Learning Outcomes

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

1	Handle computer peripherals
2	Assemble desktop systems
3	Install operating system and software in PCs
4	Troubleshoot broad based problems in Desktop and laptop systems

1. Handling of all Computer Peripherals
2. PC Troubleshooting
3. Windows Installation
4. PC Assembling
5. Fault finding in PC and recovering
6. Installation and use of Printers and Scanners
7. Fault Finding and Troubleshooting on Laptop

Rather than performing a certain prescribed number of experiments, this laboratory coursework is meant for providing sufficient hands on practice of the students with computer. However, for purpose of evaluation, at least six experiments, more or less equally divided from above listed sectors, are to be performed.

VOC-204: Environment Management

(4 Credits: 100 Marks)

Learning Objectives

1. To create awareness between the students about our ecosystem, related problems and our role in that.
2. To encourage students to solve the environment related problems

Learning Outcomes

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

1	Discuss Ecosystem and Natural Resources
2	Explain impact of Pollution on human beings and nature
3	Infer role of human being in pollution and waste management
4	Discuss Biodiversity and Relate necessities for conservation of nature
5	Describe issues related to urban environment, sustainability and sustainable development

Course Contents:

Module - I: Ecosystems and Natural Resources (10 Hrs)

Introduction: Introduction and scope of environmental science; Need of public awareness.

Ecosystem: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Natural Resources: Land resources and landuse change; Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity; Water: Use and over-exploitation of surface and ground water, floods, droughts; Energy resources: Renewable and non-renewable energy sources, growing energy needs.

Module - II: Environment Pollution,Waste Management & Role of Human being (12Hrs)

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks;Case Studies: Bhopal Tragedy, Cherbonyl disaster etc.

Waste management: Control and treatment measures of urban and industrial waste; Trade in Wastes; Industrial Ecology and Recycling Industry Waste trade;

Human population growth: Impacts on environment, human health and welfare. Growth Limits. Resettlement and rehabilitation of project affected persons; case studies.

Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics

Module -III: Biodiversity and Conservation **(10 Hrs)**

Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India; India as a mega-biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module- IV: Environment Policies & Practices **(08 Hrs)**

Fundamentals: Sustainability and sustainable development;

Urban problems: global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act;

Environment Management System: EMS Standards, ISO 19011 & ISO 14000 Series, Bharat-II and EURO- II, Eco-Audit Scheme, Clearance/ Permission for establishing Industry

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

References:

1. Subramanian.V., —The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book Agency, 21st ed., Chennai, 2000.
2. C.RayAsfahl— Industrial Safety and Health managementPearson Prentice Hall,2003.
3. National Safety Council, —Accident Prevention Manual for Industrial Operations, N. S. C. Chicago, 1988.
4. Heinrich H.W. —Industrial Accident Prevention, McGraw-Hill Company, New York, 1980.
5. Krishnan N.V. —Safety Management in Industry, Jaico Publishing House, Bombay, 1997.
6. John Ridley, —Safety at Work, Butterworth & Co., London, 1983.
7. Blake R.B., —Industrial Safety, Prentice Hall, Inc., New Jersey, 1973
8. Bharucha, E. 2003, Textbook for Environmental Studies, University Grants Commission, New Delhi and BharatiVidyapeeth Institute of Environmental Education and Research, Pune. 361.
9. Carson, Rachel. 1962. Silent Spring (Boston: Houghton Mifflin, 1962), Mariner Books, 2002
10. Economy, Elizabeth. 2010. The River Runs Black: The Environmental Challenge to China's Future.
11. Gadgil, M. &Ramachandra, G. 1993. *This fissured land: an ecological history of India*. Univ of California Press.
12. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
13. Grumbine, R. Edward, and Pandit, M.K. Threats from India's Himalaya dams. *Science* 339.6115 (2013): 36-37.
14. Heywood V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
15. McCully, P. 1996. *Silenced rivers: the ecology and politics of large dams*. Zed Books.
16. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
17. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
18. Pepper, I.L., Gerba, C.P. &Brusseau, M.L. 2011. *Environmental and Pollution Science*.

Academic press, 2011.
19. Rao MN and Datta AK,1987.Waste Water Treatment. Oxford and IBH Publishing. Pvt. Ltd.

Semester – II

Industrial Automation

(Skill Development Components)

Skill Development Components

Industrial Automation

VOC-211: INTERFACING AND SIGNAL CONDITIONING

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce students with basic concepts of interfacing and signal conditioning and timers.
2. To introduce students with the scopes of above concepts in practical applications.

Learning Outcomes

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

1	Identify basic blocks of a Data Acquisition System (DAS) and explain necessity of signal conditioning
2	Explain fundamental characteristics of Operational Amplifiers (OP-AMPs) and illustrate OP-AMPs as building blocks of Signal conditioners
3	Design and apply various signal conditioning circuits using OPAMPs
4	Define and describe IC555 as timing element for domestic and industrial applications
5	Distinguish different operational modes of IC555 timers

Course Contents:

Module -1: Introduction to Interfacing and Signal Conditioning (6 Hrs)

Concept of Interfacing, Basic Block Diagram of DAS, Concept of Analog to Digital and Digital to Analog conversion, Necessity of Signal Conditioning, Types of Signal Conditioning (Analog and Digital), Introduction To OP-AMP (Fundamental Block Diagram, Parameters, Characteristics) and its role as a signal conditioner

Module -2: Operational Amplifier as Signal Conditioner I (8 Hrs)

Open Loop Operation, Closed Loop Operation, Inverting Configuration, Non-Inverting Configuration, Operation of OP-AMP as – Unity Gain amplifier (buffer), Adder, Subtractor, Integrator, Differentiator, Scaling and Averaging Amplifier

Module -3: Operational Amplifier as Signal Conditioner II (7 Hrs)

Sample and Hold Circuit, Logarithmic amplifier, Transducer Bridge (Instrumentation Amplifier), Converters- Current to Voltage, Voltage to Current, Frequency to Voltage,

Voltage to Frequency; Comparator, Window Comparator, Schmitt Trigger

Module – 4: Integrated Timing Circuits (8 Hrs)

Introduction to Timers, Fundamentals of IC555 timer, Monostable Operation of IC555 , Astable Operation of IC555, Programmable Timer (XR-2240), Overview of Industrial Timers

Module – 5:

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

References:

1. Ramakant A Gaikwad; 2000; OP-AMP and Liner Integrated Circuits (Fourth Edition); PHI Learning PVT LTD; Delhi (India)
2. Robert F. Coughlin, Frederick F. Driscoll, 2001, Operational Amplifiers and Linear Integrated Circuits (Sixth Edition); Prentice Hall (New Jersey)
3. http://www.mccdaq.com/pdfs/andpdf/Data-Acquisition -Handbook.pdf
4. http://www.ni.com/white-paper/3536/en/pdf

VOC-212 : Control Systems Fundamentals

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce students to the classifications of control system, controllers and complex modes of operation
2. To make students understand the advantages and limitations of various types of control systems

Learning Outcomes

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

1	Define and explain basic elements and parameters of a control system
2	Contrast open loop and feedback control
3	Explain and contrast various control modes and individual and composite operation
4	Define, explain and classify industrial process technique and relate commensurate instrumentation
5	Analyze different control mode operations through NI/Lab view or equivalent software simulation

Course Contents:

Module -1: Introduction to Industrial Control Systems (6 Hrs)

Classification of Control System, Industrial Control System, Elements of Open and Close Loop Control System, Feedback Control, Dynamic Response of a Closed Loop System, Control System Parameters

Module -2: The Controller Operation (8 Hrs)

Block Diagram, Algebra Of Control System, Concept Of Process Control, Automatic Controllers – Analog And Digital, Control Modes- On-Off, Proportional Control, Integral Control, Derivative Control, PID Control, Time Proportioning Control, Time Proportioning Circuit

Module -3: Industrial Process Techniques (7 Hrs)

Batch Process, Continuous Process, Instrumentation, Measurement Devices, Feedback Loop Interface Instruments, Controllers

Module – 4: Industrial Process Instrumentation (7 Hrs)

Monitoring Instruments - Indicators, Alarms and Recorders. Manipulation Devices- The Control Valve, the Valve Body, Instrumentation Symbology- General Instrument Symbol, Tag Numbers, Line Symbols, Valve and Actuators Symbols

Module – 5:

Tutorials, Assignments, Demonstrations and Presentation Based On Module I To IV

References:

1. Terry Bartelt; 2006; Industrial Electronics: Circuits, Instrument and Control Technique (INDIA EDITION) ; Cengage Learning India PVT LTD; Delhi (India)
2. Curtis D. Johnson; 2012 ; Process Control Instrumentation Technology (EIGHTH EDITION); PHI Learning PVT LTD; New Delhi (India).
3. http://www.electrical4u.com/control-system-closed-loop-open-loop-control-system/
4. https://www.facstaff.bucknell.edu/mastascu/eControlHTML/Intro/Intro1.html
5. http://www.electronics-tutorials.ws/systems/closed-loop-system.html
6. I.J.Nagrath, M.Gopal; 2009; Control Systems Engineering (Fifth Edition); New Age International Publishers; India
7. N. Barapate; 2006; Control System; Tech Max publications; Pune (India)
8. A. Nagoorkani; 2006; Control System; RBA publications; Chennai (India)
9. K. Ogata; 2002; Modern Control Engineering; Prentice Hall; New Delhi(India)
10. Richard Dorf , Robert Bishop; 2005; Modern Control System; Pearson Education ; New Jersey

VOC-213: FUNDAMENTALS OF DRIVES

(2 Credits: 50 Marks)

Learning Objectives

1. To acquaint students of fundamental AC and DC drive modes.
2. To make students understand starting, braking and controlling of motors through Drives.

Learning Outcomes

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

1	State and describe various class electrical drives, need of electric drives and applications of it, DC and AC drives, Types of load
2	Explain Quadrantal Diagram Of Speed-Torque Characteristics
3	Describe and classify various modes of Starting and Braking Of Motors
4	Define and explain various elements of DC drives
5	Define and explain various elements of AC drives
6	Apply industry grade AC drives to control Single phase and Three phase motors by PWM method

Course Contents:

Module -1: Electrical Drives- An Introduction **(6 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

Module -2: **Starting and Braking Of Motors** **(7 Hrs)**

DC Motor Drives- Starting, Braking, Induction Motor Drive- Starting, Braking, Synchronous Motor Drive- Starting, Braking

Module -3: Electrical Drives I **(8 Hrs)**

DC Drive Fundamentals, Speed Regulators, Variable Voltage DC Drive, DC Drive System – Motor System Control, Speed Regulation, IR Compensation, Current Limiting , Speed Adjustment, Acceleration/Deceleration Adjustment

Module – 4: Electrical Drives II **(6 Hrs)**

AC Drive Fundamentals, AC Drive System, Drive Controller Internal Circuitry, Circuit Operation Of The AC Drive (The Converter, The Intermediate Circuit, The Inverter Operation) , Flux Vector Control, PWM Control Methods

Module – 5:

Tutorials, Assignments, Demonstrations and Presentation Based On Module I To IV

References:

1. Terry Bartelt; 2006; Industrial Electronics: Circuits, Instrument and Control Technique (INDIA EDITION) ; Cengage Learning India PVT LTD; Delhi (India)
2. S. K. Pillai; 2001; A First Course On Electrical Drives (SECOND EDITION); New Age International PVT LTD ; New Delhi (India)
3. Gopal K Dubey; 2001; Fundamentals of Electrical Drives (SECOND EDITION); Narosa Publishing House; New Delhi (India)
4. www.electrical4u.com/electrical-drives/
5. www.electrical4u.com/control-of-electrical-drives/
6. P. K. SEN; Electrical Drives; Prentice Hall of India Private Limited; New Delhi (India)
7. Veltman André, Pulle Duco W.J., de Doncker R.W.; Fundamentals of Electrical Drives; Springer Netherlands
8. www.mpoweruk.com/motorcontrols.htm
9. www.completepowerelectronics.com/electrical-drives-introduction-classif...

VOC-214: PLC FUNDAMENTALS

(2 Credits: 50 Marks)

Learning Objectives

1. To teach students fundamental of PLC programming.
2. To make them capable to develop Ladder Programming.

Learning Outcomes

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

1	Define and explain basic terminologies related to PLCS and identify PLCs as a core element of automation
2	Describe PLC architecture, input output devices and necessity of networking
3	Explain and apply concepts related to ladder logic based PLCs programming
4	Compare different programming methods for PLCs and apply Ladder diagrams for basic I/O programming for PLCs
5	Identify simple automation related issues and develop ladder diagrams according to physical situations

Course Contents:

Module -1: Introduction to PLCs **(6 Hrs)**

Controllers, Hardware, Internal Architecture, PLC System, Input Devices, Output Devices, Examples of Applications

Module -2: **Number System and I/O Processing** **(6 Hrs)**

Review Of Number System (Binary Number System, Octal and Hexadecimal Number System, Binary Arithmetic), PLC Data, Input/output Units, Signal Conditioning, Remote Connections, Networks, Processing Inputs, I/O Addresses

Module -3: Ladder and Functional Block Programming **(7 Hrs)**

Ladder Diagrams, Logic Functions, Latching, Multiple Outputs, Entering Programs, Function Blocks, Program Examples

Module – 4: Programming Methods and Internal Relays **(6 Hrs)**

Instruction Lists, Sequential Function Charts, Structural Charts, Internal Relays, Ladder Programs, Battery-Backed Relays, One-Shot Operations, Set and Reset, Master Control Relay

Module – 5:

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

References:

1. W. Bolton; 2006; Programmable Logic Controllers; Elsevier Publication; UK
2. John R. Hackworth, Frederick D. Hackworth Jr; 2004; Pearson Edition; New Delhi (India)
3. http://www.mikroe.com/old/books/plcbook/plcbook.htm
4. John W. Webb, Ronald A. Reis;2013; Programmable Logic Controllers, Principles And Applications; Fifth Edition; Prentice Hall India; New Delhi, India
5. Frank Petruzella; 2014; Programmable Logic Controllers; Fifth Edition; Mc Graw Hill Publishing Company; UK
6. Gary D. Anderson; 2013; PLC Programming Using RSLogix 500: Ladder Logic Diagnostics & Troubleshooting Vol 1-3.
7. www.plcs.net
8. www.plcwashington.org
9. https://www.udemy.com/nfi-plc-online-leaning/
10. www.plctutor.com
11. electrical-engineering-portal.com › Resources

VOC - 215: Lab course V
(Interfacing and Signal Conditioning)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Design various signal conditioning circuits using OP-AMPs
2	Design multivibrators (astable and monostable) with IC 555
3	Interface standard, elementary DAQ to PC for real time data recording
4	Program industrial timers and interface to real time systems

List of Experiments:

1. Study of inverting, non-inverting and buffer configuration of OP-AMP.
2. Study of OP-AMP as adder and subtractor.
3. Study of OP-AMP as integrator and differentiator.
4. Study of Schmitt trigger.
5. Study of I/V converter and V/I convertor using OP-AMP.
6. Study of instrumentation amplifier using OP-AMP.
7. Study of IC555 astable mode of operation.
8. Study of IC555 monostable mode of operation.
9. Study of IC based D/A converter.
10. Study of IC based A/D converter.
11. Study of sample / hold circuit.
12. Study of data acquisition system.
13. Study of industrial timer.

VOC-216: Lab Course VI
(Control Systems Fundamentals)

(2 Credits: 50 Marks)

Learning Outcomes

On completion of this course, students will be able to

1	Explain basic elements and parameters of a control system
2	Apply PID controller for simple control process

List of Experiments:

1. Study of ON/OFF controller.
2. Study of open loop system.
3. Study of close loop system.
4. Study of close loop system with disturbance.
5. Study of steady state error.
6. Study of proportional controller.
7. Study of integrator controller.
8. Study of Derivative controller.
9. Study of PI controller.
10. Study of PD controller.
11. Study of PID controller.
12. Study of PID controller in closed loop.
13. Study of open loop speed control for PWM controller with and without load.
14. Study of ON/ OFF temperature controller.
15. Study of light intensity control system.

VOC - 217: Lab course VII
(Fundamentals of Drives)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Demonstrate Starting and Braking Of Motors
2	Demonstrate elements of DC drives
3	Demonstrate elements of AC drives
4	Apply industry grade AC drives to control Single phase and Three phase motors by PWM method

List of Experiments:

1. Study of speed control of DC motor with armature feedback.
2. Study of forward reverse operation with dynamic breaking.
3. Study of speed control of separately excited DC motor.
4. Study of speed control of series DC motor.
5. Study of speed control of shunt DC motor.
6. Study of speed control of single phase AC motor using cyclo converter firing circuit
7. Study of speed control of three phase AC motor using cyclo converter firing circuit
8. Study of speed control of single phase AC motor using PWM firing circuit
9. Study of speed control of three phase AC motor using PWM firing circuit
10. Study of RAMP comparator firing circuit.
11. Study of single phase half wave control converter.
12. Study of firing circuit using cosine wave scheme.

VOC-218: Lab course VIII
(PLC Fundamentals)

(2 Credits: 50 Marks)

Learning Outcomes

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

1	Interface basic input / output devices to PLCs
2	Develop ladder program for basic input –output operations with PLCs
3	Troubleshoot in ladder programs

List of Experiments:

1. Study of PLC interfacing to PC and I/P & O/P devices.
2. Study of ladder programming of PLC to interface push to ON/OFF switch.
3. Study of PLC ladder programming to demonstrate NOT, AND & OR gate operation.
4. Study of PLC ladder programming to demonstrate sealing/latching contacts.
5. Study of two – handed anti-tie down circuit using PLC ladder programming.
6. Study of two – handed anti-repeat circuit using PLC ladder programming.
7. Interface PLC to time delay relay.
8. PLC programming for interfacing conveyor belt for start and stop operation.

VOC 219: In-plant Training – II (IA)

(4 Credits: 100 Marks)

In-plant coursework on Control Panel Design and Wiring

Semester – III

General Academic Components

Semester III

General Education Components

VOC 301: Linguistic Proficiency – III

(4 Credits: 100 Marks)

Learning Objectives

To improve the presentation skills of students

Learning Outcomes

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

1	Explain various types of presentation skills
2	Apply advanced concepts of grammar to formulate correct sentences and paragraphs
3	Classify various forms of written communication
4	Develop ideas and logics for effective correspondence techniques
5	Prepare scripts for comparing / conducting programme

Course Contents:

Module- I: (1) Presentation skills: **(6 Hrs)**

(a) Oral Presentation
(b) Group Discussion/Panel Discussion
(c) Speech/Lecture
(d) Visual Presentation
(e) Use of Internet
(f) Seminar Presentation
(g) Commentary/ Reporting
(h) Language of Present functions
(i) Ability to answer& questions
(j) Exercise

Module- II: (2) Grammar in Use: **(8 Hrs)**

(a) Sentence Structure
(b) Verbs-Classifications
(c) Infinitive and gerunds
(d) Passivity
(e) Conditionals
(f) Concord
(g) Recapitulation of grammatical items
(h) Exercises

Module- III : Written Communication Skill: **(8 Hrs)**

(a) Forms of written communication
(b) Developing ideas and logic
(c) Correspondence Techniques
(d) Writing paragraph and complete item.
(e) Exercises
(f) Writing in different forms proposals surveys, appraisals and Reports
(g) Language and grammar required
(h) Writing article/paper/news paper/media report
(i) Exercises

Module- IV: Comparing/Conducting Programmes: **(7 Hrs)**

(a) Positive Attitude
(b) Language /Body Language
(c) Humour
(d) Mastering the terminology
(e) Exercises

Module- V : Tutorials, assignments and presentation based on Module I to IV **(6 Hrs)**

VOC 302: Business Software Tools- I: Web Page Design

(4 Credits: 100 Marks)

Learning Objectives

To introduce students with multimedia, World Wide Web, HTML and their applications

Learning Outcomes

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

1	Explain tools of HTML
2	Define tags used in table definition
3	Compare hypertext and link in HTML documents
4	Explain various audio and video file formats
5	Apply tools of HTML to develop a simple form/webpage

Course Contents:

Module- I: **(10 Hrs)**

A. Introduction-The World Wide Web (WWW), HTML History, Hypertext and Hypertext Markup Language, Microsoft Front Page

B. HTML Documents- Dividing the document into 2 parts, Headers, Body; Tags- Format, Representing 2 types of tag (odd and even); Elements of an HTML Document -Text Elements, Tag Elements, Special Character elements

C. Structural elements of HTML documents- Header tags; Body tags- Paragraphs, Titles, Lists (Numbered lists, Non-Numbered lists, Definition lists)

D. Formatting HTML Documents- Logical styles (source code, text enhancements, variables), Physical Styles (Bold, Italic, underlined, crossed)

Module- II: **(`12 Hrs)**

A. Managing images in html- Image format (quality, size, type, …), Importing images (scanners), Tags used to insert images, Frames

B. Tables in HTML documents- Tags used in table definition, Tags used for border thickness Tags used for cell spacing, Tags used for table size, Dividing table with lines, Dividing lines with cells; Cell types- Titles cells, Data cells

Module- III: **(10 Hrs)**

A.Hypertext and Link in HTML Documents- URL/FTP/HTTP; Types of links-Internal Links, External Links, Link Tags, Links with images and buttons, Links that send email messages

B. Special effects in HTML documents- Text fonts, Sensitive Images, Tip tables; Page background- Variable, Fixed; Rotating messages (Marquee); Counters

Module- IV: **(8 Hrs)**

A. Multimedia- Audio files and acceptable formats (*AIFF, AU, MIDI, WAVE*), Inserting audio files; Video files and acceptable formats (*MPEG, Quick Time, Video for Windows*)- Inserting video files, Screen control attributes (*WIDTH, HEIGHT, ALIGN*), Start control sttributes (*START, FILEOPEN, LOOP, LOOPDELAY, MOUSEOVER*).

B. Managing forms- Interactive forms; Creating data entry forms; Calling JavaScripts for modifying entered data; JavaScript Primer; Handling Form Output with JavaScript; Filling out HTML forms

Module- V: Tutorials, assignments and presentation based on Module I to IV **(6 Hrs)**

References:

1. Special Edition Using Intranet HTML / *Mark Surfas, Mark Brown and John Juge*
2. Dynamic HTML Web Magic / *JefDouyer – Hayden development group*
3. HTML 4 for the World Wide Web / *Elizabeth Castro*
4. Writing HTML Tutorial by Maricopa Center for Learning and Instruction (MCLI)
5. http://www.w3schools.com/html/

VOC 303: Statistical Tools: Probability and Statistics

(4 Credits: 100 Marks)

Learning Objectives

1. To apply the concept of probability and probability distributions in their field. To acquire the concept of estimation theory
2. To do testing of hypothesis that will be useful in solving engineering problems.
3. To design and analyze the statistical experiments.

Learning Outcomes

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

1	Explain concepts regarding random variables
2	Classify types of data, Represent data in diagrammatic/graphical mode
3	Explain gives and normal distribution
4	Discuss basic concepts, advantages, disadvantages , limitations of Operational Research,
5	Explain Linear Programming problems, Transportation problems, Assignment Problems and sequencing problems

Course Contents:

Module- I: Probability and Random Variable **(8 Hrs)**

Probability – Random variables – Moments – Moment generating function – Standard distributions – Functions of random variables – Two-dimensional R.Vs – Correlation and Regression.

Module- II: Statistics **(10 Hrs)**

Collection of data, types of data, Classification and tabulation of data, Diagrammatic/ graphical representation of data, Measures of central Tendency for ungrouped data, Mean, median ,mode of ungrouped data, Brief revision of Tabulation of data, inclusive and exclusive type of tables, Histograms, frequency polygon, frequency curve, pie diagram, Ogives(Cumulative frequency graphs) Applications of ogives in determination of median, Relation between measures of central tendency, Introduction tonormal distribution, Properties of normal distribution.

Module- III: **(12 Hrs)**

Introduction of Operation Research (OR), Origin and Development of OR, Scientific Method in OR, advantages and limitation of OR, Application of OR

Module- IV : **(10 Hrs)**

Linear programming problems (LLP), Graphical methods, Simplex method, Transportation problem (TP), Assignment problem (AP). Sequencing Problem (SP), Game theory, Networking Scheduling by PERT/ CPM, Replacement Problem

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

References:

1. Richard Scheaffer, Madhuri Mulekar, James McClave, ―Probability and Statistics for Engineers‖, Cengage Learning, USA, 2010.

2. Gupta, S.C. and Kapur, V.K." Fundamentals of Mathematical Statistics ", Sultan Chand and Sons, New Delhi, 2011.

3. Fruend John, E. and Miller, Irwin, "Probability and Statistics for Engineering ―, Prentice Hall, 5th Edition, 1994.

4. Jay, L. Devore, "Probability and Statistics for Engineering and Sciences", Brooks/Cole Publishing Company Monterey, California, 1982.

5. Montgomery D.C and Johnson, L.A.," Forecasting and Time Series ", McGraw-Hill. 2005.

6. Anderson, O.D., " Time Series Analysis: Theory and practice ", I. North - Holland, Amsterdam, 1982.

7. Operation Research- K. Swarup, P. L. Gupta, M. Mohan; Sultan Chand & Son

8. Operation Research- Gupta & Kapur; Sultan Chand & Son

9. Operation Research- K. Swarup, P. L. Gupta ; Sultan Chand & Son

Semester – III

Industrial Automation

(Skill Development Components)

Skill Development Components

Industrial Automation

VOC – 311: Analog and Digital Circuit Design

(02 credits – 50 marks)

Learning Objectives

The course should enable students to:

1. To widen the knowledge of transistors, field effect devices, their biasing and applications
2. Understand the flip-flop and counters etc
3. Understand the important of Basic Memory Array, Basic Memory operation etc

Learning Outcome

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

1	Compare various Bipolar Junction Transistor (BJT) biasing techniques
2	Describe basic operation, and characteristics, and biasing of Junction Field Effect Transistors
3	Describe basic operation, characteristics, and biasing of Metal Oxide Semiconductor Field Effect Transistors
4	Compare various Latches, Flip Flops , Counters and apply them for specific applications
5	Define and explain basic terminologies and operation of Registers and Memory

Course Contents:

Module – I: Transistor Biasing and application (08 Hrs)

Voltage Divider bias, Voltage Divider Bias Load Line and Q Point, Base Bias, Emitter Feedback Bias, Collector Feedback Bias, CC & CB Amplifier's –Basic Idea, Voltage Gain, Input Impedance of the base , Output Impedance, CE Emitter follower, Darlington Connection, CB Amplifier.

Module- II: Field Effect Transistors (07 Hrs)

JFET – Basic Operation, JFET symbols, JFET characteristic and parameters, JFET transfer Characteristics, JFET Biasing.

MOSFET Basic Operation, E-MOSFET, The Ohmic region MOSFET characteristic and parameters And Biasing.

Module- III: Flip Flop and Counters **(04 Hrs)**

S-R Latch, Gated S-R Latch, S-R Flip flop, D-Flip Flop, Edge Triggered, Edge Triggered D flip flop JK Flip Flop, Master – slave flip flop.
Synchronous Counter – 2 bit,3 bit 4bit, Asynchronous Counter- 2 bit, 3 bit, 4bit, UP/DOWN Counter (up to decade operation)

Module- IV: Registers and Memory **(05 Hrs)**

Basic Shift Register Operation ,Serial IN and Serial OUT , Parallel IN and Parallel OUT, Bidirectional Shift register operation, Modules of binary data, The Basic Memory Array, Memory address and capacity, Basic Memory operation , RAM, ROM.

Module- V:

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

References:

1. Albert Malvino, David J Bates- Electronic Principles, Tata McGraw Hill Education Pvt. Ltd. , ISBN -13: 978-0-07-0643424-4
2. T. L. Floyd- Electronic Devices conventional current version , Dorling Kindersley (INDIA) Pvt Ltd, ISBN -978-81-775-8643-5
3. T.L. Floyd- Digital Fundamentals, 10th Edition, Pearson, ISBN -978-81-317-3448-3
4. M.M. Mano- Digital Design, Pearson Education, ISBN- 0-13-062121-8
5. P. Horowitz, W. Hill - The Art of Electronics, CAMBRIDGE University Press, ISBN 0-521-49846-5

VOC – 312:Mechanical Power Transmission

(02 credits – 50 marks)

Learning Objectives

The course will enable the students to:

Understand concepts of power transmission different fundamental mechanisms

Learning Outcomes

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

1	Illustrate fundamental concepts of kinetics and kinematics of motion
2	Explain kinematic links, kinematic pairs, related classification and constrained motion
3	Explain friction as a power transfer entity, classify types of friction, and evaluate role of friction in operation of clutches
4	Discuss terminologies and operational concepts of belt, rope and chain drives and evaluate related advantages and disadvantages
5	Describe terminologies and operational concepts of gear, gear trains and cam drives and evaluate related advantages and disadvantages

Course Contents:

Module – I: Kinetics and Kinematics of Motion and Simple Mechanisms (07 Hrs)

Revision of concepts (vector and scalar, vector addition and subtraction, resultant vector), Rectilinear Motion, Equations of Rectilinear Motion, Angular Motion, Equations of angular motion, Newton's laws, Force, Couple, Centripetal and centrifugal force, Moment of Inertia, Moment of Momentum

Introduction to Kinematic links, types, structure, Kinematic pairs, classification, types of constrained motion, Kinematic chain, Types of joints in a chain, Mechanism

Module – II: Friction (06 Hrs)

Introduction to friction as a power transfer entity, Types of friction, limiting friction, laws of static and dynamic friction, friction co-efficient, Limiting angle, angle of repose, sliding body on rough plane; Screw friction, screw jack, friction in journal bearing friction cycle; friction of pivot and collar bearing, single disc/p[late clutch, Multiple disc clutch, centrifugal clutch

Module – III: Belt, Rope and Chain Drives (07 Hrs)

Introduction to belt drive, Selection of a belt drive, Types of belt drives and belts, belt materials, types of flat belt drives, velocity ratio in belt drive, Slip of belt, creep of belt, Power transmission by a belt drive, Centrifugal tension in abelt drive, ; V-belt drive, Advantages and disadvantages of V-belt over flat belt;

Rope drive, Types, Advantages and disadvantages of a rope drive;Chain drives, advantages and disadvantages of a chain drive, terminologies in a typical chain drive, Classification, Relation between pitch and pitch circle diameter in a chain drive, Chain speed and angular velocity of a sprocket

Module – IV: Gear, Gear Trains and Cam (06 Hrs)

Introduction to toothed wheels, Advantages and disadvantages of gear drive, Classification, Terminologies in gears, Helical gears, Spiral Gears; Introduction to gear trains, types of gear trains (simple Compound, Reverted, Epicyclic) Introduction to cams, classification of cams and followers, terms used in radial cam

Module -V:
Presentations, Numerical problems, Assignments, Tutorials based on Module I to IV.

References:

1. R. S. Khurmi, J. K. Gupta – Theory of Machines, S. Chand Publishing, ISBN -81-219-2524-X
2. Rattan – Theory of Machines, Tata McGraw Hill Education Pvt. Ltd., ISBN- 00-701-4477-X
3. T. Bevan - Theory of Machines, B S Publishers and Distributors Pvt. Ltd., ISBN – 81-239-0874-1

VOC – 313: Fundamentals of Hydraulics

(02 credits – 50 marks)

Learning Objectives

The course will enable the students to:

Acquire knowledge about fluid power fundamentals, hydraulic pumps, hydraulic actuators and components and basic hydraulic circuits.

Learning Outcomes

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

1	Describe fluid in motion as a power source and basic principles related to hydraulics
2	List essential properties of hydraulic fluids and categorize hydraulic pumps , explain basic construction and operational features of hydraulic pumps
3	Describe basic constructional and operational features of linear hydraulic actuators and pressure control valves with circuit based operation
4	Describe basic constructional and operational features of flow and direction control valves with circuit based operation
5	Discuss operational features of various auxiliary hydraulic components Formulate basic hydraulic circuits pertinent to industrial automation

Course Contents:

Module – I: Fluid Power Fundamentals and Hydraulic Pumps (07 Hrs)

Fundamental Principles of Hydraulics, Concepts of fluid in motion, Laminar and turbulent flow Essential properties of hydraulic fluids, Overview of characteristics of various hydraulic oils Introduction to a basic hydraulic systems and realization of pump as the power source, classification of pumps – PD and NPD pumps, Centrifugal pump, Common Constructional features and principle of PD pumps, Gear Pump, Multigear pump, Internal gear pump, Gerotor Pump, Balanced and Unbalanced Vane pump, ANSI Symbols

Module –II: Linear Actuators and Pressure Control Valves (06 Hrs)

Hydraulic cylinders, Types (According to function and construction); Construction, Seals in cylinders; Cylinder force, acceleration and losses, Calculation of cylinder forces, Mounting of cylinders (introduction to types only), Cushioning in cylinders, ANSI symbols

Pressure Relief Valves- Direct acting relief valve, Pilot operated relief valve, Poppet relief valve; Pressure sequence valve, Pressure reducing valve, Unbalanced valve, Counterbalance valve, ANSI Symbols

Module –III: Flow and Direction Control Valves **(06 Hrs)**

Non-Return valve, Fundamental concept of flow control, Flow regulation valve (Pressure drop compensated and non-compensated), Positioning of a flow control valve (Meter-in, Meter-Out, Bleed-Off), ANSI Symbols

Basic concept of Direction Control Valve, Basic construction and Operation Principle, Operating Methods, Construction and operation of 2, 3 and 4-way Direction Control Valves, Centre conditions of spool type DCVs, ANSI symbols

Module –IV: Auxiliary Hydraulic Components and basic circuits **(07 Hrs)**

Fluid Conditioners – Filters, Heat Exchangers, Reservoirs;
Accumulators, Pressure Switches, Pressure gauges, Flow meters, Manifolds, Pressure Intensifier, Fluid Conductors

Basic cylinder acting circuits, Pump unloading circuit, counterbalance valve application, pressure sequence valve application, Two handed safety circuit, Auxiliary power backed circuit using accumulator

Module -V:

Presentations, Numerical problems, Assignments, Tutorials 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. K. S. Sundaram - Hydraulic and Pneumatic Controls: Understanding Made Easy, S. Chand and Company Ltd., ISBN – 81-219-2635-1
3. W. Bolton – Pneumatic and Hydraulic Systems, Butterworth Heinemann, ISBN – 0-07-506-383-62
4. A. Parr – Hydraulics and Pneumatics: A Technician‘s and Engineer‘s Guide, Butterworth Heinemann, ISBN – 0-08-096-674-8

VOC- 314:Embedded System Concepts

(02 credits – 50 marks)

Learning Objectives

The course should enable the students to:

1. introduce students with 8051 family, 8051 hardware
2. Learn assembly language.
3. basic programming using a microcontroller
4. effectively utilize microcontroller peripherals

Learning Outcomes

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

1	Recall basic concepts of Digital electronics and identify Microcontrollers as a core element of automation
2	Explain architecture, pin diagram/operation of each pin of 8051 microcontroller
3	Illustrate steps of assembly language program for 8051 microcontroller and explain role of important registers (PC, PSW, Flag Bits etc.) in microcontroller operation
4	Contrast various addressing modes with 8051 microcontroller
5	Apply instruction sets, timer registers in 8051 for data movement, arithmetic and logical operations

Course Contents:

Unit – I: Introduction to Computing and Microcontrollers (04 Hrs)

Numbering and coding systems, Digital Primer (review of logic gates), inside the computer, Introduction to microcontrollers and embedded processors: History of microcontrollers, Microcontroller versus general-purpose microprocessor, criteria for choosing a microcontroller, Embedded system applications

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Unit – II: 8051 Microcontroller (08 Hrs)

Overview of the 8051 family: 8051, Members of 8051 family, Microcontroller block diagram, Inside 8051, 8051 architecture, 8051 pin diagram ; Assembly Language Program : Introduction, Assembling and running a program, Program counter, Flag bits and PSW register, ROM space,

Unit – III: Addressing modes and Instructions (07 Hrs)

8051 Register banks and stack, 8051 data types and directives, Addressing modes with 8051, Data movement instructions ; Arithmetic and Logic instructions ; Loop and jump instructions

Unit – IV: 8051 Programming (05 Hrs)

8051 Timer Registers, Programming on Keil and Keypad: Procedure for running a program; Arithmetic operations: addition, subtraction, shifting; Logical operations: AND, OR, NOT, XOR, NAND, NOR

Unit - V:

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

References:

1. The 8051 Microcontroller and Embedded Systems- M.A. Mazidi, J.G. Mazidi, R.D. McKinlay; Pearson; ISBN-0-13-119-402-X
2. 8051 architecture, programming and interfacing – K.J. Ayala; Cengage Learning; ISBN-1-40-186-158-X
3. Embedded Systems Architecture Programming & Design by Raj Kamal, Tata Mcgraw Hill Education Private Limited- ISBN- 0-07-066-764-0
4. Advanced Microprocessors And Peripherals by Ray Ajoy, Bhurchandi K -Tata Mcgraw Hill Education Private Limited, ISBN- 0-07-014-062-6

VOC- 315:Laboratory Coursework–IX
(Analog and Digital Circuit Design)

(02 credits – 50 marks)

Learning Outcomes

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

1	Illustrate working of Flip Flops
2	Design basic counter circuits
3	Illustrate basic input/output characteristics of transistor, MOSFET, JFET

List of Experiments:

1. Study of Truth Table and Verification of S-R, D, T Type Flip Flop
2. Study of Truth Table and Verification of JK and Master Slave Flip Flop
3. Study of UP/DOWN Counter
4. Study of 4 bit Synchronous Counter
5. Study of 4 bit Asynchronous Counter
6. Study the characteristics of PNP transistor on common base configuration and to evaluate –Input resistance, output resistance and current gain
7. Study the characteristics of NPN transistor on common base configuration and to evaluate –Input resistance, output resistance and current gain.
8. Study of MOSFET characteristics
9. Study of JFET characteristics

VOC- 316:Laboratory Coursework–X
(Mechanical Power Transmission)

(02 credits – 50 marks)

<u>Learning Outcomes</u>

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

1	Illustrate concepts of resultant force
2	Illustrate different mechanical power transmission elements

List of Experiments:

1. Verification of triangle and parallelogram laws of vector addition
2. Study to determine resultant force
3. Study to resolve forces
4. Verification of Lami‘s Theorem
5. Study of sliding friction
6. Study of forces on an object placed on an inclined plane
7. Study of various kinematic pairs
8. Study of friction wheels, single plate clutch and multiple plate clutch.
9. Study of belt and chain drives
10. Study of different gears, simple and compound gear train
11. Study of different cam and follower arrangements

VOC- 317:Laboratory Coursework–XI
(Fundamentals of Hydraulics)

(02 credits – 50 marks)

Learning Outcomes

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

1	Identify basic components of hydraulic circuits
2	Compare applicability of various hydraulic components for dedicated applications
3	Construct basic hydraulic circuits

List of Experiments:

1. Study of Double Acting Cylinder working using 4/3 way and 4/2 way valve. (Hand Lever Operated Spring Return Type)
2. Study of Single Acting Cylinder working using 4/3 way Hand Lever Operated Spring Return Type valve.
3. Study of hydraulic motor working using 4/3 way and 4/2 way valve. ((Hand Lever Operated Spring Return Type)
4. Study of Bleed –off circuit
5. Study of Meter-IN circuit
6. Study of Meter-OUT circuit
7. Study working of Sequence Valve
8. Study working of Solenoid operated Direction Control Valves.
9. Study any one application of accumulator

VOC- 318:Laboratory Coursework–XII
(Embedded Systems Concepts)

(02 credits – 50 marks)

Learning Outcomes

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

1	Develop basic algorithms to perform mathematical and logical operations using Atmel 89C51 microcontroller
2	Illustrate concepts of writing, assembling, debugging of programs
3	Write small programs to perform mathematical and logical operations using Atmel 89C51 microcontroller

List of Experiments:

1. Write a program for studying data movement(array/sorting) operations using Atmel 89C51 trainer kit
2. Write a program for hexadecimal addition/ subtraction of two numbers using Atmel 89C51 trainer kit.
3. Write program for studying hexadecimal division/ multiplication using Atmel 89C51 trainer kit.
4. Write a program to find biggest number in the set of numbers using Atmel 89C51 trainer kit.
5. Write a program to convert hexadecimal number to decimal using Atmel 89C51 trainer kit.
6. Write a program to square a byte using Atmel 89C51 trainer kit.
7. Write a program for Fibbonacci series using Atmel 89C51 trainer kit.
8. Write a program for Logical operation (AND, OR & NOT) using Atmel 89C51 trainer kit.
9. Write a program for Logical operation (NAND, NOR & XOR) using Atmel 89C51 trainer kit.
10. Write a program for finding even odd numbers using Atmel 89C51 trainer kit.

VOC-319: In-Plant Training/ Field Work/Mini Project

(02 credits – 50 marks)

Semester – IV

General Academic Components

Semester IV

General Academic Component

VOC 401: Industrial Ethics and Safety Management

(04 credits – 100marks)

Learning Objectives

To learn students Industrial Ethics and Safety inspection procedures.

Learning Outcomes

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

1	Define Ethics and Industrial Ethics, Moral Values, OHSAS-18001 Standard and OSHA
2	Differentiate between ethics, morality and etiquette, explain ethics at workplace, profession, leadership, Unethical Behavior, discuss Significance of Industrial Safety, Select Safety Instruments, Safety standards, discuss objectives of material Handling, Principles of material handling, Classification of hazards (Safety Hazard and Health Hazard),
3	Explain Experiment measures to ensure Industrial Safety, safety measures, demonstrate storage and Handling of Material and Equipment
4	State Safety Responsibility, prioritize Hazardous Industrial zones, analyze Industrial Safety and risk management
5	Interpret Measure safety inspection procedures (Safety audit, Safety survey, Safety survey, evaluate Possible consequences of security incidents,
6	Express Fire Extinguishers and its types

Course Contents:

Module I- Introduction to Industrial Ethics (10 Hrs)

Industrial ethics, ethical issues in engineering practices(Legal, organizational, Individual), Importance of ethics and moral standards, religion and ethics, social and ethical responsibilities, moral dilemmas, profession, ethics at workplace, values, business ethics, ethical theories, spirituality, and leadership; Unethical behavior.

Module II- Introduction to Industrial Safety (12 Hrs)

Overview of Industrial Safety Management , Need for Safety, Safety standards, Safety, Health and Environment Management Systems, Occupational Health and Safety Management Systems as per OHSAS-18001 Standard and OSHA ,Security Management of Industrial Plants ,Organization, Administration and Management Responsibility in the Field of Safety, Legal Aspects of Safety, Safe Working Practices ,Personal Protective Equipment and Protective

Costumes, Storage and Handling of Material and Equipment, Safety in Transportation and Automotive Equipments, Electrical Safety, Electrical Shocks and Their Prevention

Module III- Industrial Hazards (10 Hrs)

Mechanical Hazards, Chemical Hazards, Environmental Hazards, Radiation Hazards, Industrial noise, occupational damage, sound measuring instruments, noise networks, noise surveys, risk factors, non-ionizing radiations, effects, radar hazards, microwaves and radio waves, lasers, Air sampling instruments, common causes of industrial fires, dust sample collection devices. Industrial Psychology, Ergonomics and Accidents

Module IV- Control Measures for Industrial Hazards (12 Hrs)

Safety in Hazardous Area, Industrial Safety Analysis, Risk Analysis and Risk Management, Industrial Noise and Noise Control Work Permit System ,Safety in Power Plants, Fire Prevention and Fire fighting in Plants ,Portable Fire Extinguishers ,Fire Detection, Fire Alarm and Fire Fighting Systems, Building Design and Fire Protection ,Plant Layout and Design Material, Safety during Project Construction, Safety Management of Plants During Commissioning and Maintenance ,Safety Training for Employees and Human Resource Development, Social Security in Industries, Insurance Policies for Project Construction, Operation and Maintenance, Important Ingredients of Health, Occupational Health, First Aid ,Exercises for Healthy Living. Occupational Health and Industrial Hygiene, Controlling Environmental Pollution, Environmental Guidelines for Power Plants and Infrastructure Development Energy, Conservation, Efficiency and Audit, Disaster Management.

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

References:

1. Slote L. handbook of Occupational safety and Health, John Willey and sons, Newyork.
2. Frank P Lees, Loss of Prevention in process industry , Vol 1 and 2, Butterworth-Heinemann Ltd , London.
3. R.K.Jain and Sunil S. Rao : Industrial Safety , Health and environment management systems, Khanna publishers, New Delhi 2006
4. Grimaldi and Simonds, Safety management: ATTBS publishers, new Delhi 2001
5. Industrial safety and pollution control handbook; national safety council and associate publishers pvt. ltd; Hyderabad
6. Code of practice on Safety management :- PDF
7. http://www.saylor.org/books
8. The Business Ethics Workshop

VOC- 402: Business Software Tools

(04 credits – 100marks)

Learning Objectives

To learn students various business software tools.

Learning Outcomes

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

1	Describe basic functionalities of CSS and Photoshop
2	Describe basic functionalities of Dreamviewer and Flash
3	Apply key concepts of CMS (Computer Management System)
4	Create different projects using CMS
5	Apply key concepts of hypertext processor

Course Contents:

Module I: CSS and Photoshop **(10 Hrs)**

Introduction to CSS: Concept of CSS, Creating Style Sheet, CSS Properties, divs and spans, ids and classes, CSS Styling, Working with block elements and objects, working with Lists and Tables, internal CSS declarations, CSS formatting and alignment.

CSS Advanced: CSS color, Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Image Sprites, Attribute sector, Creating page Layout and Site Designs, Embedded audio files

Module II: Dreamweaver and Flash **(10 Hrs)**

Introduction to Photoshop: Creating new files, Resizing images, Image transformations, Levels & Color Balance, Cropping, The Ruler Tool, Zooming, History Panel, Saving & file formats.

Photoshop Advance: Selections, Extracting regions of an image, Combining images (basic), Introduction to layers, Layer styles, History panel, Setting up your workspace, Frames & Objects, Working with text, Text formatting, Paragraph formatting, Linked text frames.

Module III: Management System **(12 Hrs)**

Introduction of CMS is Web Development, Configuring a domain name and web hosting, Exploring CMS terminology, including open source, server-side, client side, Static HTML website, how CMS web pages are generated, Website strategy and planning, site mapping, content planning, Introduction of Joomla, Adding and displaying menus in Joomla, Linking menus to articles and other features Joomla

Dreamweaver: Dreamweaver basics, Setting up your workspace, Site management, Text formatting, Images & Media, Links, styles, Inserting Tables, Adding Frames, Rollovers, Putting it all together

Flash basics: Introduction to the Flash IDE, Creating a new project, Drawing simple vector shapes, Lines & Fills, Colors, Shape Tweens, Layers

Flash advance: Review symbols and instances, Review internal timelines, 3D rotation tool, Mask layers, Deco Brush, Custom mouse pointers

Module IV: PHP (Hypertext Preprocessor) (12 Hrs)

Introduction, installation , syntax , variables, echo/print, data types, constant, string operators, if-else else if, switch, while, for, array, super globals, Form validation, form required Array Multi, Date and Time, Include, File open read, create / write, upload, Cookies, Sessions, My Sql-Connect, Create DB, Create Table, Insert Data, Prepare , select, delete and updates

References:

1. Thomas POW; 2010; HTML & CSS: The Complete Reference (Fifth Edition); Mc Graw Hill Education; USA.
2. Thomas Powell and Fritz Schneider; 2013; JavaScript: The Complete Reference Paperback (Third Edition); Mc Graw Hill Education; USA
3. Steven Holzner; 2008; PHP: The Complete Reference (Second Reprint); Tata Mc Graw Hill Publishing Company Limited; New Delhi
4. Graig Grannell; 2007; The Essential Guide to CSS and HTML Web Design;Apress
5. Nicholas C. Zakas (2012); Professional Javascript for Web Developers; John Willey and Sons (Third Edition)
6. Kogent Learning Solutions Inc; 2009; Dreamweaver Cs5 in Simple Steps by Dreamtech Press, New Delhi.

VOC 403: Fundamentals of Business and Accounting

(04 credits – 100marks)

Learning Objective

The course aims to provide basic concepts and knowledge of a business enterprise and with the basic accounting principles and techniques of preparing and presenting the accounts for user of accounting information.

Learning Outcomes

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

1	Describe overall concept of a business system, process of identification of entrepreneurial opportunities in business and process of setting up a business enterprise
2	Explain concepts, terminologies and Functioning of Financial Accounting
3	Elaborate Accounting terms, Equation and Journal
4	Apply Voucher approach in accounting
5	Explain the terminologies and prepare trading and profit./loss account and balance sheets

Course Contents:

Module- I : Introduction to Business **(12 Hrs)**

Concept, Nature and Scope of Business Enterprise; Concept of Business as a System; Business and Environment Interface; Entrepreneurial opportunities in contemporary business environment or emerging trends in business: Networking marketing, Franchising, Business Process Outsourcing, knowledge Process Outsourcing, Ecommerce and M-Commerce. Opportunity and Idea Generation - role of Creativity and Innovation. Feasibility study and preparation of Business Plan Basic considerations in setting up a Business Enterprise. Process of setting up a Business Enterprise.

Module- II : Introduction to Financial Accounting **(10 Hrs)**

Accounting-An Introduction: Business transactions, Book-keeping, Accounting and its branches. Nature, functions and objectives of Financial Accounting. Accounting Assumptions-Accounting Concepts: Meaning, concepts: Matching, Accrual, Realisation and Dual Aspect Concept.

Module- III: Accounting Terms, Accounting Equation and Journal **(12 Hrs)**

Accounting Terms-Accounting Equation Need of Accounting equation, Meaning and preparation of Accounting equation. Rules of Accounting -Journal Meaning, classification of journal into General journal and special journals (with examples). Incorporation of journal entries involving different accounts. Cash Book Meaning, types-Simple Cash Book, Two column Cash Book and Three column Cash Book.\

Module- IV : Voucher Approach in Accounting and Financial Statements (12 Hrs)

Vouchers and their preparation - Day Book and Subsidiary Day Books -Recording the vouchers into Day Books -Recording the Vouchers into Subsidiary Day Books -Ledger Posting of Day Book -Posting of Subsidiary Day -Trial Balance -Errors and their Rectification

Capital and Revenue - Preparation of Trading and Profit and Loss Account and Balance Sheet - Preparation of Trading and Profit and Loss A/c and Balance Sheet (with adjustments).

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

References:

1. Anthony, R.N., and J.S. Reece, *"Accounting Principles",* Richard D. Irwin, Inc.
2. Monga, j.R., *"Financial Accounting: Concepts and Applications",* Mayoor Paper Backs, New Delhi.
3. Shukla, M.C., T.S. Grewal and S.C.Gupta, *"Advanced Accounts",* Vol-I, S.Chand& Co., New Delhi.
4. Gupta, R.L. and M. Radhaswamy, *"Advanced Accountancy*", Vo!-I, Sultan Chand & Sons, New Delhi.
5. Maheshwari, S.N. and. S. K. Maheshwari, *"Financial Accounting",* Vikas Publishing House, N ew Delhi.
6. Tulsian, P.C., *" Advanced Accounting",* Tata Me Graw Hill, New Delhi.
7. *"Compendium of Statements and Standards of Accounting",* The Institute of C hartered Accountants of India, New Delhi.

Semester – IV

Industrial Automation

(Skill Development Components)

Skill Development Components
Industrial Automation

VOC-411:PLC Based Automation

(02 credits – 50 marks)

Learning Objectives

To introduce students with advance PLC functions, and interfacing of PLC to real world devices and processes

Learning Outcomes

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

1	Explain various inbuilt timers in PLCs
2	Explain various inbuilt counters in PLCs
3	Discuss timer, counter, and other intermediate programming functions
4	Formulate application based ladder logic for data manipulation and arithmetic operations

Course Contents:

Module -I: Timer in PLCs **(06 Hrs)**

Timer, Types of timer-ON-delay timer, Off-delay timer, Pulse timer,- Programming Timer, Programming Examples- flashing light, Traffic light sequence.

Module –II: Counter in PLCs **(06 Hrs)**

Counter, Up Counter, Down Counter, Counter Reset, Timer with counter, Programming Forms of Counter Sequencer.

Module -III: Data Manipulations and Arithmetic Instructions **(06 Hrs)**

Data Comparisons Instruction – Equal to, Less Than, Greater Than, Not Equal to, Less than equal to, Greater than Equal to, Limit Function. Concept of Integer and Floating Address, Arithmetic Instruction – ADD, SUB, MUL, DIV, SQR

Module -IV: Application Oriented PLC Programming **(06 Hrs)**

Conveyor Belt using DC motor, Linear Bottle Filling Station, Rotary Bottle Filling Station, Elevator Simulator, Density Based Traffic Light Control

Module –V:

Tutorials, Assignments, Demonstrations and Presentation Based on Module I to IV

References:

1. J. W. Webb, R. A. Reis – Programmable Logic Controllers: Principles and Applications- PHI, New Delhi, 2013 ISBN: 9788120323087, 8120323084
2. W. Bolton – Programmable Logic Controllers – Elsevier, UK, 2006 **ISBN:** 9780128029299
3. http://www.mikroe.com/old/books/plcbook/plcbook.htm
4. J. R. Hackworth, F. D. Hackworth Jr- Programmable Logic Controllers: Programming Methods and Applications – Pearson, New Delhi, 2004 ISBN-10: 0130607185 ISBN-13: 978-0130607188
5. F. Petruzella – Programmable Logic Controllers – MGH, UK, 2014 ISBN10:9352602129 ISBN-13: 978-0073510880
6. G. D. Anderson – PLC programming using RS Logix 500: Ladder Logic Diagnostics and Troubleshooting (Vol 1-3) ISBN-10: 1511770341 ISBN-13: 978-1511770347

1. www.plcs.net
2. www.plcwashinton.org
3. www.plctutor.com

VOC-412: PROCESS CONTROL

(02 credits – 50 marks)

Learning Objectives

1. To introduce students with the classifications of control system, controllers, complex modes of process control and computer based controlling.
2. To introduce students with process instrumentation and control elements

Learning Outcomes

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

1	Classify control system, describe a through block diagram, define terminologies related to industrial process control and interpret process control drawings
2	Define process characteristics, Explain and contrast discontinuous, continuous and corrective control actions
3	Explain constructional features and basic operations of control elements and instrumentation at actuation end
4	Explain overview of multivariate control system and define terminologies related to control system quality
5	Explain methods leading to stability and tuning of process loops

Course Contents:

Module -I: Introduction to Process Control **(06 Hrs)**

Control System (Process Control Principles, Servomechanism, Discrete State Control System), Process Control Block Diagram, Control System Evaluation Criteria, Analog and Digital Process, Units, Standards and Definitions in Process Control, Process Control Drawing

Module -II: **Controller Principles** **(06 Hrs)**

Introduction, Process Characteristics (Process Equation, Process Load, Process Lag, Self Regulation), Discontinuous Controller Modes, Advanced Control Techniques (Cascade Control, Ratio Control, Feed-Forward Control, Adaptive Control), Composite Control Modes

Module -III: Final Control Elements **(06 Hrs)**

Final Control Operation, Signal Conversions (Analog Signal, Digital Signal, Pneumatic Signal), Actuators (Electrical Actuators, Pneumatic Actuators, Hydraulic Actuators), Control Elements (Mechanical, Electrical, Fluid Valve)

Module – IV: Control Loop Characteristics **(06 Hrs)**

Control System Configuration (Single Variable, Cascade Control) , Multivariable Control Systems (Analog Control, Supervisory and Direct Digital Control),Control system Quality (Definition of Quality, Measure of Quality), Stability (Transfer function Frequency Dependence, Stability Criteria, Process Loop Tuning (Open Loop Transient Response method, Ziegler-Nichols method, Frequency Response Methods)

Module – V:

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

References:

Text:

1. Terry Bartelt; 2006; Industrial Electronics: Circuits, Instrument and Control Technique (INDIA EDITION) ; Cengage Learning India PVT LTD; Delhi (India)
2. Curtis D. Johnson; 2012 ; Process Control Instrumentation Technology (EIGHTH EDITION); PHI Learning PVT LTD; New Delhi (India).
3. William Dunn; 2005; Fundamentals of Industrial Instrumentation and Process Control; McGraw-Hill; USA

4. N. P. Lieberman, E. P Lieberman; 2014; A Working Guide to Process Equipment (Fourth Edition), Mcgraw-Hill Book CoMyke King; 2010; Process Control: A Practical Approach; Wiley International
5. I.J.Nagrath, M.Gopal; 2009; Control Systems Engineering (Fifth Edition); New Age International Publishers; India
6. N. Barapate; 2006; Control System; Tech Max publications; Pune (India)
7. http://nptel.ac.in/courses/103103037/#
8. www.pacontrol.com/download/process-control-systems.pdf
9. www.learnerstv.com/Free-Engineering-Video-lectures-ltv689-Page1.htm

VOC-413: Fundamentals of Pneumatics

(02 credits – 50 marks)

Learning Objectives

1. To introduce students with the components of pneumatic technology and their individual operation
2. To introduce students with the application of pneumatic components for automization of industrial processes

Learning Outcomes

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

1	Identify the actuators used in pneumatic technology and describe their individual operation
2	Identify the flow control valves, direction control valves and logic function valves used in pneumatic technology and describe their individual operation
3	Describe constructional features and operation of air compressors, FRL units and other servicing units for compressed air
4	Relate application specific pneumatic components, and will be able to apply them for basic automated actuations
5	Illustrate design concepts to develop basic pneumatic circuits using Automation Studio/ AutoSIM software and implement the designs

Course Contents:

Module -I: Introductory Concepts in Pneumatics (05 Hrs)

Atmospheric pressure, Gas laws, Units of pressure, Measurement of volume, SI units for fluid power engineers.
Basic pneumatic system, generation of compressed air, selection of pipeline for pneumatic system, pressure rating for pipe materials, pipeline fittings, tube sizes, connectors, pressure loss in pneumatic line, line fittings.Air compressors, air receiver.

Module -II: Servicing of Compressed Air and Pneumatic Actuators (06 Hrs)

FRL unit, pressure gauge monometer, installation of FRL unitDrying of compressed air, humidity, refrigerated dryers, chemical dryers, dew point suppression, adsorption dryers, regeneration methods, heatless regeneration, selection of dryers
Pneumatic cylinders- types, construction and working; Considerations of piston speed, piston force, air consumption, and size of pneumatic cylinders; Maintenance aspects; Air motor

Module -III: Control Elements in Pneumatics **(06 Hrs)**

Pneumatic controls, directional control valves- basic construction and control operation; Impulse valve, Speed Regulators, Quick Exhaust valve, Time delay valve. Logic function- Shuttle valve, Twin pressure valve; Solenoid operated valves

Module -IV: Pneumatic Circuits **(07 Hrs)**

Revision of Symbols for pneumatic devices, Basic considerations for pneumatic circuits design, Example(s) on pneumatic circuit design; Circuit examples - Impulse operation, Speed control, Sequencing of motion, Vacuum Handling

Module – V:

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

References:

1. S R Majumdar; 2006 (Sixteenth Reprint); Pneumatic Systems (Principal and maintenance); Tata McGraw - Hill Publishing Company Limited; ISBN 0-07-4602314
2. K. Shanmuga Sundaram; 2006; Hydraulic and Pneumatic Controls; S.CHAND Limited; ISBN 8-12-192635-1
3. P. Joji; 2008; Pneumatic Controls; Willey India Pvt. Ltd., ISBN 978-81-265-1542-
4. Antony Barber; 1997 (Eighth Ed.); Pneumatic Handbook; Elsevier Science Ltd.; ISBN 978-81-265
5. 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
6. hydraulicspneumatics.com
7. nptel.ac.in/courses/112103174/pdf/mod6.pdf
8. resources.hkedcity.net/res_files/201101/20110128101153_259037.pdf

VOC – 414: Embedded System Applications

(02 credits – 50 marks)

Learning Objectives

1. To introduce students with the concepts of interfacing 8051 microcontroller to real world elements
2. To introduce students with the protocols for interfacing 8051 microcontroller to real world elements

Learning Outcomes

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

1	Describe techniques and develop program to interface LEDs, 7 segment displays, 16X2 LCD matrix to 8051 microcontroller
2	Describe techniques and develop program to interface DAC, ADC and Sensors to 8051 microcontroller
3	Describe techniques and develop program to interface standard keypad and DC, stepper and servo motor to 8051 microcontroller
4	Describe MAX 232 features and apply MAX 232 for serial communications with 8051
5	Describe DS12887 RTC features and develop necessary program to interface DS12887 RTC to 8051

Course Contents:

Module -1: Interfacing of Display Devices to 8051 (06 Hrs)

Different types of display units - basic theory of the LED, Interfacing circuit of LED; 7 Segments & its types, Principle of Operation, Interfacing circuit of 7 segments; Basic theory of 16x2 LCD, Pin diagram of 16x2, working mechanism LCD using Arrays & Pointers, Interfacing of 16X2 LCD

Module -2: DAC, ADC and sensor interfacing to 8051 (06 Hrs)

Introduction to DAC, PIN Description for any standard DAC and its interfacing; Basic concepts of ADC interfacing, PIN Description of any standard ADC and its interfacing, Concept of Encoders and Decoders; Interfacing of sensors

Module -3: Keypad and Motor interfacing to 8051 (06 Hrs)

Keypad interfacing concepts, Standard Keypad interfacing; Relay interfacing concepts, Relay interfacing; DC motor interfacing concepts, DC motor interfacing; Stepper motor interfacing concepts; Stepper motor interfacing; Servo motor interfacing concepts, Servo motor interfacing

Module -4: Serial Communication and RTC interfacing with 8051 (06 Hrs)

Concept of Serial Communication, Hardware Description of MAX 232, Interfacing of MAX 232 to 8051 and serial communication; Concept of RTC, Hardware Description of DS12887 RTC, Interfacing of DS12887 RTC to 8051

Module – 5:

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

References:

1. M. A. Mazidi, J. G. Mazidi, and Rolin D. McKinlay; 2006; 8051 Microcontroller and Embedded Systems - using assembly and C; Pearson Education; ISBN-13: 978-01-311-9402-1
2. S. Ghosal; 2010; 8051 Microcontroller: Internals, Instructions, Programming and Interfacing; Pearson Education; ISBN 978-81-317-3143-7
3. James W. Stewart, Kai X. Miao; 1999; The 8051 Microcontroller: Hardware, Software, and Interfacing; Prentice Hall; ISBN 0-13-531948-X
4. S. Yeralan, A. Aluhwalia; 1993; Programming and Interfacing the 8051 Microcontroller; Addison-Wesley Publishing Company; ISBN 0-13-531948-X
5. www.engineersgarage.com/microcontroller/8051projects
6. www.electronicshub.org/8051-microcontroller-projects-engineering-students
7. circuitdigest.com/8051-microcontroller-projects

VOC 415: Laboratory Coursework–XIII
(PLC based Automation)

(02 credits – 50 marks)

Learning Outcomes

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

1	Apply inbuilt PLC timers for basic application
2	Apply inbuilt PLC counters for basic applications
3	Integrate Allen Bradley PLCs with different sensors and actuators for automated industrial operations
4	Develop Ladder diagram for Allen Bradley PLCs with different sensors and actuators for automated industrial operations

List of Experiments:

1. Hardware Implementation of 'Latch and Hold' concept
2. PLC ladder programming with Simulator (logical instruction) and hardware implementation
3. PLC ladder programming with Simulator (program control instructions) and hardware implementation
4. PLC ladder programming with Simulator (Timer Instruction) and hardware implementation
5. PLC ladder programming with Simulator (Counter Instruction) and hardware implementation
6. Implementation of sequential operation of PLC with basic output devices
7. PLC ladder programming for interfacing with conveyor belt (hardware implementation)
8. PLC ladder programming for water level control (hardware implementation)
9. PLC ladder programming for elevator control (hardware implementation)
10. PLC ladder programming for linear bottle filling station (hardware implementation)

VOC- 416 :Laboratory Coursework–XIV
(Process Control)

(02 credits – 50 marks)

Learning Outcomes

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

1	Set parameters of a PID controlled level control loop to stabilize the same
2	Set parameters of a PID controlled flow control loop to stabilize the same
3	Set parameters of a PID controlled pressure control loop to stabilize the same
4	Set parameters of a PID controlled temperature control loop to stabilize the same
5	Illustrate characteristics of linear, equal percentage or on-off type control valves
6	Illustrate components of basic level, pressure, flow feed back control loop

List of Experiments:

1. Study of PI,PD and PID control using Computer Simulator
2. Study of characteristics of linear, equal percentage or on-off type control valves
3. Implementation of ON/OFF control in a closed loop system
4. Study of level feedback control loop
5. Study of flow feedback control loop
6. Study of temperature feedback control loop
7. Study of pressure transmitter
8. Study of I/P converter

VOC – 417: Laboratory Coursework–XV

(Fundamentals of Pneumatics)

(02 credits – 50 marks)

Learning Outcomes

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

1	Design basic pneumatic circuits using actuators and Valves
2	Design sequential circuits using basic pneumatic components and/or sensors
3	Design logic based pneumatic circuits

List of Experiments:

1. Implementation of a 3/2 way palm operated NC Direction Control valve to operate SAC & DAC.
2. Implementation of a 5/2 way spring returned pilot operated valve to operate a DAC & 3/2 way single pilot operated valve to operate a DAC.
3. Study of ‘OR’ and ‘AND’ logic using pneumatic components & Study of 5/2 way push button actuation valve.
4. Implementation of 3/2 and 5/2 roller level operated valve for automated sequential operations.
5. Implementation of foot level operated valve and disc rotary valve to operate a DAC.
6. Implementation of solenoid operated direction control valve in pneumatic circuits
7. Implementation of a unidirectional flow control valve to control speed of a pneumatic motor.
8. Automated actuation of a DAC (Using limit switch/ Proximity sensor)

VOC – 418 : Laboratory Coursework–XVI

(Embedded System Application)

(02 credits – 50 marks)

Learning Outcomes

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

1	Illustrate interface electronics for basic input-output devices with 8051 microcontroller
2	Develop simple programs to operate basic input-output devices and actuators by 8051 microcontroller
3	Troubleshoot 8051 microcontroller circuits developed with basic inout-output devices

List of Experiments:

1. Study the interfacing of LED with 8051 microcontroller
2. Study the interfacing of Seven segment display with 8051 microcontroller
3. Study the interfacing of LCD with 8051 microcontroller
4. Study the interfacing of Relay with 8051 microcontroller
5. Study the interfacing of ADC with 8051 microcontroller
6. Study the interfacing of DAC with 8051 microcontroller
7. Study the interfacing of Stepper motor with 8051 microcontroller
8. Study the interfacing of Servo motor with 8051 microcontroller
9. Study the interfacing of DC motor with 8051 microcontroller
10. Study the interfacing of Keypad with 8051 microcontroller

Semester – V

General Academic Components

General Education Components

VOC 501: Personality Development and Stress Management

(04 credits – 100marks)

Learning Objective

1. To enable the students to understand the necessity of a good personality and provide them to improve their personality
2. To make students understand the sources of stress and techniques to handle stress

Learning Outcome

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

1	Describe basic traits of personality, discover individual strength and weakness, and plan corrective and developmental exercises
2	Administer communication skills for debates, elocution, convincing skills etc., point out necessities for personal grooming, and compare among various modes of etiquettes
3	Identify stress and its various forms, relate it with physiological and psychological illness.
4	Defend necessities for stress management
5	Demonstrate measures for stress management

Course Contents:

Module- I: Personality Development **(10 Hrs)**

Basic traits of personality - Dress, address, gestures and manners; Self evaluation and development- identification of strengths and weaknesses; Overcoming hesitation and fear of facing the public; Corrective and developmental exercises - confidence building, role plays.

Module- II: **Communication and Personal Grooming** **(12 Hrs)**

Advance communication skills- debates, elocution, persuasive communication, convincing Skills, conversations. Personal grooming and business etiquettes, corporate etiquette, social etiquette and telephone etiquette, role play and body language, impression management.

Module- III: Stress **(10 Hrs)**

Meaning - Approaches to stress, Good Stress Vs Bad Stress, The individual and work. Manifestations of Stress - Stages of Stress, Signs of Stress at work, Personal types and Stress.

General sources of Stress - Stress and Health - Physiological and psychological illness.

Module- IV: Stress Management **(12 Hrs)**

Stress Diary, Becoming change skilled, Adopting a healthy life style, Right attitude, Thought Awareness, Imaginary (Auto-genic Therapy), Learning to relax, Correct breathing, Value and goal planning, Time Management, General advice - The individual's ten Commandments for effective Stress management.

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

References:

1. Interpersonal Skills for Travel and Tourism - Jon & Lisa Burton - Longman Group Ltd.
2. Business Communication - Rayon and V. Lesikar, John D. Pettit, JR. - Richard D. Irwin, INC
3. Managing Stress, Ann Edworthy, Open University Press, Buckingham, Phildephia.
4. Organizational Stress, K.Hari Gopal, University Press.

General Academic Components

VOC-502: Operation Management

(2 Credits: 50 Marks)

Learning Objective

1. Understand the role of operations management in organizations
2. Differentiate between strategic and tactical operations decisions
3. Describe the key operations management decisions faced by managers
4. Understand three of the most important operations management practices: Total Quality Management, Supply Chain Management, and Just-in-Time/Lean Operations
5.

Learning Outcomes:

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

1	Define Operation Management, Operations Strategy, Describe Basics of Work Study, Job Design and Work Measurement, Basics of ISO 14000 / 9000, Basics of Value Engineering & Analysis
2	Summarise Aggregate Planning, Scheduling, Project Management, express Supply Chain Management and Just-in-Time/Lean Operations, Classification of production system,
3	Illustrate Capacity Planning, Waiting Lines, Demand Management-models, , Total Quality Management, , Batch Sizing- Models- Optimization, Batch Scheduling-models-optimization ,
4	Explain Evolution of Production Systems Competitive Advantage and Time Based Competition
5	Discuss Product Decision and Analysis, Product Development, Process Selection, Process Design, Process Analysis, Process-Product Matrix, and Capacity Decisions
6	Develop Facility Location, Facility Layout, and Resource Planning-models

Course Contents:

Module I: Introduction to Operation Management **(8 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 Decision and Analysis **(6 Hrs)**

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

Module III: Demand and Supply **(8 Hrs)**

Demand Management-models, Resource Planning-models, Total Quality Management, Supply Chain Management and Just-in-Time/Lean Operations.

Module IV: Introduction to Planning and Scheduling **(8 Hrs)**

Aggregate Planning, Basics of MRP / ERP**,** Basics of Scheduling**,** 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 **(6 Hrs)**

References:

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 – KanishkaBedi– Oxford
8. Production & operation Management – R.C. Manocha
9. Production & operation Management – Muhlemann

VOC- 503: Business Communication

(04 credits – 100marks)

Learning Objectives

To acquaint students about practices in advance business communication

Learning Outcomes

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

1	Explain characteristics of successful communication, communication structure in organization
2	Apply communication as a tool to resolution of conflicts
3	State and use principles of effective writing
4	Discuss analyze and present a case study
5	Categorize communication areas and construct monologues/ dialogues for effective communication as per situation

Module- I: Introduction (10 Hrs)

Meaning & Definition, Classification, Role; Characteristics of successful communication – Importance of communication in business – Communication structure in organization – Communication in conflict resolution - Communication in 31 crisis. Communication and negotiation. Communication in a cross-cultural setting. Personality and Emotion interference.

Module- II: Writing Skill and Case Analysis (12 Hrs)

Principles of effective writing – Approaching the writing process systematically: The 3X3 writing process for business communication: Pre writing – Writing – Revising – Specific writing features – Coherence – Electronic writing process. Writing routine and persuasive letters – Positive and Negative messages Writing Reports, Writing memos

Different types of cases – Difficulties and overcoming the difficulties of the case method – Reading a case properly (previewing, skimming, reading, scanning) – Case analysis approaches (Systems, Behavioural, Decision, Strategy) – Analyzing the case – Dos and don‘ts for case preparation – Discussing and Presenting a Case Study

Module- III: Employment Communication and Negotiation (12 Hrs)

Introduction – Composing Application Messages - Writing CVs – Group discussions – Interview skills Impact of Technological Advancement on Business Communication – Technology-enabled Communication - Communication networks – Intranet – Internet – e mails – SMS – teleconferencing – videoconferencing

Negotiation – Nature and need for negotiation – Factors affecting negotiation – Stages of negotiation process – Negotiation strategies

Module- IV: Group Communication **(10 Hrs)**

Meetings – Planning meetings – objectives – participants – timing – venue of meetings – leading meetings. Meeting Documentation: Notice, Agenda, Resolution & Minutes. Seminars – workshop – conferences Media management – The press release – Press conference – Media interviews Etiquette Advantage in Business Communication

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

References :

1. Business Communication : Concepts, Cases And Applications – Chaturvedi P. D, & Mukesh Chaturvedi ,2/e, Pearson Education, 2011
2. Business Communication: Process And Product – Mary Ellen Guffey, 3/e, Cengage Learning, 2002.
3. Communication – Rayudu C. S, Himalaya Publishing House
4. Business Communication – Lesikar, Flatley, Rentz & Pande, 11/e, TMH, 2010
5. Advanced Business Communication – Penrose, Rasberry, Myers, 5/e, Cengage Learning, 2004
6. BCOM – Lehman, DuFrene, Sinha, Cengage Learning, 2/e 2012
7. Business Communiacation – Madhukar R. K, 2/e, Vikas Publishing House.
8. Effective Technical Communication - Ashraf Rizvi M, TMH, 2005.
9. Business Communication - Sehgal M. K & Khetrapal V, Excel Books.
10. Business Communication – Krizan, Merrier, Jones, 8/e, Cengage Learning, 2012.
11. Basic Business Communiaction – Raj Kumar, Excel Books, 2010

General Academic Components

VOC 504 Production Engineering

(2 credits-50 Marks)

Learning Objectives

- Understand importance of productivity and factors for improvement of productivity.
- Know different production systems and modern trends in manufacturing systems.
- Find the break even point for manufacturing a product.
- Prepare / modify layout of production system.
- Select suitable material handling devices and plant facilities.

Learning Outcomes

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

1	Define Types of production systems, describe Productivity and its Importance , memorize the concept of cost- Fixed cost, Variable Cost etc.
2	Interpret Break even analysis, observe techniques of improving productivity, discuss material handling devices, judge factors affecting Site Selection, review Government Policies, demonstrate work Measurement and time Study, classify allowances,
3	Calculate of Breakeven point, Calculation of EOQ, list methods of Inventory Management, Recording techniques of Process Chart, calculation of standard time
4	Distinguish between production and productivity , selection of plant layout,
5	Describe Economic Batch Quantity, EOQ Model, recommend stores function , storage system , justify FIFO
6	Design Plant Layout, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout, modify Storage systems like One bin , Two bin system etc

Course Contents:

Module I: Production System **(6 Hrs)**

Definition , Types of production systems, Productivity - Importance , Measurement of Productivity, Techniques of improving productivity, Elements of cost- Fixed cost, Variable Cost, Break even analysis, Calculation of Breakeven point.

Module II: Plant Location, Plant Layout and Material Handling **(8 Hrs)**

Plant Location - Importance of Site Selection, Factors affecting Site Selection, Government Policies, and relaxation for Backward Areas. Plant Layout - Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. Group Technology, Cellular layout. Material handling – Need, Principles and Types of material handling devices – conveyors , Hoist & cranes , forklift truck, trolleys, Pipes, Automated Guided Vehicles (AGV's) Selection of Material Handling systems and Devices.

Module III: Work Study and Work Measurement (8 Hrs)

Method Study- Definition, Objectives, Procedure, Selection of work. Recording Techniques:- Process Charts – Outline process chart, Flow process chart, Two Hand process chart, Multiple activity chart, Flow diagram, String diagram, Travel chart. Micro motion study-Critical Examination, Principles of Motion Economy, Concept of ergonomics and workplace layout.

Work Measurement -Objectives, procedure, Time Study, Time Study Equipments. Stop Watch Time Study, Standard Time, Work Sampling, Analytical Estimating, Predetermined Motion Time Study, Allowances, Calculation of Standard Time, Concept of Merit Rating.

Module IV: Inventory Control (6 Hrs)

Methods of Inventory Management Inventory Cost relationship, Deciding Economic Batch Quantity, EOQ Model, Calculation of EOQ, Concepts of discounts, Introduction of Material Requirement Planning. Stores Function – Storage systems – One bin , Two bin system, Material Issue Request (MIR), Bin card.FIFO

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

References:

1. L.C. Jhamb, Industrial Management, Everest Publication.
2. James C. Rigs Production System, Planning, Analysis & Control, N.Y.Wiley& Sons.
3. O.P. Khanna Industrial Engineering and Management DhanpatRai& Sons.
4. P.C. Sharma Production Engineering
5. Kempster, Introduction to Jigs and Fixtures Design.
6. BaffnaSarin ,Modern Production and Operations Management
7. Terry Wireman, Total Productive Maintenance, Industrial press inc.
8. Taiichiohno, Toyota Production system, Productivity Press.

Semester – V

Industrial Automation

(Skill Development Components)

Skill Development Components

Industrial Automation

VOC- 511: Workshop Technologies

(02 credits – 50 marks)

Learning Objectives

1. To acquaint with basic machine processes
2. To familiarize with necessary safety precautions for working with machine tools
3. To familiarize with applications of machine tools

Learning Outcomes

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

1	Categorize welding processes, cutting and cutting tools, basic operations in sheet metal working
2	Describe functions and operations of lathe machine and apply concepts of turning to perform operations on lathe machine
3	Discuss drilling, reaming and grinding processes, choose operation specifications of drilling machines/ grinding machines for specific operations
4	Describe functions and operations of milling machine and classify attachments of milling machines for specialized operations
6	Describe basic practices and safety measures of a machine shop

Course Contents:

Module I – Welding, Metal Cutting, and Sheet Metal Work (08 HRS)

Welding – Introduction and classification of welding processes; Gas welding, carbon arc welding, Shielded metal arc welding, TIG welding, MIG welding, Resistance welding, Laser beam welding, welding defects

Basic Elements of Machining, Types of Cutting, Classification of Cutting Tools, Important Terminologies, Principal Angles of Single Point Tools, Tool Signature, Reference Planes; Chips – Formation, Types, Brakers; Cutting speed, Feed and depth of Cut, Sources of heat in metal cutting, Tool Failure, Tool Life and factors affecting tool life, Cutting tool materials; Dynamometry: Measurement of Cutting Forces

Introduction to sheet metal work, Metals used in sheet metal work, Tools and Machines, Basic operations in sheet metal working

Module II – Lathe and Lathe Work (07 HRS)

The Lathe and its Principle of Working, Types of lathe, Parts of Lathe, Standard Lathe Operations- Plain and Step Turning, Facing, Taper Turning, Screw Cutting, Drilling, Boring, Reaming, Knurling, Grooving and parting off, Form Turning; Lathe tools, Tool geometry, Speed, Feed and Depth of Cut, Cutting Tool materials, Coolants

Module III –Drilling, Reaming and Grinding Operation (08 HRS)

Drilling overview, Tools for Drilling, Classification of Drills, Parts and terminologies in twist drill, Important drill dimensions and angles, Special purpose drills, Drill size and specifications, Types of drilling machines (portable, Bench, Upright, Radial) Operations on drilling machine, Tool holders, Work holders

Reaming overview, Terminologies, Types, Reaming operation, Cutting speed and feed

Overview of grinding process, Forms of abrasive tools, Abrasive materials, Grinding materials, Grinding wheels (grain, grade, structure, shapes, selection, mounting, loading, glazing, trueing, dressing) Grinding Machine types, Grinding methods, Speed , feed and depth of cut

Module IV – Milling Machine and Milling work (07 HRS)

Introduction, Working Principle, Types on Milling machine, Principal parts of column type milling machine, Main attachments for milling machine, Milling methods, Milling cutters (principal types), Angles of a plain milling cutter, Number of teeth in cutter, Milling operations (Broad classification), Cutting speed and feed, Coolants, Concept of indexing.

Module V:

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

References:

1. A Course in Workshop Technology (Vol -2): Dhanpat Rai and Co Pvt. Ltd., B.S. Raghuwanshi; Edition: 10th, 2017
2. Workshop Technology (Volume – 1 and 2): Media Promoters & Publishers Pvt. Ltd.; S. K. Hajra Chowdhury, A. K. Hajra Chowdhury, N. Roy ; Edition : 16th
3. Workshop Technology (Part - 2): W. A. J. Chapman; CBS Publisher Edition: 4th
4. Manufacturing Processes: Pearson Publication., Serope Kalpakjian and Steven Schmid; Edition Fifth; ISBN 978-81-317-0566 -7
5. Manufacturing Technology- Material Processes and Equipment: CRC Press., H.A. Youssef and M.H. Ahmed; ISBN-13:978-1-4398-9708

VOC 512- Introduction to Robotics

(2 Credits: 50 Marks)

Learning Objectives

1. To provide acquaintance with basic terminologies of robotics
2. To provide ideas on basic sensors and actuators employed in robotics
3. To provide ideas of anatomy, motion and programming of robots
4. To provide familiarization with necessary safety precautions for working with industrial robot
5. To introduce with industrial robot and its applications

Learning Outcomes

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

1	Define basic terminologies of robotics ,describe development in robotic aspects, and various applications of industrial robots
2	Define the needs acquire necessary information and select appropriate robots for various industrial applications
3	Explain the robot anatomy and apply robot kinematics, dynamics, motion planning, trajectory generation and control
4	Describe features of a robot software and discuss robot programming languages
5	Discuss various sensors and actuators employed in robotics
6	Recognize the responsibility of engineers for the safety issues and the importance associated with the use of robots for various applications

Course Contents:

Module I: Introduction to Robotics **(06 HRS)**

Evolution of Robot and Robotics, Laws of Robotics, Progressive advancement in Robotics, Types of Robot, Selection of Robot- Payload, speed, Reach, Sensors in robots, Actuators, Major parts of Industrial robot

Module II: Anatomy of Robot **(07 HRS)**

Links, Joints and Joints Notation Scheme, Degree of Freedom (DOF), Required DOF in a Manipulator, Work Cell, Work Envelope, and Work Volume, Robot End Effectors – Definition, Classification of End Effectors, Types of Grippers, General structure of Robot and Specifications of Robots.

Module III: Robot Motion Analysis **(07 HRS)**

Introduction, link description, Joint link connection description, Kinematic modeling of manipulator, Direct and Inverse manipulator Kinematics – Basics, Manipulator dynamics- Basics, Trajectory planning – Basics, **Robotic Vision System-** Robot Sensors, Function & use of sensors in robotics, Definition & Concept-Robotic vision system,

Module IV: Robot Software and Programming& Robot Applications (07 HRS)

Introduction, Robot software features, Concept of programmability and related languages, Robot programming languages and Robotic Functions, Control functions of a Teach box, Robot Coordinate Systems, Jogging of a Robot, Robot Applications, Robot Maintenance, Robot Safety systems, Present state of safety technology

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. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
5. Robotics control, sensing, vision and intelligence, Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “”, McGraw Hill Book co, 1987
6. Robots and Manufacturing Automation, Ray Asfahl. C., John Wiley & Sons Inc.,1985
7. Introduction to Robotics mechanics and control, by Craig. J. J., Addison- Wesley, 1999

VOC- 513 Networking Essentials

(02 credits – 50 marks)

Learning Objectives:

1. To provide fundamental concepts of communication and data networks.
2. To provide knowledge and skills to work effectively with network engineers

Learning Outcomes:

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

1	Describe and classify various modes of data communication and explain basic networking concepts
2	Classify communication techniques in Industries and explain various Networking Models
3	Explain communication hierarchy in factory automation
4	Classify and explain I/O bus networks and protocol standards
5	Describe architecture and topologies for fieldbus

Course Contents

Module I – Data Communication (06 HRS)

Introduction, Comparison between Digital and Analog, Data Communication, Data Types, Data Transfer Characteristics, Data Flow Methods, Transmission Modes: parallel, serial, asynchronous, synchronous, isochronous, Use of Modems, Power Spectral Density

Module II – Network Models (07 HRS)

Introduction, Three-Layer Model, OSI Model- Physical Layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer, TCP/IP Protocol Suite-Introduction, Protocol Architecture, Operation, PDUs in Architecture, Addressing-Physical, Logical, Port, Specific.

Module III – Networks in Process Automation (07 HRS)

Introduction, Communication Hierarchy in Factory Automation, I/O Bus Networks – Types, Network and Protocol Standards, Advantages. OSI Reference Model, Networking at I/O and Field Levels, Networking at Control Level, Networking at Enterprise/Management Level

Module IV – Fieldbuses (06 HRS)

What Is a Fieldbus?- Evolution, Architectural Progress, Types, Expanded Network View, Topologies- Point-to-Point, Bus with Spurs, Tree (Chicken Foot), Daisy Chain, Mixed Topology, Terminators, Fieldbus Benefits, Foundation Fieldbus.

Module V:

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

References:

1. Fieldbus and Networking in Process Automation – Sunit Kumar Sen may 14, 2014 by CRC Press Reference - 461 Pages - 15 Color & 279 B/W Illustrations ISBN 9781466586765 - CAT# K20308
2. Industrial Automation IDC Engineering pocket guide first Edition *ISBN* 1 875955 09 7
3. Data Communications Networking (McGraw-Hill Forouzan Networking) 4th Hardcover Import, 1 Feb 2006 by Behrouz A Forouzan (Author) ISBN-10: 0073250325 ISBN13: 978-0073250328

VOC- 514: Advance Embedded Systems

(02 credits – 50 marks)

Learning Objectives

1. To introduce with PIC Microcontroller family, PIC hardware
2. To familiarize with PIC assembly language.
3. To interface real world devices
4. To introduce with arduino functions, analog operations and interfacings.

Learning Outcomes

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

1	Explain differences between 8051 and PIC family of microcontrollers and describe various registers, data format and directives
2	Explain and apply instruction sets to perform assembly language programming with PIC 18 microcontroller
3	Interpret simple branching, mathematical, and logic related Programming with PIC 18 microcontrollers using Assembly language
4	Interface of real world device through I/O programming with PIC 18 family microcontrller
5	Apply arduino uno controller for real world device interfacing

Course Contents

Overview:

Difference between 8051 and PIC, Overview of the PIC18 family: PIC18 features, Simplified view of PIC, Members of PIC family, Comparison of 8051 and PIC Family

Course Contents:

Module– I: PIC Microcontrollers and Assembly Language Programming (07 HRS)

Introduction to PIC microcontrollers and embedded processors, Assembly Language Programming : WREG Register in PIC, PIC File Register, PIC Status register, PIC data format and directives, Introduction to PIC Assembly Programming: Structure of Assembly language, Assembling and linking a PIC Program, Program counter and program ROM space in the PIC, RISC architecture in PIC

Module – II: Addressing Modes and Instruction Set (07 HRS)

Branch Instructions, Looping, Call instructions and Stack, PIC 18 Time delay and Pipeline concepts Arithmetic Instructions and operations, Logic and Compare Instructions, Rotate operation and Data serialization,

Module – III: Hardware connections, I/O programming and Interfacing (06 HRS)

Pin connection, PIC configuration registers, I/O port programming in PIC 18, I/O port bit manipulation programming
Real World device interfacing: LCD, ADC, DAC, Relay, Stepper Motor, DC motor

Module – IV: Introduction to Arduino Programming (07 HRS)

Arduino Structure, Variables, Data types, Arithmetic , Constants, Flow Control, Digital i/o, Analog i/o, time, math, random, serial, Arduino Programming

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

References:

1. PIC microcontrollers and embedded systems- M.A. Mazidi, R. D. Mc. Kinlay, C, Causy; Pearsn, 2008, fourteenth impression ISBN-13: 978-0131194045 ISBN-10: 0131194046
2. Basic for PIC microcontrollers- N. Matic; webmaster, 2001
3. Getting started with arduino - Massimo Banzi, 2nd edition ISBN: 978-1-449-309879
4. Arduino notebook v1-1-Brian W Evans,1st edition
5. Intro Arduino Book- Alan G Smith, ISBN: 1463698348, ISBN-13: 978-1463698348
6. John B. Peatman, "Design with PIC microcontroller", McGraw Hill International Ltd., 1997
7. Han-way Huang, "Using the MCS-51 microcontroller", Oxford University Press, 2009
8. Getting Started with Aurduino 3rd Edition by M. Banzi and M. Shiloh

VOC- 511A: Fundamentals of Microprocessor 8086

(02 credits – 50 marks)

Learning Objectives:

To facilitate the students to understand the concepts of microprocessor and assembly language programming.

Learning Outcomes

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

1	Explain architecture of 8086 microprocess
2	Describe operation of each pin of 8086 microprocessor
3	Interpret simple branching, mathematical, and logic related Programming with 8086 microprocessor microcontrollers using Assembly language

Course Contents

Module - I 8086 microprocessor architecture (08 Hrs)

Overview of Microcomputer structure and operation, memory, input / output, CPU, address bus, data bus, control bus, 8086 microprocessor family overview, 8086 internal architecture: execution unit, (flag register, general purpose register, ALU), Bus interface unit, segment register, stack pointer register, pointer and index register [Refer Douglas and Hall book for above articles],

Module - II 8086 microprocessor hardware aspects and addressing modes (07 Hrs)

Pin out and pin functions of 8086 : The pin out, power supply requirements, DC characteristics, input characteristics, output characteristics, pin connections (common pins, maximum mode pins and minimum mode pins) **Addressing Modes:** Data addressing modes: Register addressing, Immediate addressing, Direct addressing, register indirect addressing, base plus index addressing, register relative addressing, base relative plus index addressing, Programme memory addressing modes: Direct program memory addressing, relative program memory addressing, indirect program memory addressing; stack memory addressing modes.

Module III :Data Movement Instructions with 8086 microprocessor (05 Hrs)

MOV revised: machine language, the opcode, MOD field, register assignments, R/M memory addressing, special addressing, **PUSH/POP :** PUSH, POP, initializing the stack**;** **Miscellaneous data transfer instructions:** XCHG, IN and OUT,

Module IV :Arithmatic and Logic Instructions with 8086 microprocessor (07 Hrs)

Arithmetic and Logic Instructions: Addition, subtraction and comparison: Addition: Register addition, immediate addition, memory to register addition, array addition,increment addition, addition with carry**; Subtraction:** Register subtraction, immediate subtraction, decrementsubtraction, subtraction with barrow**; Comparison, Multiplication and division: Multiplication:** 8 bitmultiplication, 16 bit multiplication; **Division:** 8 bit division,16 bit division; **Basic Logic Instructions:** AND, OR, Ex-OR,TEST, NOT, NEG**; Shift and Rotate: Shift:** left shift, rightshift; **Rotate:** Rotate left, rotate right

References:

1. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ; Sixth Edition ; Prentice Hall International, Publications, (2002), ISBN-10: 0130607142, ISBN-13: 978-0130607140
2. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ;Eighth Edition ; Prentice Hall International, Publications (2009), ISBN 0-13-502645-8
3. Microprocessors and Interfacing : Programming and Hardware, Douglas V Hall : II Edition ; Tata McGraw-Hill(1990), ISBN-10: 0070257426, ISBN-13: 978-0070257429.
4. Microcomputer Systems : The 8086 / 8088 Family; Architecture, Programming and Design, Yu-Cheng Liu and Glenn A. Gibson,Prentice Hall International, Publications (1986), ISBN-10: 013580499X, ISBN-13: 9780135804995.
5. The 8086/8088 Family: Design, Programming and Interfacing, John, Uffenbeck, Prentice Hall International, Publications (1986), ISBN-10: 0132467526, ISBN-13: 978-0132467520

VOC- 512A: Interfacing with Microprocessor 8086

(02 credits – 50 marks)

Learning Objectives:

To facilitate the students to understand the concepts of real world interfacing with 8086 microprocessor

Learning Outcomes

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

1	Write assembly language routines employing program control instructions
2	Describe Assembly Language Program Directives for 8086 microprocessor
3	Explain interface protocols with 8086 microprocessor through 8255 PPI

Course Contents

Module - I: Program Control Instructions **(06 hrs)**

The Jump Group: **Unconditional jump:** short jump, near jump, far jump, indirect jumps using an index; **Conditional Jumps:** LOOP, conditional LOOPs; **Procedures**: CALL, near CALL, far CALL, indirect memory address, RET; **Machine Controland Miscellaneous Instructions:** Controlling the carry flag bit, wait, HLT, NOP ;

Module – II: Assembly Language Programming **(06 hrs)**

Assembly Language Programming: Assembler directives: ASSUME, DB, DD, DQ, DT, DW, END, ENDP, ENDS,EQU, EVEN, EXTRN, GLOBAL, GROUP, INCLUDE,LABEL, LENGTH, NAME, OFFSET, ORG, PROC, PTR,PUBLIC, SEGMENT, SHORT, TYPE [Refer Douglas andHall book for above articles **Assembly Language Programming:** Sum of an array, factorial, largest / smallest from given array, sorting of numeric array, square root.

Module -III : Input / Out Interfacing-I (with reference to 8086 Microprocessor) **(06 hrs)**

Introduction to I/O interface, I/O instructions, isolated and memory mapped I/O, basic input and output interfaces, handshaking, I/O port address decoding: decoding of 8-bit I/O addresses, decoding of 16 – bit I/O address;

Module -IV :Input / Out Interfacing-II (with reference to 8086 Microprocessor) **(06 hrs)**

The programmable peripheral interface: basic description of 8255, programming the 8255, mode 0 operation, an LCD display interfaced to 8255, a stepper motor interfaced to 8255, Mode 1 strobed input, mode1 strobed output , Mode 2 bisectional operation

References:

1. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ; Sixth Edition ; Prentice Hall International, Publications, (2002), ISBN-10: 0130607142, ISBN-13: 978-0130607140
2. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ;Eighth Edition ; Prentice Hall International, Publications (2009), ISBN 0-13-502645-8
3. Microprocessors and Interfacing : Programming and Hardware, Douglas V Hall : II Edition ; Tata McGraw-Hill(1990), ISBN-10: 0070257426, ISBN-13: 978-0070257429.
4. Microcomputer Systems : The 8086 / 8088 Family; Architecture, Programming and Design, Yu-Cheng Liu and Glenn A. Gibson,Prentice Hall International, Publications (1986), ISBN-10: 013580499X, ISBN-13: 9780135804995.
5. The 8086/8088 Family: Design, Programming and Interfacing, John, Uffenbeck, Prentice Hall International, Publications (1986), ISBN-10: 0132467526, ISBN-13: 978-0132467520

VOC – 515: Laboratory Coursework -XVII

(Lab Course pertaining to VOC 511 and 512)

(03 Credits – 50 marks)

Learning Outcomes

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

1	Apply basic machine shop tools to perform simple machine operations
2	Apply DC geared motor and stepper motor as motion control elements
3	Illustrate operation of a gantry robot
4	Operate a six axis articulated robot in fundamental modes of operation

List of Experiments:

Visit to a machine tool shop and to get introduced to various machines, work practices, types of jobs, job roles, safety measures.

1. Grinding a job in a given angle
2. Drilling and reaming operation on a given job
3. Welding operation on a given job (either of lap or butt joint)
4. Study of a centre lathe machine
5. Facing and taper turning operation on a given job in centre lathe
6. Grooving and knurling operation on a given job in centre lathe
7. Study of a milling machine
8. Machining of a hexagonal head with slot on a given job in milling machine
9. Study of position control with a DC geared motor for different values of forward gain at different values of angular position
10. Study of effect of loading on the speed of a DC motor in the open loop and closed loop using variable gain error amplifier
11. Study of various operational modes of a stepper motor
12. Study on individual control of each axis of a six axis pick and place robot (2 axes stepper coupled belt driven and 4 axes servo driven) and program the robot for a pick-place operation.
13. Study of a robotic platform with different sensors integrated onto it and build one project by integrating at least one sensor on similar platform (self study mode – one project to be submitted by a batch of three students)
14. Introductory programming of industrial Cartesian robot (six axis) for pick/place operation
15. Jogging of Robot (Axis Mode, World Coordinate Mode)
16. Referencing / Zeroing / Mastering of Robot
17. TCP Calibration
18. Base / Frame Coordinate Calibration

19. Creating a new simple motion program with PTP, Lin and Cir motion with calibrated tool base. Speed of each point to be specified
20. Creating a program for pick and place including opening and closing of grippers
21. Backup and Restoring of Robot

VOC – 516: Laboratory Coursework -XVIII

(Lab Course pertaining to VOC 513 and 514)

(03 credits – 50 marks)

Learning Outcomes

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

1	Illustrate various interfacing protocols
2	Apply PIC microcontroller to control basic input –output devices and actuators
3	Apply Arduino Uno platform to control basic input –output devices and actuators

List of Experiments:

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. Implementation of Star topology using 100Base Tx
5. Implementation of Bus topology using 10Base2
6. To create the scenario and study the performance of token bus protocols through simulation
7. Implementation of Ring topology using DB9
8. To create the scenario and study the performance of token ring protocols through simulation
9. Implementation of Data Encryption and Decryption
10. Study of fieldbus protocol.
11. Comparision of Star, Bus, and Ring Topologies
12. Study on a interfacing of Relay and Stepper Motor with PIC microcontroller
13. Study on a interfacing of LCD and ADC with PIC microcontroller
14. Study on a interfacing of DAC and DC motor with PIC microcontroller
    (Self study mode – one application utilizing any one of the experiments from sr. no. 12-14 has to be demonstrated by a group of three students)
15. Study of Aurduino interfacing with real world devices.

    (Students will be introduced with Aurduino interfacing for at least two applications. Thereafter, in self study mode- a group of three students will have to submit at least one project using aurduino platform

VOC – 515A: Laboratory Coursework -XVIIA

(Lab Course pertaining to VOC 511A and 512A)

(03 credits – 50 marks)

Learning Outcomes

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

1	Develop Assembly Language Program with 8086 microprocessors for data movement, arithmetic and logic instructions
2	Develop Assembly Language Program with 8086 microprocessors for program control instructions
3	Interface real-time devices with 8086 microprocessors through 8255 PPI

Experiments using 8086 Kit

1. Data transfer, addition, subtraction, multiplication, division and sum of series
2. Factorial and square of the number
3. Sorting of data (ascending / descending), square root of a number
4. Arithmetic mean of N- numbers and sum of square of Numbers
5. Interfacing of SPDT switches and 7 segment display as a position encoder / decoder
6. Interfacing of stepper motor
7. Interfacing of DC motor
8. Interfacing of DAC to generate ramp wave, triangular wave and square wave.
9. Interfacing of 8-bit ADC
10. Interfacing of LCD display

Experiments Using 8086 Assembler

11. Data transfer, addition, subtraction, multiplication, division and sum of series
12. Factorial and square of the number
13. Sorting of data (ascending / descending), square root of a Number
14. Arithmetic mean of N- numbers and sum of square of Numbers

(Students will be introduced with Aurduino interfacing for at least two applications. Thereafter, in self study mode- a group of three students will have to submit at least one project using aurduino platform

VOC 517:Major Project – Phase I

(04 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 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 –

1. build up a concrete fundamental of the concept on which they are going to work,
2. carry out thorough literature survey to find out scope of work in the particular field,
3. thereby, finalizing the topic of further study/investigation
4. and finally, draft a systematic experimental plan to achieve projected goal
5. deliver regular presentations
6. 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 – VI

General Academic Components

Semester – VI

General Education Components

VOC 601: Foreign Language (German/Chinese/Japanese/Russian)

(4 Credits: 100 Marks)

Learning Objectives: The course should enable students: to know basic Japanese-Reading, writing and speaking

Learning Outcomes:
After completion of the course, students are expected to be able to: read, write Hiragana and Katakana, know basic kanjis, can participate in simple conversation.

Module 1: **(10Hrs)**
Scripts in Japanese- Hiragana, katakana and introduction to Kanji Self introduction, Daily used greetings,expressions used in the classroom Introduction to Japanese Grammer

Module 2: **(12Hrs)**
Day,date,nos.,grammer related to place and time Counters

Module3: **(12Hrs)**
Introduction to adjectives and verbs

Module 4 : **(12Hrs)**
Forms of adjectives,verb tense forms

Module 5: Tutorials, Case studies and presentation based on Module I to IV (02Hrs)

References:

Minna no nihongo I
Japanese for Busy People Kyoukasho wo tsukuro

VOC-602: ENTREPRENEURSHIP DEVELOPMENT

(4 Credits: 100 Marks)

Learning Objectives

1. Identify and apply the elements of entrepreneurship and to entrepreneurial processes
2. Recognize the importance of entrepreneurship and identify the profile of entrepreneurs and their role in economic growth
3. Use the entrepreneurial mind-set and behave responsibly and ethically in their roles as entrepreneurs.

Learning Outcomes

After completion of this course, students should be able to-

1	Discern distinct entrepreneurial traits
2	Interpret the parameters to assess opportunities and constraints for new business ideas
3	Summarize a systematic process to select and screen a business idea
4	Design strategies for successful implementation of ideas
5	Prepare a business plan

Module I: **(12 Hrs)**

Entrepreneur - meaning - importance - Qualities, nature types, traits, culture, Similarities and differences between entrepreneur and entrepreneur. Entrepreneurship and economic development - its importance, Role of entrepreneurship, entrepreneurial environment. Evolution of entrepreneurs - entrepreneurial promotion: Training and developing motivation: factors - mobility of entrepreneurs - entrepreneurial change - occupational mobility - factors in mobility - Role of consultancy organizations in promoting entrepreneurs

Module II: **(10 Hrs)**

Small Business : Concept & Definition, Role of Small Business in the modern Indian Economy, Small entrepreneur in International business; Steps for starting a small industry, registration as SSI, Role of SIDBI; advantages and problems of SSIs; Institutional Support mechanism in India; Incentives & Facilities, Govt. Policies for SSIs

Module III: **(10 Hrs)**

Setting MSMEs- location of enterprise - steps in setting - Problems of entrepreneurs - Sickness in small industries - reasons and remedies - Incentives and subsidies - Evaluating entrepreneurial performance - Rural entrepreneurship - Women Entrepreneurship.

Module IV: **(12 Hrs)**

Project finance: Sources of finance – Institutional finance - Role of IFC, IDBI, ICICI, LIC, SFC, SIPCOT, and Commercial Bank - Appraisal of bank for loans. Institutional aids for entrepreneurship development - Role of DST, DICS, SIDCO, NSICS, IRCI, NIDC, SIDBI, SISI, SIPCOT, Entrepreneurial guidance bureau - Approaching Institutions for assistance.

Module V:

Meeting the entrepreneurs, interviewing them and making a presentation.

References:

1. Vasanth Desai ―Dynamics of Entrepreneurial Development and Management‖ Himalaya Publishing House, New Delhi, India, ISBN 10: 8184884974 ISBN 13: 9788184884975
2. N.P.Srinivasan & G.P. Gupta ―Entrepreneurial Development‖ S. Chand & Sons, New Delhi, India. ISBN 10: 8170148014 ISBN 13: 9788170148012
3. P.Saravanavelu ―Entrepreneurship Development‖ Eskapee publications.
4. S.S.Khanka ―Entrepreneurial Development‖ S.Chand & Company Ltd.,
   Satish Taneja ― Entrepreneur Development‖ ; New Venture Creation.

VOC-603: Production Management

(4 Credits: 100 Marks)

Learning Objectives

The course should enable students:

1. Understand the principles and decision analysis related to the effective utilization of the factors of production.
2. Understand the efficiency and effectiveness of processes.

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Learning Outcomes

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

1.	Students would describethe nature of how production management is carried out in an organization
2.	Describe the nature of products or services in the organization..

Module 1: Introduction: An overview of Production Management (9 Hrs)

Production Management: Introduction and overview, Production Management Strategy framework, Understanding similarities and difference among products, goods and services, Historical evolution of production management-Changes & Challenges

Module 2: Product development & production strategy (10 Hrs)

Product Strategy and integrated product development, Determining Product Concept, Determining Commonality, Requests for Deviation from Customer Requirements, Developing Design-to-Cost Goals, Determining Production Philosophy and Location, Process Strategy, Capacity Planning Decisions, Facilities Location Strategies

Module 3: System Design (10 Hrs)

Facilities Layout and Material Handling Strategy, Develop Preliminary Manufacturing Plan, Identify New Manufacturing Technologies, Determine Product-Packaging Requirements, Develop Prototype Assembly Tooling, Determine Logistical Support Requirements,Group Technology, Flexible manufacturing system, Assembly line balancing, Project Management-CPM PERT, Line of Balance (LOB)

Module 4: Planning and managing operations **(10 Hrs)**

Productivity Concepts: Quality Circle, Kaizen and other SGA, Statistical Quality Control, Maintenance Planning and Control (Reliability, availability, maintainability),Forecasting, Queueing Theory,

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

References:

1. Aggarwal L.N, ParagDiwan (1997), Management of Production Systems, Global Business Press.
2. Alan Muhlemann, John Oakland, Keith Lockyer (1978), Production and Operations Management, Mac Milan , India, IV Edition.
3. Artiba and S.E Elmaghaby(1997), The Planning and scheduling of production Systems methodologies and Applications, Chapman & Hall.
4. Aswanthappa K, Sridhar Bhatt K(2005), Production and Operations Management, Himalya Publishing House.

Semester – VI

Industrial Automation

(Skill Development Components)

VOC 611- Flexible Manufacturing System

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce students with Manufacturing systems.
2. To make aware the students about the advance manufacturing practices/methods being implemented at leading industries across the globe, which ultimately leads to more customer satisfaction in terms of low cast and high quality.

Learning Outcomes:

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

1	State the basic concepts of FMS, cell, JIT, KANBAN system and CMM
2	Classify and compare different types of FMS, machining centers, Kanban, CMM, AGVS, AS/RS; also differentiate between FMS and FMC
3	Illustrate area of applications of a FMS, CMM, JIT, various equipments and their functions required for an FMS
4	Analyze the reasons for adopting group technology, analyze the AGV Systems, AS/RS as well as distinguish between Axes and Format of Machining Centers, Horizontal and Vertical Machining Centers
5	Explain the visual inspection aspects

Module – I: Introduction to FMS (5 Hrs)

Introduction and Definition, Basic Components of FMS, The Significance of FMS in the 1990s, Different Types of FMS, Types of FMS Layouts, Factors Influencing the FMS Layouts, Seeking Benefits on Flexibility, FMS—An Example of Technology and an Alternative Layout, Objectives of an FMS, Aims of FMS, The Principle Objectives of FMS, Advantages and Disadvantages of FMS Implementation, Advantages and Disadvantages of FMS, Area of Application of a FMS in Industry, Various Equipments and their Functions Required for an FMS, Innovations that have Advanced the Manufacturing Industries, CIM Technology, Hierarchy of CIM, Direct Real Time Schedule Control, FMS Concepts

Introduction of manufacturing cell, Definition of Cell, Classification of Cell, Unattended Machining, Differences between FMC and FMS

Module – II: JIT , KANBAN System, and Group Technology (6 Hrs)

Introduction and Definition, Big JIT, Little JIT, JIT Concept, Goals of JIT, JIT Reality, Objectives of JIT, JIT Ingredients, Quality and Quantity Principles of JIT, The Primary Quantity JIT Principles, Benefits of JIT, JIT Implementation
Introduction to Kanban/Card System, Push vs. Pull System , Types of Kanban
Introduction , Definition, Reasons for Adopting Group Technology, Visual Inspection , Part Classification and Coding, Production Flow Analysis , Benefits of Group Technology Affecting Many Areas of a Company, Obstacles to Application of GT

Module – III: FMS Elements – I (7 Hrs)

Machining Centers: Introduction, Types of Machining Centers , Machining Center Innovations and Developments, Axes and Format of Machining Centers, Horizontal and Vertical Machining Centers, Automated Features and Capabilities of Machining Centers.

Coordinate Measuring Machines: Introduction, CMM Construction, Probe, Mechanical Structure, Types of CMM, Functions of CMM Computer, Operational Cycle Description , CMM Applications , CMM Advantages

Module – IV: FMS Elements – II (7 Hrs)

Automated Material Movement and Storage System: Introduction, Types of AGVS, Unit Load Carriers, ASRS Systems, Analysis of AGV Systems, Automated Storage and Retrieval Systems (AS/RS), Unit Load AS/RS, Mini Load AS/RS, Carousel AS/RS, Advanced Automated Storage and Retrieval System, Analysis of AS/RS, Quantitative Analysis, Industrial Robots Case Studies

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

References:

1. Flexible Manufacturing System Author : H. K. Shivanand, M. M. Benal, V. Koti Publisher : New Age Pub. ISBN-10: 8122418708 ISBN-13: 978-8122418705
2. Automation, Production Systems and Computer Integrated Manufacturing by Author : Groover M.P
3. Approach to Computer Integrated Design and Manufacturing Author : Nanua Singh Publisher : John Wiley and Sons ISBN-13: 978-0471585176 ISBN-10: 0471585173
4. Principles Of Computer - Integrated Manufacturing, Author : Vajpayee, S K Book Code : 9788120314764
5. Flexible Manufacturing Cells and Systems Author : Luggen ISBN-13: 978-0133217384 ISBN-10: 0133217388

6. Ian Gibson 2009, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer [ISBN: 9781441911193]
7. Serope Kalpakjian 2013, Manufacturing Engineering & Technology., 7th Ed., Pearson [ISBN: 9780133128741]
8. Mikell P. Groover 2012, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems., 5th Ed., Wiley [ISBN: 9781118393673]

VOC 612- Industrial Robotics

(2 Credits: 50 Marks)

Learning Objectives

1. To provide familiarization with necessary safety precautions for working with industrial robot
2. To introduce with industrial robot and its applications

Learning Outcomes

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

1	Define the automation and robotics, robotics market and future prospects, robot anatomy , safety implementation principles of industrial robotics, social issues and future of robotics
2	Classify and compare machine loading and uploading, processing operations
3	Demonstrate application of robotics in manufacturing
4	Analyze the robot cell layouts, economic aspects of robot manufacturing
5	Test the operation of pick and place robot
6	Develop programs for industrial robotic application

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 Groover1St 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

VOC-613: SCADA

(2 Credits: 50 Marks)

Learning Objectives

1. introduce SCADA and its applications to Students

Learning Outcomes

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

1	State the basic features of SCADA, HMI
2	Explain the importance of SCADA in critical industrial control and supervision
3	Demonstrate system graphic designing, data acquisition, messages and alarms, Software requirement for HMI Specifications and Selection Criteria with respect to process demands
4	Analyze the theory and applications of SCADA
5	Execute, debug and test the programs developed for digital and analog operations.
6	Develop projects with SCADA and HMI

MODULE – I : Introduction To SCADA **(07 HRS)**

SCADA: Need, Concept and Basic Features of SCADA, Hardware and Software (Specification & Configuration) requirements for SCADA
Window's Control Center (WinCC) Software for SCSDA (WinCC- Advanced): Introduction, Getting Started and Creation of New Project, Components, Tag Concept and various Tags in WinCC Advanced, Creation and Linking of Tags with PLC

MODULE – II : System Graphic Design and Data Acquisition (08 HRS)

System Graphic Designing: Digital and Analog Supervision & Control through Graphic Screen, Graphic Object Pallets and Library (Standard, Smart and Windows), Creating Process Pictures with Active X Control and Methods Objects Dynamic, Navigator and Face Plate Designing
Data Acquisition, Messages and Alarms: Archiving Various Tags and On Line and Historical Trending and Table Display, Displaying , acknowledging and Resetting Messages & Alarms (Digital and Analog)

MODULE – III : Special Supportive Features and HMI (07 HRS)

Special Supportive Features: Recipes Generation & Selection; Standard Report Generation, User Administration
Cross References and Project Backup
Human Machine Interface (HMI): HMI Types (OP / TP) and Software requirement for SIEMENS make HMI Specifications and Selection Criteria WinCC Flexible System Overview and its installation, HMI Configuration and Application

Module – IV: Project Development and HMI (07 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 V: Tutorials, assignments and presentation based on Module I to IV

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

References:

1. Scada: Supervisory Control And Data Acquisition 4th Edition by Author Stuart A. Boyer ISBN-13: 978-1936007097 ISBN-10: 1936007096

2. PLC & SCADA SYSTEMS: Quick Reference ; Francis G.L
3. A Guide to Utility Automation: Amr, Scada, and: it Systems for Electric PowerPaperback – Import, 15 Jan 1999 by Author Michael Wiebe
4. Power System SCADA and Smart Grids 1st Edition by Mini S. Thomas (Author), John Douglas McDonald (Author) ISBN-13: 978-1482226744 ISBN-10: 148222674X
5. Behrouz A. Forouzan 2005, Data Communications Networking, McGraw-Hill Education [ISBN: 9780071254427]
6. Kevin Collins 2007, PLC Programming for Industrial Automation, Exposure Publishing [ISBN: 1846854962]
7. David Bailey 2003, PRACTICAL SCADA FOR INDUSTRY, NEWNES [ISBN: 13: 978-0-7506-5805-8]
8. Srinivas Medida 2008, Pocket Guide on Industrial Automation, 1st Ed., IDC Technologies

VOC 614- IOT (Internet of Things)

(2 Credits: 50 Marks)

Learning Objectives

1. To introduce building blocks of Internet of Things (IoT) and their characteristics.
2. To study various case studies of IOT and understand how they works.

Learning Outcomes:

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

1	Descibe the basic building blocks of Internet of Things (IoT), their characteristics and applications
2	Compare physical and logical design of IOT, IOT model specifications
3	Interpret the concepts of IOT in Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle
4	Explain Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification
5	Evaluate the IOT systems in specific application e.g. Weather Monitoring

Module I: Introduction to IOT **(06 HRS)**

Introduction, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels and Development Template

Module II: Domain Specific IOTs **(07 HRS)**

Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

Module III: IOT Design Methodology **(07 HRS)**

Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device & Component Integration, Application Development

Module IV: **Various Case Studies** **(07 HRS)**

Case Study on IoT System for Weather Monitoring, Case Studies illustrating IOT Designs.

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

References:

1. Internet of Things: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti; Universities Press; ISBN- 978-81-7371-954-7
2. Designing The Internet of Things by Adrian Mcewen and Hakin Cassimally; Willey (2015); ISBN-10: 8126556862
3. The Internet of Things: Enabling Technologies, Platforms, and Use Cases by Pethuru Raj, Anupama C. Raman (2017) by Auerbach Publications: ISBN 9781498761284

VOC 611A- Numerical Control

(2 Credits: 50 Marks)

Learning Objectives

1. Introduce students to the fundamental concepts of Numerical Control

Learning Outcomes:

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

1	Describe the fundamental concepts NC technology
2	Explain broad-based features of CNC software
3	Analyze NC positioning systems
4	Develop basic concepts of NC part programming

Module I: Fundamentals of NC Technology (06 HRS)

Basic components of an NC system, NC coordinate system, Motion Control systems
Features of CNC, Machine control unit for CNC, CNC software

Module II: Distributed Numerical Control and NC applications (04 HRS)

General Configuration of a distributed numerical control
Machine Tool Applications, Advantages and Disadvantages of NC

Module III: Analysis of NC positioning systems (07 HRS)

Open-loop positioning systems, Closed loop positioning system, Precision in NC positioning

Module IV: **NC part programming** **(07 HRS)**

Manual part programming, computer-assisted part programming, NC part programming using CAD/CAM, Manual Data input

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

References:

1. Automation, Production Systems, And Computer Integrated Manufacturing : M. P. Grover Publisher : Pearson ISBN-978 -93-325-4981-4
2. Computer Numerical control: Warren Seames, Delmar Cengage Learning; 4th edition edition ISBN 978-0766822900
3. CNC Programming Techniques: Peter Smid, Industrial Press Inc.,U.S.; 1 edition ISBN-13**:** 978-0831131852

VOC 612A- Single Station Manufacturing Cells

(2 Credits: 50 Marks)

Learning Objectives

1. Introduce students to the fundamental concepts of Single Station Manufacturing Cells

Learning Outcomes:

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

1	Describe the fundamental concepts Single Station Manufacturing Cells
2	Distinguish Applications of Single Station Manned and Automated Cells
3	Analyze Single Station Manufacturing Cells
4	Interpret Parts Storage Subsystem and Automatic Parts Transfer

Module I: Fundamental of Single Station Manufacturing Cell **(06 HRS)**

Basic of Single Station Manufacturing Cell, Classification if single station manufacturing cells, Single station manned cells, Cases of Single station manned cells

Module II: Single Station Automated Cells **(04 HRS)**

Single Station Automated Cells, Advantages of Single Station Automated Cells, Enablers for Unattended Cells Operation, Parts Storage Subsystem and Automatic Parts Transfer

Module III: Applications of Single Station Cells **(07 HRS)**

Applications of Single Station Manned Cells, Applications of Single Station Automated Cells, CNC Machining Centers and Related Machine Tools

Module IV: **Analysis of Single-Station Systems** **(07 HRS)**

Analysis of Single-Station Systems, Number of Workstations Required, Machine Clusters

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

References:

1. Automation, Production Systems, And Computer Integrated Manufacturing : M. P. Grover Publisher : Pearson ISBN-978 -93-325-4981-4
2. Simply Complex Mechanical Engineering, Abrams M, January 2006,pp.28-31
3. Turnings Just The Begininning Manufacturing Engineering, Aronson, June 1999,pp 42-53

VOC 615 : Laboratory Coursework – XIX

(Pertaining to VOC 611 and VOC 612)

(2 Credits: 50 Marks)

Learning Outcomes:

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

1	Illustrate distinct parts of a flexible manufacturing system
2	Develop part projects with modular flexible manufacturing system
3	Develop projects with modular flexible manufacturing system

List of Experiments:

1. Study of different parts of a flexible colour sorting station
2. Experiment with retrieval of modular workpieces from cartridge assembly
3. Experiment with linear transport station
4. Sorting of finished products on basis of their shape/ contour.
5. Sorting of finished products on basis of their material of construction
6. Sorting of finished products on basis of their colour
7. Experiments with combining (iv), v, vi at different difficulty levels
8. Study with Linear transport and material station (Linear movement of Object and sequential/batch wise placing)
9. Study pick and place Robot on Rotating station.

10. Programming of Robot as in for pick and place operation
11. Study of Cartesian robot customized for AS/RS.
12. Programming of a Cartesian robot for AS Operation.
13. Programming of a Cartesian robot for Retrieval Operation.

VOC 616 : Laboratory Coursework – XX

(Pertaining to VOC 613 and VOC 614)

(2 Credits: 50 Marks)

Learning Outcomes:

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

1	Develop simple projects employing PLCs and SCADA
2	Illustrate components of IOT based system
3	Develop simple projects by implementing basic concepts of IOT

List of Experiments:

1. PLC interfaced with SCADA and status read/command transfer operation.
2. Parameter reading of PLC in SCADA
3. Alarm annunciation using SCADA
4. Reporting and trending in SCADA System
5. Tank Level control using SCADA System
6. Temperature monitoring using SCADA System
7. Speed control of machine by SCADA System
8. Study of physical and soft component in a IOT System
9. Study of Linux operating system (introduction, managing files and directories, working with command line and shell managing user access security)

10. Shell scripting programming for IOT
11. Study of Python programming
12. Hardware (Sensors and Actuators) interfacing protocol for IOT
13. Study of Communication protocols (at least 2)
14. System development for agriculture/ ambient atmospheric condition.

Five axis machining

https://youtu.be/CqePrbeAQoM

https://youtu.be/jbIU7l_8pR8 (Skull)

Horizontal Machining cEntre

https://youtu.be/5k5vpwdWbS0

Universal Machining Center

https://youtu.be/uc5P6Ss3LRE

Vertical Machining Centre

https://youtu.be/w_pKDXQlqQM

5. Master of Vocation (Industrial Automation)

This M.Voc (Industrial Automation) 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	Research/Industrial project			
	Part 1		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

<u>Preamble:</u>

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.**

<u>Program Educational Objectives:</u>

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.

<u>Program Outcomes (PO):</u>

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.

Course Outcomes (for all courses):

Course outcomes for all courses have been framed as statements that describe the knowledge & abilities to be developed in the student by the end of course (subject) teaching. The focus is on development of abilities rather than mere content. There can be 5 to 7 course outcomes of any course. These have written in the specific terms and not in general. Course Outcomes has been presented at the beginning of syllabus of respective course.

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

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

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.

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

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.

Attainment Assessment Mechanism:

a) Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies.

In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

b) Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.
The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

c) Course Attainment Levels:

a. CO attainment is defined/set at three levels;
b. The CO attainment is based on end term examination assessment and internal assessment;
c. The Co attainment is defined at three levels in ascending order-
    i. e.g. For end term and internal examination;
    ii. Level-1: 40% students scored more than class average
    iii. Level-2: 50% students score more than class average;
    iv. Level-3: 60% students score more than class average.
d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 50% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.
e. CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

d) Program Attainment Level:

a. PO attainment is defined at five levels in ascending order;
b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);
c. The PO attainment levels are defined / set as stated below;
    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1)- Poor
    ii. Level-2: 1.0>1.5-Average
    iii. Level-3: 1.5>2.0-Good
    iv. Level-4: 2.0>2.5-Very Good
    v. Level-5: 2.5>3.0 -Excellent
d. The PO attainment target level is set/defined (say, Level-4). It implies that, the department is aiming at minimum level-4 (very good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;
e. PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

The **CO-PO MATRIX** is provided in the below table

Master of Master of Vocation (Industrial Automation)

Paper Code	Paper Title		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
CC100	Constitution of India	2	*	*	*	*	*											
IAC110	Electronic Systems	3	*	*	*	*	*											
IAC111	Power Electronics	0	*	*	*	*	*											
IAC112	Transducer Technology	2	*	*	*	*	*											
IAC113	Electric Drives	3	*	*	*	*	*											
IAF120	Embedded Systems Design	2	*	*	*	*	*											
IAF121	Programmable Logic Controllers	0	*	*	*	*	*											
CF101	Research Methodology	2	*	*	*	*	*						*	*	*	*	*	*
EF1XX	Elective Foundation (Any One) ▪ Operations Management (EF130) ▪ Materials management (EF 131)	0	*	*	*	*	*								*	*	*	*
IALC140	Electronic Systems lab	0	*	*	*	*												
IALC141	Power Electronics lab	2	*	*	*	*												
IALC142	Instrumentation lab – I	0	*	*	*	*												
IALC143	Electric Drives lab	2	*	*	*	*									*	*	*	*
IALF150	Embedded Systems Lab	0	*	*	*	*									*	*	*	*
151	PLC lab	2	*	*	*	*									*	*	*	*
IAC210	Communication Protocols for Instrumentation	3	*	*	*	*	*											
IAC211	Mechatronics	3	*	*	*	*	*								*	*	*	*
IAC212	Advanced Transducers	2	*	*	*	*	*								*	*	*	*

IAF 220	Robotics	3	*	*	*	*	*								*	*	*	*
IAF 221	Process Control	2	*	*	*	*	*								*	*	*	*
IAF 222	Industrial Automation	2	*	*	*	*	*								*	*	*	*
IALC 230	Industrial Networking lab	2	*	*	*	*	*								*	*	*	*
IALC 231	Mechatronics lab	3	*	*	*	*	*								*	*	*	*
IALC 232	Instrumentation lab –II	3	*	*	*	*	*								*	*	*	*
IALF 240	Robotics lab	2	*	*	*	*	*								*	*	*	*
IALF 241	Process Control lab	3	*	*	*	*	*								*	*	*	*
IALF 242	Industrial Automation lab	2	*	*	*	*	*						*	*	*	*	*	*
IAR 250	Research/ Industrial Project – Phase I (Review of Literature/ Industrial Orientation, Formulation of Topic, Experimental Plan)	2			*	*	*	*	*	*	*	*	*	*	*	*	*	*
IAGE 31X	Generic Elective – I	3	*	*	*	*	*						*	*	*	*	*	*
IAGE 31X	Generic Elective – II	2	*	*	*	*	*						*	*	*	*	*	*
IAGE 31X	Generic Elective – III	1	*	*	*	*	*						*	*	*	*	*	*
IAGE 31X	Generic Elective – IV	1	*	*	*	*	*						*	*	*	*	*	*
IAOE 32X	Open Elective –I	1	*	*	*	*	*						*	*	*	*	*	*
IALE 33X	Lab Course based on Generic Elective – I	2	*	*	*	*	*								*	*	*	*
IALE 33X	Lab Course based on Generic Elective – II	3	*	*	*	*	*								*	*	*	*
IALE 33X	Lab Course based on Generic Elective – III	2	*	*	*	*	*								*	*	*	*
IALE 33X	Lab Course based on Generic Elective – IV	1	*	*	*	*	*								*	*	*	*
IAR 340	Research/ Industrial Project – Phase II (Experimental Work)	2			*	*	*	*	*	*	*	*	*	*	*	*	*	*
IAGE 41X	Generic Elective – V	2	*	*	*	*	*							*	*	*	*	*
IAOE 42X	Open Elective – II	1	*	*	*	*	*							*	*	*	*	*

IALE 43X	Lab Course based on Generic Elective – V	3	*	*	*	*	*											
IAR 440	Research/ Industrial Project – Phase III (Experimental Work Continued, Organization and Interpretation of Result, Dissertation, Presentation)	2			*	*	*	*	*	*	*	*	*	*	*	*	*	*

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)

<u>Course Outcomes</u>

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)

<u>Course Outcomes</u>

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 – 7th 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)

<u>Course Outcomes:</u>

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).

AUTOMOBILE

Faculty of Science & Technology

Deen Dayal Upadhyay KAUSHAL Kendra

Title of the Program (s):

A. **Bachelor of Vocation Automobile**
B. **Master of Vocation Automobile**

A. Bachelor of Vocation (Automobile)

This Bachelor in Vocation programme is divided into six semester shaving 180 credits. Each semester will have courses based on General Education Components and Skill Development Components. In each Semester, there will be four theory components of skill development with their corresponding laboratory coursework, apart from general education components. Moreover, each semester will contain dedicated Project and/or Industrial Training/Internship. The program offers following **General Education Components** viz. Linguistic Proficiency, Computer Science, Environment Management, Business & Accounting, Industrial Ethics and Safety Management, Statistical Tools, Commerce & Management Fundamentals and **Skill Development Components** in Industrial Automation.

Preamble:

Dr. Babasaheb Ambedkar Marathwada University proposes to offer a three year Bachelor programme invocation (B. 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 skilled manpower so that wide variety of options in automobiles, industrial automation and travel &tourism would be available and it will 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 C ommerce and Industry of India (ASSOCHAM), there will 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. The end result of this programme is to enable an individual to at train self-employment.

Program Educational Objectives:

The Objective of the B.VOC Automobile program are to produce 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 technicians and supervisors.
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 (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 B.Voc program are expected to -

PO1. **Domain knowledge:** Apply broad based fundamental 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 broad based 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 broad 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 broad 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 B.Voc (Automobile) program are expected to -

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

1. Apply knowledge of motor vehicles, their manufacturing and servicing & repair technology 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.

Course Outcomes (for all courses):

Course outcomes for all courses have been framed as statements that describe the knowledge & abilities to be developed in the student by the end of course (subject) teaching. The focus is on development of abilities rather than mere content. There can be 5 to 7 course outcomes of any course. These have written in the specific terms and not in general. Course Outcomes has been presented at the beginning of syllabus of respective course.

Exit Options:

The course allows exit of a student from the course on successful employment. Scopes will be there for further continuation of study. The other wise exit options will be as follows-

Exit Point	***Duration***	***Diploma / Degree to be Offered***
First exit	After 6 months	Certificate in Vocation
Second exit	After 1 yr.	Diploma in Vocation(D. Voc.)
Third exit	After 2 yrs.	Advanced Diploma in Vocation(Adv. D. Voc.)
Fourth exit	After 3 yrs.	Bachelor in Vocation (B. Voc.)

Eligibility:

Automobile, Industrial Automation:

Those who have completed XII Science OR equivalent/ MCVC / ITI (Two Years) with relevant / equivalent trade from any recognized Board/Institution are eligible for registration / admission to first year (Semester I) of B. Voc degree program.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves for a Common Entrance Test (CET). 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.

A candidate who has sought admission to Semester – I shall be admitted to Semester – II automatically (provided, he submits an application to that effect). A candidate who has passed 75% of the papers at First Year (First and Second Semesters together) examinations shall be allowed to take admissions in third semester. Similarly, a candidate who has passed 75% of the papers at the Second Year (Third and Fourth Semesters together) examinations shall be allowed to take admission in the Fifth semester. However, if a candidate has not passed the First and Second Semester examinations, he shall not be allowed to take admission in the Fifth Semester. Appearance in the First, Third and Fifth semester is compulsory to get promoted to next semester.

Dropout students will be allowed to register for second or third year as and when the concerned courses are offered by the Centre, however he/she should not exceed more than twice the duration of the course from the date of first registration at the Centre. Therefore, for obtaining B. Voc. degree a student will have to complete all semesters successfully within 6 years/12 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 30 credits for the award of Six Month Certificate in Vocation
- Students will have to earn 60 credits for the award of one year Diploma in Vocation(D. Voc.)
- Students will have to earn 120 credits for the award of two year Advance Diploma in Vocation (Adv. D. Voc.)
- Students will have to earn 180 credits for the award of three year Bachelor Degree in Vocation (B. 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 not be strictly allowed for appearing the examination of each course.

Departmental Committee:

The Departmental Committee (DC) of DDU-KK will monitor the smooth functioning of the programme.

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 Director of

DDU-KK, 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 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 respective exit point.

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 respective exit point.

<u>Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)</u>

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

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

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.

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

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

Grade Card

Results will be declared by the Centre and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will 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 respective exit point).

Cumulative Grade Card:

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

Attainment Assessment Mechanism:

a) Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

b) Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.
The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

c) Course Attainment Levels:

a. CO attainment is defined/set at three levels;
b. The CO attainment is based on end term examination assessment and internal assessment;
c. The Co attainment is defined at three levels in ascending order-
    i. e.g. For end term and internal examination;

ii. Level-1: 40% students scored more than class average
iii. Level-2: 50% students score more than class average;
iv. Level-3: 60% students score more than class average.

d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 50% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.
e. CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

d) Program Attainment Level:

a. PO attainment is defined at five levels in ascending order;
b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);
c. The PO attainment levels are defined / set as stated below;
    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1)- Poor
    ii. Level-2: 1.0>1.5-Average
    iii. Level-3: 1.5>2.0-Good
    iv. Level-4: 2.0>2.5-Very Good
    v. Level-5: 2.5>3.0 -Excellent
d. The PO attainment target level is set/defined (say, Level-4). It implies that, the department is aiming at minimum level-4 (very good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;
e. PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

The **CO-PO MATRIX** is provided in the below table.

Bachelor of Vocation (Automobile)

Paper Name		a	b	c	d	e	f	g	h	i	j	K PSO1	L PSO2
Linguistic Proficiency-I (English & Marathi)	3									*			
Computer Fundamentals-I (Theory)	2	*	*	*	*								
Auto Service Technician (Theory)	3	*	*	*	*	*							
Auto Service Technician (Practical)	2	*	*	*	*	*							
Occupational Practice Essentials (Theory)	2	*	*	*	*	*							
Automobile Technology	2	*	*	*	*	*							
Automotive Tools and Equipment	2	*	*	*	*	*							
Workshop Technology	1	*	*	*	*	*							
Engineering Drawing	2	*	*	*	*	*							
Lab. Course-I (AU) (Automobile Technology)	2	*	*	*	*	*		*	*				
Lab. Course-II (AU) (Automotive Tools and Equipment	3	*	*	*	*			*	*				
Lab. Cource-III (AU) (Workshop Technology	2	*	*	*	*			*	*				
Lab. Course-IV (AU)(Engineering Drawing	2	*	*	*	*			*	*				
Communicative English and Hindi	2	*	*	*	*					*			
Computer Hardware System : Theory	3	*	*	*	*								
Computer Hardware	3	*	*	*	*			*	*				

System : Lab. Course													
Environment Management	1	*	*	*	*								
Engine Systems	1	*	*	*	*								
Engineering Material	3	*	*	*	*								
Manufacturing Processes	2	*	*	*	*								
Engineering Drawing - II	2	*	*	*	*								
Laboratory Coursework - (Engine Systems)	2	*	*	*	*			*	*				
Laboratory Coursework- (Two Wheeler Servicing)	3	*	*	*	*	*		*	*				
Laboratory Coursework- (Workshop Practice)	2	*	*	*	*	*		*	*				
Laboratory Course work - (Engineering Drawing-II	2	*	*	*	*	*		*	*				
In- plant Training / Field Work / Mini Project	3	*	*	*	*	*		*	*				
Linguistic Proficiency - III	2	*	*	*	*	*				*			
Business Software Tools - I	2	*	*	*	*	*							
Statistical Tools (Probability and Statistics)	2	*	*	*	*								
Machine Drawing	2	*	*	*	*								
Thermodynamics	1	*	*	*	*								
Automotive Petrol Engine	1	*	*	*	*								
Automotive Diesel Engine	2	*	*	*	*								
Laboratory Course work based on Machine Drawing	1	*	*	*	*			*	*				
Laboratory Course work based on Automotive Petrol Engines	3	*	*	*	*			*	*				

Laboratory Course Work based on Automotive Diesel Engines	3	*	*	*	*			*	*				
Laboratory Course Work based on Two-wheeler overhauling	3	*	*	*	*			*	*				
In Plant Internship / Field work / Mini - Project - III	3						*	*	*	*	*	*	*
Industrial Ethics and Safety Management (IA&AU)/Ethical, Legal and Regulatory	1						*	*	*	*	*	*	*
Business Software Tools - II	2	*	*	*	*	*	*						
Fundamentals of Business and Accounting	2	*	*	*	*	*	*						
Fundamentals of Mechanisms	1	*	*	*	*	*	*						
Automobile Transmission	2	*	*	*	*	*	*						
Auto Electrical Systems	2	*	*	*	*	*	*						
Automobile Systems	1	*	*	*	*	*	*						
Laboratory Coursework based on Automobile Transmission	3	*	*	*	*	*	*						
Laboratory Coursework based on Auto Electrical Systems	3	*	*	*	*	*	*		*	*			
Laboratory Coursework based on Automobile Systems	2	*	*	*	*	*	*		*	*			
Laboratory Coursework based on Auto - CAD	2	*	*	*	*	*	*		*	*			
In-plant Internship / Field Work / Mini - Project - IV	2			*	*	*	*	*	*	*	*		

Personality Development and Stress Management	2					*	*	*					
Operations Management	1	*	*	*	*	*	*						
Business Communication	1				*	*	*	*					
Vehicle testing	1	*	*	*	*	*	*			*	*		
Engine Diagnostic & trouble shooting	1	*	*	*	*	*				*	*	*	*
Metrology	3	*	*	*	*	*							
Hydraulic and Pneumatic	3	*	*	*	*	*							
Fuel Testing and Standards	2	*	*	*	*	*		*	*				
Heat, Ventilation, and Air conditioning (HVAC)	3	*	*	*	*	*		*	*				
Laboratory Coursework - Engine Diagnostics and Troubleshooting	2	*	*	*	*	*		*	*				
Laboratory Coursework – Hydraulic and Pneumatic	3	*	*	*	*	*		*	*				
Laboratory Coursework - Engine and Fuel Testing Laboratory	1	*	*	*	*	*		*	*				
Major Project – Phase I	2					*	*	*	*	*		*	*
In-plant Training/Field work/Mini Project – V (AU)	1					*	*	*	*	*		*	*
Foreign Language	2									*			
Entrepreneurship Development	3									*		*	*
Production Management	2	*	*	*	*	*	*						
Autotronics	2	*	*	*	*	*	*					*	*
Farm Equipment and Machinery	1	*	*	*	*	*	*					*	*
Transport	2	*	*	*	*	*	*						

Management and safety Regulation													
Design of Automotive Components	3	*	*	*	*	*	*						
Lab. Course based on wheel Balancing and wheel Alignment	3	*	*	*	*	*	*		*	*			
Lab. Course based on Solid Modeling	3	*	*	*	*	*	*		*	*			
Major Project - Phase -II	2						*	*	*	*	*		
In-Plant Training Field work Mini Project	3						*	*	*	*	*		

Course Structure (B.Voc. Automobile)

Paper No	Paper Title	Credits
Semester – I		
General Education Components (A)		
VOC 101	Linguistic Proficiency-I (English Marathi) with Language lab training	4
VOC 102	Computer Fundamentals-I (Information Technology) : Theory	2
VOC 103	Auto Service Technician (Theory)	2
VOC 104	Auto Service Technician (Practical)	
VOC 105	Occupational Practice Essentials	4
Skill Development Components (B)		
VOC 131	Automobile Technology	2
VOC 132	Automotive Tools and Equipments	2
VOC 133	Workshop Technology	2
VOC 134	Engineering Drawing	2
VOC 135	Laboratory Course –I (AU)(Automobile Technology)	2
VOC 136	Laboratory Course –II (AU) (Automotive Tools and Equipments)	2
VOC 137	Laboratory Course – III (AU) (Workshop Technology)	2
VOC 138	Laboratory Course – IV (AU) (Engineering Drawing)	2
Total Credits = General Education Components + Skill Development Components		12+16 =28
Semester – II		
General Education Components (A)		
VOC 201	Linguistic Proficiency- II (English and Hindi) with Language Lab	4
VOC 202	Computer Fundamentals- II (Basic Computer Hardware system)	2
VOC 203	Computer Fundamentals- II (Laboratory Course)	2
VOC 204	Environment Management	4
Skill Development Components (B)		
VOC 231	Engine System	2
VOC 232	Engineering Material	2
VOC 233	Manufacturing Processes	2
VOC 234	Engineering Drawing - II	2
VOC 235	Laboratory Coursework based on Engine System	2
VOC 236	Laboratory Coursework based on Two wheeler servicing	2
VOC 237	Laboratory Coursework based on Workshop practices	2
VOC 238	Laboratory Coursework based on Engineering Drawing - II	2
VOC 239	In-plant Training – II (AU)	4
Total Credits = General Educational Components + Skill Development Components		12+20 =32

Semester – III		
General Education Components (A)		
VOC 301	Linguistic Proficiency-III	4
VOC 302	Business Software Tools –I	4
VOC 303	Statistical Tools (Probability and Statistics)	4
Skill Development Components (B)		
VOC 331	Machine Drawing	2
VOC 332	Thermodynamics	2
VOC 333	Automotive Petrol Engines	2
VOC 334	Automotive Diesel Engines	2
VOC 335	Laboratory Coursework based on Machine Drawing	2
VOC 336	Laboratory Coursework based on Automotive Petrol Engines	2
VOC 337	Laboratory Coursework based on Automotive Diesel Engines	2
VOC 338	Laboratory Coursework based on Two-wheeler Overhauling	2
Total Credits = General Education Components + Skill Development Components		12+16 =28

Semester – IV		
General Education Components (A)		
VOC 401	Industrial Ethics and Safety Management	4
VOC 402	Business Software Tools-II	4
VOC 403	Fundamentals of Business and Accounting	4
Skill Development Components (B)		
VOC 431	Fundamentals of Mechanisms	2
VOC 432	Automobile Transmission	2
VOC 433	Auto Electrical systems	2
VOC 434	Automobile Systems	2
VOC 435	Laboratory Coursework based on Automobile Transmission	2
VOC 436	Laboratory Coursework based on Auto Electrical systems	2
VOC 437	Laboratory Coursework based on Automobile systems	2
VOC 438	Laboratory Coursework based on Auto-CAD	2
VOC 439	Laboratory Coursework based on In-plant Internship/Field Work/ Mini-Project-IV	4
Total Credits = General Education Components + Skill Development Components		12+20= 32

Semester – V		
General Education Components (A)		
VOC 501	Personality Development and Stress Management	4
VOC 502	Operations Management	4
VOC 503	Business Communication	2
VOC 504	Production Engineering	2
Skill Development Components (B)		
VOC 531	Vehicle Testing	2
VOC 532	Engine Diagnostics and Troubleshooting	2
VOC 533	Metrology	2
VOC 534	Hydraulic and Pneumatic	2
VOC 531 A	Fuel Testing and Standards	2
VOC 532 A	Heat, Ventilation, and Air conditioning (HVAC)	2
VOC 535	Laboratory Coursework - Engine Diagnostics and Troubleshooting	3
VOC 536	Laboratory Coursework – Hydraulic and Pneumatic	3
VOC 535 A	Laboratory Coursework - Engine and Fuel Testing Laboratory	3
VOC 537	Major Project – Phase I	2
VOC 538	In-plant Training/Field work/Mini Project – V (AU)	2
Total Credits = General Education Components + Skill Development Components		12+18=30
Semester - VI		
General Education Components (A)		
VOC 601	Foreign Language(German/Chinese/Japanese/Russian)	4
VOC 602	Entrepreneurship Development	4
VOC 603	Production Management	4
Skill Development Components (B)		
VOC 631	Autotronics	2
VOC 632	Farm Equipment and Machinery	2
VOC 633	Transport Management and safety regulation	2
VOC 634	Automotive Component Design	2
VOC 631 A	Electric and Hybrid Vehicles	2
VOC 632 A	Intelligent Vehicle Technology	2
VOC 635	Laboratory Coursework – Wheel Alignment and Balancing	3
VOC 636	Laboratory Coursework – Solid Modelling	3
VOC 635 A	Laboratory Coursework - Suspension system laboratory	3
VOC 637	Major Project – Phase II	2
VOC 638	In-plant Training/Field work/Mini Project – IV (AU)	2
Total Credits = General Education Components + Skill Development Components		12+18=30
	Total Credits (Semester I to VI)	180

In Semester V, students have to opt for either course group I- (VOC 531, VOC 532, VOC 535) or course group II- (VOC 531A, VOC 532A , VOC 535A) In Semester VI, students have to opt for either course group I- (VOC 631, VOC 632, VOC 635) or course group II- (VOC 631A, VOC 632A , VOC 635A)

Paper Code Description:

Each course will be identified by a unique three digit code.

The first digit refers to Semester.

The second digit refers to General academic component or Skill Development Component (according to specialization / trade) as per following scheme of nomenclature

0 - Refers to General paper / course

3 - Refers to Automobile

Third digit refers to incremental number for paper / course of respective semester.

Semester – I

General Academic Components

Semester – I

General Education Components

VOC 101: Linguistic Proficiency-I (English and Marathi) with language lab training
(4 Credits: 100 Marks)

Course Outcomes:

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

1	Define and Differentiate between different tenses in English Define different types of linguistic expressions in Marathi
2	Apply concept of tenses to formulate correct sentences in English Apply proper linguistic expression in Marathi to address situational demand
3	Describe basic rules of Pronunciations and phonetic subscriptions in English
4	Formulate different types of dialogues, expression of ideas/information in English and Marathi to address situational demand
5	Compose applications, reports, requests, responses, summary and comprehensions in English and Marathi

Part A: BASIC STRUCTURE OF THE ENGLISH LANGUAGE

Module I Tenses **(8 Hours)**

1.Present tense (includes all four types of tenses each)
2. Past tense
3. Future tense

Module II Spoken English: **(6 Hours)**

1. Basic of pronunciation : Vowels, diphthongs,
2. Certain basic sounds including th, dh, gh sounds, fricatives etc.
3. Differences in the sounds of the letters, especially, w/v, f/ph etc.
4. Phonetic transcriptions.
5.

Module – III **(8 Hours)**

1. Introducing yourself (The communicator)
2. Introducing people to others
3. Giving personal information
4. Getting people's attention and interrupting
5. Giving instructions and seeking clarifications
6. Making requests and responding to requests

References:

1. Business Communicator – V.K. Jain, O. P. Biyani, S. Chand, New Delhi.
2. The Communicator – Board of Editors , Orient Blackswan Pvt. Ltd

3. The Art of Powerful Communication – Dinesh K. Vohra, Are Maria Publications, Pune

Part B : BASIC STRUCTURE OF THE MARATHI LANGUAGE

(ON NEXT PAGE….)

उद्दिष्टे -

१) संज्ञापनाचे स्वरूप आणि प्रकार, संज्ञापन व्यवहारातील भाषेचे महत्त्व आणि कार्य यांचे महत्त्व समजावून देणे.

२) भाषा व्यवहाराची अपारंपरिक आणि अनौपचारिक क्षेत्रे, औपचारिक भाषा व्यवहाराची क्षेत्रे आणि त्याचे क्षेत्रनिहाय स्वरूप समजावून देणे.

३) विविध स्तरावरील भाषिक कौशल्ये आणि क्षमता विकसित करणे.

४) प्रसार माध्यमांचे स्वरूप आणि त्यासाठी आवश्यक असलेल्या भाषा व्यवहाराचे स्वरूप समजावून देणे.

५) कार्यालयीन / लेखन व्यवहारातील भाषेचे स्वरूप समजावून घेणे.

६) परिभाषानिष्ठ भाषाव्यवहार म्हणजेच निरनिराळ्या शास्त्रीय विषयांवरील लेखना करिता

७) भाषाव्यवहारातील आधुनिक तंत्रोपकरणांची (व तंत्रांची) माहिती करून देणे, मराठीतून व्यवहार करणाऱ्या संस्थांना भेटी देणे इत्यादी.

घटक४

संज्ञापन व भाषिक कौशल्ये

अ) संज्ञापन म्हणजे काय ? संज्ञापनाचे प्रकार - संज्ञापनातील भाषेचे, महत्त्व आणि कार्य भाषेचे औपचारिक व अनौपचारिक उपयोग.

आ) भाषेची प्राथमिक कौशल्ये (श्रवण, भाषण, वाचन, लेखन)

इ) भाषेची प्रगत कौशल्ये -

१) वर्णन, कथन, निवेदन, संभाषण, सूत्रसंचालनइ.
२) आकलन, संक्षेप, विस्तार, भाषांतर, गद्य रूपांतर, संवादलेखन इ.

औपचारिक भाषाव्यवहाराचे विविध प्रकार

अ) इतिवृत्त, टिप्पणी, अर्जलेखन, कार्यालयीन पत्रलेखन, निवेदन प्रसिध्दीपत्रक, निविदा इ.
ब) मुलाखत लेखन

स्मरणिका / गौरविका / संस्थापत्रिका / वार्षिक अहवाल इत्यादींचे संपादन

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

संदर्भ पुस्तके:

१) मराठी शुध्दलेखन प्रदीप	- मो. रा. वाळंबे, गो. य. राणे प्रकाशन
२) मुद्रित शोधन	- य. ए. धायगुडे - वि. पूना प्रेस ऑनर्स असो.
३) मराठी शुध्दलेखनविवेक	- द. न. गोखले - सोऽहं प्रकाशन
४) शुध्दशब्दसूची	- स्नेहल तावरे - स्नेहवर्धन
५) राजभाषापरिचय	-
६) व्यावहारिक मराठी	- पुणेविद्यापीठ
७) व्यावहारिक मराठी	- ल. रा. नसिराबादकर -फडके बुकसेलर्स,कोल्हापूर
८) व्यावहारिक मराठी	- प्रकाश परब
९) वार्तासंकलन	- चंद्रकांत ताम्हणे
१०) व्यावहारिक मराठी	- (संपादकडॉ. स्नेहल सावरे) स्नेहवर्धन प्रकाशन, पुणे

VOC 102:
Basic Computing

(2 Credits: 50 Marks)

Course Outcomes:

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

1	Define Elements and Tools of Word Processing, Spreadsheet, Presentation Graphics, DBMS, and Internet in MS-Office
2	Extend the knowledge of basic and advanced tools of Word Processing, Spreadsheet, Presentation Graphics, DBMS, and Internet in MS-Office for specific tasks
3	Apply Word Processing tools to create Notice, Application
4	Use Spreadsheet tools to create and manage attendance sheets
5	Demonstrate Presentation Graphic tools to create, modify and refine presentation
6	Apply DBMS tools create/modify tables/forms, reports
7	Use search engines and write e-mails

Software for Hands-on:

- Windows Vista
- MS Office 2007
- Internet Explorer
- Online collaboration tools

This course offers the following modules:

Module - I: Word Processing **(6 Hours)**

- Overview of Word Processing
- Creating and Editing a Document (Exercise 1 - Creating Notice)
- Revising and Refining a Document (Exercise 2 - Revise your notice)
- Using Additional Word Features (Exercise 3 – Creating notice for different classes)
- Changing the Display of the Document (Exercise 4 - Changing the display of your notice)
- Using Mail Merge (Exercise 5 – Sending notice using Mail Merge)
- Using Standard Templates (Exercise 6–Create notice using standard templates)
- Word Processing in Other Languages (Exercise 7 - Creating a notice in Marathi)

Module - II: Spreadsheet and Presentation Graphics **(8 Hours)**

- Overview of Excel
- Creating and Editing (Exercise 1 – Creating attendance sheet)
- Using Charts (Exercise 2 – Creating a chart)
- Managing a Workbook (Exercise 3 – Managing Attendance Sheet)
- Overview of Presentation Graphics
- Creating a Presentation (Exercise 1 – Creating a Annual Day Presentation)
- Modifying and Refining a Presentation (Exercise 2 – Modifying and Refining Presentation)
- Using Advanced Presentation Features (Exercise 3 – Advanced Features for Presentation)

Module - III: Database Management Systems **(8 Hours)**

- Overview
- Creating a Database (Exercise 1 – Creating a Student Database)
- Modifying a Table (Exercise 2 – Modifying a Student Database)

- Creating Forms (Exercise 3 – Creating Form for Student Database)
- Queries and Reports (Exercise 4 – Creating Report)
- Protecting the Database (Exercise 5 – Protecting a Student Database)

Module - IV: Internet **(8 Hours)**

- Internet Basics
- Navigating the Web (Exercise 1 – Navigating the web site)
- Finding Information on the Web (Exercise 2 – Searching result on the web)
- Communication Using E-Mail (Exercise 3 – Communicate result to your friends)

Module - V: Tutorials, assignments and presentation based on Module I to IV **(6 Hours)**

References:

1. Microsoft Office Word 2007 a Beginners Guide: A Training Book of Microsoft Word 2007, By W.R. Mills, United States of America, Bloomington, Indiana.
2. Microsoft Office Word 2007: Illustrated Co: Illustrated Complete, By Jennifer A. Duffy, Carol M. Cram
3. Sams Teach Yourself Microsoft Office 2007 All in One, By Greg Perry
4. Microsoft Office Excel 2007: Comprehensive Concepts and Techniques, By Greg B. Shelly, Thomas J. Cashman, Jeffrey J. Quasney.
5. Microsoft Office Power Point 2007: Illustrated Introductory: Introductory, By David Beskeen
6. Microsoft Office Power Point 2007: Top 100 Simplified Tips & Tricks, By Paul McFedries.
7. Microsoft Office Access 2007: Comprehensive Concepts and Techniques, By Thomas J. Cashman, Philip J. Pratt
8. New Perspectives on Microsoft Office Access 2007, Comprehensive, Joseph J. Adamski, Kathleen T. Finnegan
9. Basic Internet, By O.H.U. Heathcote
10. Microsoft Office 2007 Power Point: A Training Book for Microsoft Power Point 2007, By W. R. Mills

VOC 103 Auto Service Technician (Theory)

(2 Credits: 50 Marks)

Course Outcomes:

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

CO1	Assist senior technician in diagnosing faults in a given motor vehicle
CO2	Perform servicing and minor repairs of a given motor vehicle
CO3	Plan and organize work to meet expected outcomes
CO4	Perform effectively in teams
CO5	Maintain healthy, safe and secure working environment
CO6	Prepare report

Module I: Introduction to Automobile Industry (8 Hours)

Qualifications Pack -Occupational Standards for Automobile Industry by Automotive Skill Development Council (Auto service Technician Corresponding ASC/N 0003)

Module II: Functioning of various components and aggregates of the vehicle (6 Hours)

Qualifications Pack -Occupational Standards for Automobile Industry by Automotive Skill Development Council (Auto service Technician Corresponding ASC/N 1402)

Module III: Assessing service and repair requirements (6 Hours)

Qualifications Pack -Occupational Standards for Automobile Industry by Automotive Skill Development Council (Auto service Technician Corresponding ASC/N 1402)

Module IV: Interaction with Co-workers and Colleagues (6 Hours)

Qualifications Pack -Occupational Standards for Automobile Industry by Automotive Skill Development Council (Auto service Technician Corresponding ASC/N 0002)

Module V:Tutorials, assignments and presentation based on Module I to IV (4 Hours)

References:

1)Automotive Mechanics: William H. Crouse. Donald L. Anglin: Tata McGraw Hill 10th edition.
2) Automotive Electrical Equipment: P L Kolhi: Tata McGraw Hill.
3) Basic Automobile Engineering: C P Nakara: Dhanpatrai publication.

VOC 104 Auto service technician (Practical) (2 Credits: 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain various precautions to be taken to avoid damage to the vehicle and its components while working on diagnosis or troubleshooting the vehicle for any faults
CO2	ensure all workshop tools, equipment and workstations are adequately maintained by carrying out scheduled checks, calibration and timely repairs where necessary
CO3	identify the auto component manufacturer specifications related to the various components/ aggregates in the vehicle,
CO4	record all service and repairs carried out and ensure completeness of tasks assigned before releasing vehicle for the next procedure
CO5	Analyze carry out adjustments, replacement of vehicle components and replenishment of consumable materials following the manufacturer's current specification for the particular maintenance interval, working methods and procedures, use of equipment, the tolerances for the vehicle
CO6	Plan for how suspension systems, steering systems, braking systems, non-electrical body systems, wheels and tyres operate for the type of vehicle on which you are working (including regenerative braking systems and other energy recuperation systems used on hybrid / electric and alternative fuel vehicles)

As Per Automotive skill development council Corresponding ASC/N 0003, ASC/N 1402, ASC/N 0002.

VOC 105 Occupational Practice Essentials

(2 Credits: 50 Marks)

Course Outcomes

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

1	Define Inventory Management, quality management, recognize Manufacturing practices, Define of Project, Jobs, Events - Arrow Diagrams - Time Analysis and Derivation of the Critical Path.
2	Explain the effect of demand uncertainty, Risk pooling, A single warehouse inventory example
3	Apply Kaizen, T.P.M., S.M.E.D., 5-S Principles, Housekeeping, Kanban, Poka -Yoke, JIT as tools for better productivity
4	Distinguish centralized versus decentralized systems, plan JIT manufacturing and Lean manufacturing through waste elimination.
5	Test Problem solving tools such as- seven Tools for quality control such as Pareto charts, Check sheets, Cause and effect diagram, Scatter diagrams, Histogram, Graphs or flow charts, Control charts
6	Prepare Shortest Route Problem, develop Project Planning & Control by use of CPM/PERT Concepts

Module 1 - Inventory Management (8 Hours)

Introduction, A single warehouse inventory example, The economic lot size model, The effect of demand uncertainty, Risk pooling, Centralized versus decentralized systems, Managing inventory in the supply chain.

Module 2 – Manufacturing Tools (6 Hours)

Total productivity through such practices- Kaizen, T.P.M., S.M.E.D., 5-S Principles, Housekeeping, Kanban, Poka -Yoke, JIT, JIT manufacturing and Lean manufacturing through waste elimination.

Module 3 – Quality Management (6 Hours)

Introduction and evolution of quality movement, Problem solving tools such as- TQC Tools – problem solving, TQC Tools – Management, Quality Improvement and Total Employee Involvement

Module 4 - Network Analysis (8 Hours)

Minimal Spanning Tree Problem - Shortest Route Problem, Maximal Flow in Capacitated Network - Concepts and Solution Algorithm as Applied to Problem, Project Planning & Control by use of CPM/PERT Concepts. Definitions of Project, Jobs, Events - Arrow Diagrams - Time Analysis and Derivation of the Critical Path.

Module V- Presentation's, case studies, Assignments, Tutorials based on Module I to IV (6Hours)

Reference Text:

1. Toyota Production Systems - Taichi Ohno, Kaizen , Masaki Imai
2. Chronicles of a Quality Detective - Dr Shrinivas Gondhalekar, Payal Sheth
3. Beyond T.Q.M - By Robert L. Flood
4. T.Q.M Process - By Gopal Kanji, Mike Asher
5. Operation Research - Taha
6. Quantitative Techniques in Management – N.D.Vohra
7. Quantitative Techniques in Management – J.K.Sharma

Semester – I
Automobile

(Skill Development Components)

Skill Development Components

Automobile

VOC-131: Automobile Technology

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Demonstrate automobile vehicle components (two and four wheeler)
CO2	Differentiate and demonstrate all types of engine components
CO3	Apply knowledge of identify engine and vehicle components.
CO4	Clarify engine and vehicle specifications
CO5	Apply knowledge to for better driving skills and their safeties.
CO6	Identify various electrical equipments used in automobile.

Course Content:

Module I:Introduction to automobile (6 Hours)

History of automobile, Indian and worlds leading automobile Industries, Introduction to the Components of automobile, Classification of automobile, (Two wheeler and four wheeler) engine, Clutch, gear box, differential, axle, wheel, brake, suspension, steering, electrical components, frame, body etc.

Module II: Engine and its components (6 Hours)

Construction and working principle of I.C engine, classification of I.C engine, Construction and working of two stroke petrol engine, Construction and working of four stroke petrol engine; Difference between two stroke and four stroke engine; Petrol and diesel engine, Various rule and road signs for safety driving.

Module III: Driving Technique Technical details and vehicle (6 Hours)

Driving hints, Driving technique Technical details and vehicle specification, engine specifications and driving safety Technical details included in owners and service manual. Work, power, energy, efficiency, bore, stroke, displacement, compression ratio, IHP, BHP.

Module IV: Basic Concept of Electricity (6 Hours)

Current, Ampere, Volt, Resistance, Ohm law, potential difference, parallel circuit, series circuits Introduction of material. Classification, properties & uses of materials. Basic concept of electricity.

Module V: Tutorials, assignments and presentation based on Module I to IV (6 Hours)

References:

1) Automotive Mechanics: William H. Crouse. Donald L. Anglin: Tata McGraw Hill 10thedition ISBN: 9780070634350.

2) Automotive Electrical Equipment: P L Kolhi: Tata McGraw Hill.

3) Basic Automobile Engineering: C P Nakara: Dhanpatrai publication.

4) Automotive Mechanics: S Shrinivasan: Tata McGraw Hill Second edition

5) Automobile engineering Vol-I: Dr. Kripal Singh: Standard Publisher distributers.

6) Automobile engineering Vol-II: Dr. Kripal Singh: Standard Publisher distributers.

7) Internal Combustion Engine: V. Ganesan: Tata McGraw Hill Third edition.

8) Automobile engineering: R. B. Gupta: SatyaPrakashan

9) Automobile Engineering Vol-I: K. M. Gupta: Umesh Publication

10) Automobile Engineering Vol-II: K. M. Gupta: Umesh Publication

VOC 132 Automobile Tools and Equipments

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Define tools and equipment used in automobile workshop.
CO2	Describe method of 5 s operation.
CO3	Demonstrate use of measuring and marking tool.
CO4	Selection of proper tools and equipment for prescribed operation.
CO5	Recommend tools and equipment for different automotive application

Module I:Introduction of work shop, General Tools and Equipments:- (6 Hours)

Introduction of work shop, work shop ethics, discipline, safety precaution, elementary first aid, workshop lay out, 5's' techniques. Introduction and use of various tools and equipment used in work shop.

Module II: General and Special Tools (6 Hours)

Hammers, Chisels, Screw drivers, Torque Wrench, Adjustable wrenches, Wheel nut spanners, Punches, Pliers, Files, Spanner, Allen keys, Taps, Hacksaws, Dies, Reamers, Scrapper, Cleaning tools

Module III: Measuring and Marking Tools (6 Hours)

Inside caliper, outside caliper, Vernier caliper (Inside/Outside), Micrometer (Inside/Outside), Height gauge, bore gauge, Compression gauge, Vacuum gauge, Try square, Feeler gauge, Tachometer, AVO meter, Surface plate, Angle plate, Scribing block, Height gauge, Dial indicator, 'V' Block etc.

Module IV: Automotive Equipments (6 Hours)

Mechanical & Hydraulic Jack, Piston ring compressor, Piston ring expander, Stud extractor, Valve spring lifter, Tap extractor, Tyre remover, Wheel balancing Equipment, Brake testing equipment, Pullers,Filter wrench, Battery tester, Growler, Hydrometer spark plug tester, coil and condenser tester, Bench vice, Spray gun, Painting process and Tools etc.

Module V: Tutorials, assignments and presentation based on Module I to IV (6 Hours)

References:

1. Workshop Technology Vol-I: B. S. Raghuwanshi: Dhanpat Rai& Co.
2. Automobile engineering Vol-I: Dr. Kripal Singh: Standard Publisher distributers.
3. Engineering Metrology, R.K. Jain, Khanna Publisher Delhi.
4. Workshop Technology Vol- I ,W.A.J. Chapman.

VOC 133 Workshop Technology

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Define Manufacturing Machines used in automobile workshop.
CO2	Describe method of Wheel Alignment machine. Wheel balancer machine.
CO3	Demonstrate use of General Purpose Machine and its Cutting tools.
CO4	Demonstrate use of Special Purpose Machines in manufacturing industry.
CO5	Selection of manufacturing process and Machine for prescribed operation.
CO6	Recommend Machines and equipment for different automotive application.

Module I: Introduction of General machineries (6 Hours)

Introduction, working, Construction and use of machines: - Lathe, Milling, Shaper, Drilling, Grinding, Welding machine (Arc/Gas), Soldering and Brazing, air Compressor, Fly press, Pipe bending Machine, Wheel alignment machine, Wheel balancer Machine, F.I pump testing bench, Tyre changer Machine, Tyre inflection Machine, Decarburizing Machine.

Module II: General Purpose Machines (6 Hours)

Lathe machine, types of Lathe machine, Construction of Lathe, Thread cutting mechanism, Accessories and attachments, Lathe operations, Taper turning, Milling machine, Milling Methods, Types of Milling machine, operations on milling machine

Module III: Special Purpose Machines (6 Hours)

Drilling machine, Construction of drilling machine, Types of drilling machines, operations on drilling machine, Shaper machine, working principle of shaper machine, Types of shaper, operations on shaper machine, Planer machine, Working principle, Types of planer.

Module IV: Metal Joining Methods (6 Hours)

Welding, Electrodes, Gas Welding, Oxy fuel gas welding, MIG, TIG, SAW, SMAW, Thermit welding, Electroslag welding, Types of joints, Riveting, Soldering, Brazing.

Module V: Tutorials, assignments and presentation based on Module I to IV(6 Hours)

References:

1) Workshop Technology Vol-I: B. S. Raghuwanshi: DhanpatRai& Co.
2) Workshop Technology Vol-II: B. S. Raghuwanshi: DhanpatRai& Co.
3) Workshop Technology Vol-I: S. K. Hajra Choudhari. A. K. Hajra Choudhari. NirjharRoy :Media Promoters and Publication Pvt.Ltd.

VOC 134: Engineering Drawing

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Distinguish between isometric drawing and orthographic drawing.
CO2	Adapt the necessary nomenclature, specifications, rules, tools required for Engineering drawing.
CO3	Interpret different types of planes.
CO4	Distinguished between Aligned and unidirectional system of dimensioning.

Module I: Introduction to engineering drawing (6 Hours)
Drawing equipments, instruments and materials, instrument types, specifications, Lines, Lettering and dimensioning, types of lines, Geometric construction, Numerals and Greek alphabets, Dimensioning methods.

Module II: Projections of point, Lines and Planes (6 Hours)
Introduction to projection, Reference planes, orthographic projections, 1stangle and 3rdangle projection and their symbols, projections of point, projections of lines, Projections of planes, Projection of planes parallel to one of the reference planes, Projection of plane inclined to one reference plane and perpendicular to another.

Module III: Orthographic Projections (6 Hours)
Types of projections-orthographic, perspective, isometric and oblique: concept and applications, Methods of projections, Conversion of simple pictorial views into Orthographic views, B.I.S. code of practice.

Module IV: Isometric Projections (6 Hours)
Isometric axis, lines and planes, Isometric scales, Isometric view and isometric drawing, Difference between isometric projection and isometric drawing, isometric view from orthographic views of objects.

Module V: Tutorials, assignments and presentation based on Module I to IV(6 Hours)

References:

1. "Elements of Engineering Drawing" ,N.D. Bhatt, Charotar Publishing House.
2. "Engineering Drawing" ,P.J.Shah, S.Chand, New Delhi.
3. "Fundamentals of Engineering Drawing" ,W.J.Luzzadar, Prentice-hall of India Pvt. Ltd.-New Delhi.
4. "Fundamentals of Drawing" ,K.R.Gopalkrishna, Subhash Publications, Banglore.
5. "Engineering Drawing" ,M.B.Shah, B.C.Rana, Pearsons.
6. "Fundamentals of Engineering Drawing" ,French & Vierck, McGraw-Hill Publication.

VOC-135: Laboratory Course-I (AU) (Automobile Technology)

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Apply knowledge on differentiating two and four wheeler vehicle
CO2	Identify various engine and vehicle components
CO3	Differentiate various types of engine their working, construction application
CO4	Apply knowledge on road safety and safe driving techniques
CO5	Apply knowledge to identify various automobile dealers, their functions, various activities under dealership

1) Demonstration on difference in two wheeler & four wheeler.
2) Demonstration of various automobile parts used in Two wheeler, Three wheeler, Four wheeler their basic function, construction & location etc.
3) Demonstration of various engine components their function, construction, location, material etc. Sketching of Various engine components.
4) Demonstration on working of two strokes and four stroke engine on cut section Model (petrol & diesel engine also used of).
5) Demonstration on difference in petrol engine and diesel engine.
6) Demonstration on difference in two stroke and four stroke engine.
7) Practice on road safety and use of road sings. Draw sketching of various road sings, prepare chart of registration code.
8) Practice on driving techniques, importance of safe driving.
9) Collection of vehicle information broacher from authorized dealer and prepare chart on technical details.
10) Prepare chart of various two and four wheeler dealers available in city - Dealer name, address, contact number, manufacturer details and their various Models.
11) Study on service manual on any one automobile vehicle model.
12) Study of electrical circuit - parallel and series.
13) Practice on using various electrical measuring equipment.
14) Visit to automobile garages/ automobile industries.

VOC 136 Lab Course on Automobile Tools and Equipments

(2 credits 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe the procedure of using general purpose tools and equipments.
CO2	Practice general safety procedure in Automobile Garages.
CO3	Practice 5 S technique
CO4	Operating special purpose automotive tools and equipments.
CO5	Checking the battery for charging, connecting the battery for charging

1) Practice on health &safety - importance of safety precaution, Shoes, Dressing, safety symbol, safety equipments.(In relation with practical No.8) Practice on how to use first aid & fire extinguishers.

2) Practice on 5.s technique.

3) Demonstration on how to use various tools used in work shop, their free hand sketching.

General tools –

Measuring tools,

Marking tools,

Special tools,

4) Demonstration on how to use various Tools and equipments used in two wheeler garage , Tools and equipments used in four wheeler garage.

5) Practice on checking the battery for charging, connecting the battery for charging

6) Demonstration on painting equipments, coating and polishing.

7) Demonstration of Decarburizing Process, smoke tester, FI pump testing, car washing, hydraulic hoist, air compressor etc.

8) Visit to Garage for usage of Tools &Equipments Used in two, three and four wheeler garage. To Various automobile dealers/ authorized work shop.

-To Automobile Industry/ Automobile components manufacturing industries.

VOC 137 Lab Course on Workshop Technology

(2 credits 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe the workshop, work done in workshop
CO2	Demonstrate use of various Machines in Automobile Industries
CO3	Examine General Purpose machines and analyze it.
CO4	Recognize special purpose machine and explain it.
CO5	Design to plan Jobs on Machining operations.

1. Introduction to the work shop, types of work done in work shop, job opportunity
2. Demonstration on various machine used in automobile industries - Compressor, Drilling, Grinding, Welding (Arc & Gas), Hand Operated & Hydraulic Operated Press, lathe, milling, Shaper machine, crank shaft grinding, cylinder boring, cylinder head refacing, honing, Wheel Alignment, Tyre changer, Wheel balancing M/c.
3. Study of General Purpose machines
4. Study of Special Purpose machines
5. Two Jobs on machining operations

VOC 138 Lab Course on Engineering Drawing

(2 credits 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Draft the orthographic view of Mechanical parts.
CO2	Differentiate between types of line used in engineering drawing.
CO3	Draft the isomeric view of Mechanical parts.
CO4	Read isometric and orthographic drawing completely.

1. Sheet based on types of lines, types of dimensioning, Numerals and Alphabets.
2. Projections of points and lines (4 problems).
3. Projection of different planes with different conditions(triangle, square / rectangular, pentagonal / hexagonal).
4. Orthographic projections of different objects. (Two problems)
5. Isometric drawings from given orthographic views (Three problems)
6. Introduction to AutoCAD Software.

Semester – II

General Academic Components

Semester II

General Education Components

VOC - 201: Linguistic Proficiency-II

(4 Credits: 100 Marks)

Part - A: English

Course Outcomes:

On completion of the course, students will be able to

1	Write notices, agendas, minutes of meetings in English and Hindi
2	Write applications for jobs, and business related letters in English and Hindi
3	Develop effective listening skills and prepare speeches, proposals and reports in English and Hindi
4	Prepare Surveys, Proposals and Projects reports in English and Hindi

Module –I: Introducing written communication (10 Hours)

1. Writing Notices
2. Drafting Agendas (Synergy)
3. Writing minutes
4. Note taking
5. Basic of spoken English

Module-II: Writing applications, letters and business Correspondence (12 Hours)

(Introducing Business Correspondence):

1. Writing applications for various jobs, referring to the ads.

2. Writing letters:

   a. Letters of inquiry
   b. Letters of order
   c. Letters of complaint
   d. Letters of indent
   e. Letters of credit
   f. Bills of lading
   (Exercises from Synergy) Orient Longman

Module- III: Introducing listening skills (8 Hours)

1. Approaches to listening skills
2. Barriers to effective listening
3. Tips for effective listening
4. Preparing for interview, Interview facing techniques
5. Preparing -

a. Speeches
b. Presentations
c. Meetings
d. Surveys
e. Report writing
f. Making Project reports
g. Preparing Proposals
h. Seeking financial assistance / loan for your proposal

References:

1) Synergy: Communication in English and study skills (Orient Blackswan) – (2008)
2) Macmillan foundation English – R. K. Dwivedi, A. Kumar: Macmillan India Ltd. 2001
3) Mastring Communication – Nicky Stanlon: Palgrave Macmillan (2009)
4) Scientists must write – Robert Barrass: Routledge Publication, London
5) Functional Grammar and Spoken and Communication in English – Bikram K. Das: Orient Longman Publication (2006)

PART-B: BASIC STRUCTURE OF THE HINDI LANGUAGE

(ON NEXT PAGE…………..)

Part-B: Hindi

संप्रेषणमूलक व्यावसायिक हिंदीः

Module- IV:

वाणिज्य व्यवसाय और हिंदीः

- वाणिज्य व्यापार से तात्पर्य एंव व्यावसायिक व्यापार के साधन

- वाणिज्य व्यापार और भाषिक प्रकार्य

- वाणिज्य-व्हावसायिक संरचनात्मक विशेषताएँ

- भाषा कौशल्यः

  श्रवण, भाषण, वाचन, लेखन

व्यावसायिक - संप्रेषणः

- संप्रेषण के तात्पर्य एवं स्वरुप
- संप्रेषण के प्रमुख प्रकारः भाषिक तथा भाषेतर
- व्यावसयिक पत्राचार

क) व्यापारिक- व्हावहारिक सामाण्यपत्रा, आवेदनपत्र, यासाखपत्रा, संदर्भ तथा साखपत्रा के जाँचपत्रा, मुल्य ज्ञापनपत्र, आदेशोके निरसन सम्बंधीपत्रा, शिकायतपत्रा, समायोजनपत्र, तगादायावसूलीपत्र, विक्रय प्रतिनिधत्व संबंधीपत्र,

ख) विशेष व्यावहारिकपत्रः

-बीमातथाबीमा - पत्र

-रेल तथा जहाज द्वारा माल परिवहन से संबंधितपत्र

ग) प्रकल्प / सर्वेक्षण / प्रात्यक्षिकः

- भाषिक कौशल्य अभ्यास

- वाणिज्य - व्हावसायके भाषिक प्रकार्या कासर्वेक्षण

- व्यापरिक संप्रेषण - पत्रलेखन का अभ्यास

सहायक ग्रंथः-

१. व्यावसयिक संप्रेषणः डॉ. अनूपचंद्र मायानी, राजपाल एण्ड संस, नईदिल्ली

२. भाषाशिक्षणःसिध्दांतऔरप्रक्रिया - मनोरमागुप्त, केंद्रियहिंदीसंस्थान, आगरा

३.मीडियालेखनः सिध्दांतऔरव्यवहार - डॉ. चंद्रप्रकाश

४. व्यावसायिकहिंदी - डॉ. दिलीपसिंह, वाणीप्रकाशन, काशन, नईदिल्ली.

५. संप्रेषणमूलक व्यावसायिक हिंदी - डॉ. माधवसोनटक्केः ओरियण्ट ब्लैक स्वाईन, दिल्ली.

VOC – 202: Computer Fundamentals-II
(Basic Computer Hardware System)

(2 Credits: 50 Marks)

Course Outcomes:

On completion of the course, students will be able to

1	Define and Discuss Basic architecture, hardware aspects, peripherals (memory, input/output devices) of Computers
2	Explain step by step hardware assembly of Computers
3	Compare printer categories, describe printing principles and types of scanners
4	Describe hardware features, maintenance basics and develop wi-fi network related troubleshooting skill with laptops
5	Assemble a desktop computer and install operating system/ softwares , while identifying components in Bios set-up and address problems related to installation

Module-I: Computer Architecture (6 Hours)

Computer Architecture, Mother Board and its all components, Computer Components (Input/ Output Devices, Primary and Secondary Memory, Power Supply, Monitor).

Observation of all parts of Floppy drives, HDD, CD, and SMPS. Identification of cables and computers. Mounting Motherboard in cabinet, Installation of cards, devices and then connecting cables. Fitting of cabinet. CMOS – Setup, Troubleshooting.

Module-II: Computer Assembling (6 Hours)

Computer Assembling, Make your own Computer, Operating System Installation, Windows Vista, Software Installation, Trouble Shooting, Bios Setups, Identifications of Components. Advanced Trouble Shooting and Maintenance.

Module-III: Printers and printing mechanism (6 Hours)

Types of printers and printing mechanism, How printer works, Inject printer, working of laser printer, Fonts/Type faces, Trouble shooting printers. Types of Scanners and its used.

Module-IV Introduction to Laptops (6 Hours)

Introduction to Laptops, Portable System background, System Features, Processors, Mother Boards, Memory, Power, Expansion Bus, Hard Disk & Removable Storage Devices, Laptop Components, Laptop Maintenance & Assembling, Linux, Multimedia, Internet, Computer VIRUS, Wi-Fi Network Trouble Shooting.

Module V : Tutorials, assignments and presentation based on Module I to IV (6 Hours)

REFERENCES:

(01) Hardware bible By : Winn L Rosch, Techmedia publications

(02) Trouble shooting, maintaining and repairing PCs By : Stephon J Bigelow Tata McGraw Hill Publication

(03) Modern All about printers By :Manohar Lotia, Pradeep Nair, BijalLotia BPB publications.

(04) The complete PC upgrade and maintenance guide By : Mark Minasi, BPB Publications

VOC – 203: Computer Fundamentals-II (Basic Computer Hardware System)

(2 Credits: 50 Marks)

1. Handling of all Computer Peripherals
2. PC Troubleshooting
3. Windows Installation
4. PC Assembling
5. Fault finding in PC and recovering
6. Installation and use of Printers and Scanners
7. Fault Finding and Troubleshooting on Laptop

Rather than performing a certain prescribed number of experiments, this laboratory coursework is meant for providing sufficient hands on practice of the students with computer. However, for purpose of evaluation, at least six experiments, more or less equally divided from above listed sectors, are to be performed.

VOC 204: Environment Management

(4 Credits: 100 Marks)

Course Outcomes:

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

1	Discuss Ecosystem and Natural Resources
2	Describe impact of Pollution on human beings and nature
3	Infer role of human being in pollution and waste management
4	Discuss Biodiversity and Relate necessities for conservation of nature
5	Describe issues related to urban environment, sustainability and sustainable development

Module - I: Ecosystems and Natural Resources (8 Hours)

Introduction: Introduction and scope of environmental science; Need of public awareness.

Ecosystem: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Natural Resources: Land resources and landuse change; Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity; Water: Use and over-exploitation of surface and ground water, floods, droughts; Energy resources: Renewable and non-renewable energy sources, growing energy needs.

Module - II: Environment Pollution, Waste Management and Role of Human being (8 Hours)

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks;Case Studies: Bhopal Tragedy, Cherbonyl disaster etc.

Waste management: Control and treatment measures of urban and industrial waste; Trade in Wastes; Industrial Ecology and Recycling Industry Waste trade;

Human population growth: Impacts on environment, human health and welfare. Growth Limits. Resettlement and rehabilitation of project affected persons; case studies.

Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics

Module -III: Biodiversity and Conservation (8 Hours)

Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India; India as a mega-biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module- IV: Environment Policies & Practices (6 Hours)

Fundamentals: Sustainability and sustainable development;

Urban problems: global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act;

Environment Management System: EMS Standards, ISO 19011 & ISO 14000 Series, Bharat- II and EURO- II, Eco-Audit Scheme, Clearance/ Permission for establishing Industry

Module - V : Tutorials, assignments and presentation based on Module I to IV (6 Hours)

References:

1. Subramanian.V., ―The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book
Agency, 21st ed., Chennai, 2000.
2. C.RayAsfahl― Industrial Safety and Health managementPearson Prentice Hall,2003.
3. National Safety Council, ―Accident Prevention Manual for Industrial Operations, N. S. C. Chicago, 1988.
4. Heinrich H.W. ―Industrial Accident Prevention, McGraw-Hill Company, New York, 1980.
5. Krishnan N.V. ―Safety Management in Industry, Jaico Publishing House, Bombay, 1997.
6. John Ridley, ―Safety at Work, Butterworth & Co., London, 1983.
7. Blake R.B., ―Industrial Safety, Prentice Hall, Inc., New Jersey, 1973
8. Bharucha, E. 2003, Textbook for Environmental Studies, University Grants Commission, New Delhi and BharatiVidyapeeth Institute of Environmental Education and Research, Pune. 361.
9. Carson, Rachel. 1962. Silent Spring (Boston: Houghton Mifflin, 1962), Mariner Books, 2002
10. Economy, Elizabeth. 2010. The River Runs Black: The Environmental Challenge to China's Future.
11. Gadgil, M. &Ramachandra, G. 1993. *This fissured land: an ecological history of India*. Univ of California Press.
12. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
13. Grumbine, R. Edward, and Pandit, M.K. Threats from India‘s Himalaya dams. *Science* 339.6115 (2013): 36-37.
14. Heywood V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
15. McCully, P. 1996. *Silenced rivers: the ecology and politics of large dams*. Zed Books.
16. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
17. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
18. Pepper, I.L., Gerba, C.P. &Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic press, 2011.

Semester – II

Automobile

(Skill Development Components)

Skill Development Components

VOC-231Engine System

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe engine and its classification, various systems provided on engine, performance parameters.
CO2	Define ignition system its type, advance technology used on it, and identify various components.
CO3	Define cooling system its type, advance technology used on it, and identify various components.
CO4	Define lubrication system its type, advance technology use on it, and identify various components.

Module – I : Engine and various types of Engine (6 Hours)
Introduction to engine, Heat Engine, Classification of Engine; with respect to cylinder arrangements; with respect to ignition; with respect to method of charging, Engine components and nomenclature, Valve timing for four stroke engine, Engine performance parameters.

Module – II : Ignition System (6 Hours)
Introduction, Requirements of an Ignition system, Battery Ignition system; Battery, Ignition switch, Ballast resistor, Ignition coil, Contact breaker, Capacitor, distributor, spark plug, Operation of battery ignition system; Limitations, Magneto ignition system, Modern ignition systems, firing order, spark advance mechanism, Ignition timing.

Module – III : Cooling System (6 Hours)
Need for cooling system, Characteristics of efficient cooling system, types of cooling systems, Thermosyphon system, Pump cooling, Water pump, Radiator, Air cooled system, Comparison of Air cooled and Liquid cooled system, advantages and limitations.

Module – IV :Lubrication System (6 Hours)
Introduction, Need for Lubrication, significance of Lubrication, Pumping loss, Blowby losses, Mechanism of Lubrication, Lubrication of engine components, Types of lubrication system, Mist lubrication, Wet sump lubrication, dry sump lubrication, types of lubricants and their properties, Crankcase dilution, SAE Rating of Lubricants.

Module V: Tutorials, assignments and presentation based on Module I to IV (6 Hours)

References:

1) Automotive Mechanics: William H. Crouse. Donald L. Anglin: Tata McGraw Hill 10th edition ISBN: 9780070634350.

2) Automotive Electrical Equipment: P L Kolhi: Tata McGraw Hill ISBN 10:0074602160.

3) Basic Automobile Engineering: C P Nakara: Dhanpatrai publication ISBN-10:9352160983.

4) Automotive Mechanics: S Shrinivasan: Tata McGraw Hill Second edition ISBN10 8187433221.

5) Automobile engineering Vol-II: Dr. Kripal Singh: Standard Publisher distributers ISBN-10: 8180141969.

6) Internal Combustion Engine: V. Ganesan: Tata McGraw Hill Fourth edition, ISBN: 9781259006197.

7) Automobile engineering: R. B. Gupta: SatyaPrakashan

8) Internal Combustion Engines: Shyam K. Agrawal, New Age International Publishers.

VOC 232 Engineering Materials

(02 credits – 50 marks)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Aware of engineering materials used in automobile systems.
CO2	Explain properties of engineering materials.
CO3	Explain ferrous materials and their alloys.
CO4	Explain non-ferrous materials and their alloys.
CO5	Explain Composites and Non Metallic Materials.

Module-I: Classification and Properties of Material (6 Hours)

Introduction, Classification of Materials, Mechanical properties of metals – Strength, Elasticity, Stress, Strain, Plasticity, Malleability, Ductility, Toughness, Hardness, Brittleness, Resilience, Creep, Fatigue, Tensile test, Rockwell Hardness test, Brinell Hardness Test, Bend Test.

Module-II: Ferrous Metal and their Alloys (6 Hours)

Cast iron, Types of cast irons, properties, structures, compositions and applications, plain carbon steels, low alloy steels and effects of alloying elements like Nickel, Silicon, Chromium, Tungsten, and Molybdenum on the properties of steel, high alloy steels, stainless steel types, heat resistance steels, Shock resistance steel and their composition, application, Designation of cast iron and steel, Heat treatment- Annealing, Quenching, Normalizing, Tempering.

Module-III: Non Ferrous Metals and their Alloys (6 Hours)

Copper Alloys: Brasses – Muntz metal, Cartridge brass, Admiralty brass, Naval Brass, Bronzes – Gun Metal, Phospher Bronze, Aluminium Bronze, Copper-Nickels alloys. Bearing metals- Babbit, Copper lead alloys, Bronze bearing alloys. Light metal alloys: Aluminium alloys-Duralumin, Cast Aluminium alloys, Aluminium Silicon Alloys. Sintered Carbide., properties, applications

Module-IV: Composites and Non Metallic Materials (6 Hours)

Types of composites, plastics, Ceramics, abrasives, polymers: thermosetting and thermoplastics, Fibre, rubber and their properties and application, Smart materials, Composite materials.

Module - V: Tutorials, assignments and presentation based on Module I to IV. (6 Hours)

References:

1. V.D.Kodgire, S.V.Kodgire "Material Science and Metallurgy for Engineers"
2. Swarup D. and Saxena M.N., "Elements of Metallurgy", Rastogi Publishers, Meerut, 1994
3. Daniel Yesudian C., "Materials Science and Metallurgy", Scitech Publications (India), 2004.
4. Srinivasan N.K. and Ramakrishnan S.S., "The Science of Engineering Materials", Oxford and IBH Pub. Co., New Delhi, 1993
5. Guy A.G," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990

VOC - 233 Manufacturing Processes

(2 Credits: 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain Manufacturing processes required to manufacture different parts of automobile.
CO2	Explain Metal Casting process.
CO3	Explain Forging and Rolling Processes.
CO4	Explain Extrusion and Drawing Process.
CO5	Explain Powder Metallurgy Process.
CO6	Prepare Presentations

Course Content:

Module-I: Metal Casting (6 Hours)

Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of patterns, Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, CO_2 Moulding, continuous casting-squeeze casting, Fettling and finishing, defects in Castings.

Module-II: Forging and Rolling Processes (6 Hours)

Forging principle, classification, equipment, tooling-processes, parameters ,defects (cause and remedy) & application; Principles of rolling processes, classification, types of rolling mills, rolling mill control, effects of friction. Form rolling, rolling defects, causes and remedies

Module-III: Extrusion and Drawing Processes (6 Hours)

Classification of extrusion processes-tool, equipment, Hot working, cold working, principle of extrusion and drawing processes, influence on friction, defects, wire drawing-tool, equipment, defects(cause and remedy) & application -Tube drawing and sinking processes.

Module-IV: Powder Metallurgy (6 Hours)

Introduction to Powder Metallurgy process, preparation of powders, types & function of binders, green compaction, sintering process and its effect on the product, application of powder metallurgy products, advantages of powder metallurgy products, Sintering equipment.

Module - V: Tutorials, assignments and presentation based on Module I to IV. (6 Hours)

References:

1. Production Technology: R.K.Jain, Khanna Publishers.
2. Manufacturing Technology: Vol I, P.N.Rao, Tata McGraw Hill.
3. Manufacturing Technology: R.K. Rajput, Laxmi Publications.
4. Welding and Welding Technology: Richard L.Little, Tata McGraw Hill.
5. Principle of Metal casting- Rosenthal, Tata McGraw Hill.
6. Manufacturing Processes and Systems: Ostwald Phillip F., Munoz Jairo, John Wiley & Sons (Asia) Pvt. Ltd.

VOC 234 Engineering Drawing II

(2 credits 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Distinguish between developed and undeveloped view of drawing.
CO2	Interpret the sections of solids such as prism and pyramid.
CO3	Interpret sectional orthographic view of Mechanical parts.
CO4	Design and development of lateral surfaces for industry applications.

Course Content:

Module – I Projections of Solids (6 Hours)

Introduction, Type of solids, Projections of solids in simple position, Projection of solids with axes inclined to one of the reference planes and parallel to the other, Projections of solids with axes inclined to both H.P. and the V.P

Module – II Sections of Solids (6 Hours)

Introduction, projection of sectional view, Types of section plane, Section plane perpendicular to V.P. and parallel to H.P., Section plane perpendicular to H.P. and parallel to V.P., Section plane perpendicular to V.P. and inclined to H.P., Section plane perpendicular to H.P. and inclined to V.P., Section plane perpendicular to both H.P. and V.P.

Module – III Sectional Orthographic Projections (6 Hours)

Introduction, Cutting plane line, types of sectional view, Different types of Holes, problem on sectional orthographic projections.

Module – IV Development of Surfaces (6 Hours)

Introduction, Application of Development of surfaces in engineering products, Methods of development: Parallel line method, Radial line method, Development of prism, cylinder, pyramid and Cone.

Module - V: Tutorials, assignments and presentation based on Module I to IV. (6 Hours)

References:

1. “Elements of Engineering Drawing” , N.D. Bhatt, Charotar Publishing House.
2. “Engineering Drawing” , P.J.Shah, S.Chand, New Delhi.
3. “Fundamentals of Engineering Drawing” , W.J.Luzzadar, Prentice-hall of India Pvt. Ltd.- New Delhi.
4. “Fundamentals of Drawing” , K.R.Gopalkrishna, Subhash Publications, Banglore.
5. “Engineering Drawing” , M.B.Shah, B.C.Rana, Pearsons.

VOC-235: Laboratory Course-V (AU) (Engine System)

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Demonstrate how two stroke, four stroke engine disassemble and assemble
CO2	Demonstrate how conventional ignition and advance ignition system work and identify faults.
CO3	Demonstrate how cooling system works, locate the components and identify faults.
CO4	Demonstrate how lubrication system works, locate the components and identify faults.
CO5	Apply knowledge to replace of oil, repairing of alternator.

1. Assembly and Disassembly of 2 Stroke petrol Engine
2. Assembly and Disassembly of 4 Stroke diesel Engine
3. Demonstration of Battery Ignition System
4. Demonstration of Electronic Ignition System
5. Demonstration of Cooling system used in 4 wheeler
6. Demonstration of Lubrication System used in 2 wheeler
7. Assembly and Disassembly of Alternator
8. Overhauling of Crank case; Oil filling and replacing.

VOC 236 Two wheeler servicing

(2 credits 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Perform Assembly and disassembly of Multi plate Clutch.
CO2	Perform Assembly and Disassembly of Constant mesh gear box.
CO3	Perform Overhauling of gearbox; replacing gear oil, 4 stroke Engine; replacing engine oil.
CO4	Explain various components of Telescopic shock Absorber.

Course Content:

1. Cleaning and Washing of vehicle by using jet washer kit.

2. Assembly and disassembly of Multi plate Clutch.

3. Demonstration of Carburetor used in 2 Wheeler.

4. Assembly and Disassembly of Constant mesh gear box.

5. Overhauling of gearbox; replacing gear oil.

6. Overhauling of 4 stroke Engine; replacing engine oil.

7. Demonstration of Telescopic Shock Absorber.

8. Overhauling of Brake system used in 2 Wheeler.

VOC-237: Laboratory Course-VII (AU) (Workshop Practice)

(2 Credits: 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Perform Lap welding joint.
CO2	Perform Step turning and Taper Turning operation on lathe machine
CO3	Perform fitting shop (‘V’ Fitting)
CO4	Perform Butt welding joint.

Course Content:

1. Job on lap welding joint (50 mm x 50 mm)
2. Job on Step turning and Taper Turning operation on lathe machine
3. Job on fitting shop (‘V’ Fitting)
4. Job on butt welding joint.

VOC 238 Lab course based on Engineering Drawing II

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Draw the orthographic projections of regular solids.
CO2	Analyze the sections of solids such as prism and pyramid.
CO3	Draft sectional orthographic view of Mechanical parts.
CO4	Draft development of lateral surfaces for industry applications.

1. Sheet based on Projections of Solids.(4 problems)
2. Sheet based on Sectional Orthographic view (2 problems).
3. Sheet based on Development o Surfaces (2 problems)
4. Sheet based on section of solids. (2 problems)
5. Drawing based on Autocad Software.

Semester – III

General Academic Components

Semester III

General Education Components

VOC: 301: Linguistic Proficiency - III

(4 credits 100 Marks)

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

1	Explain and classify various types of presentation skills
2	Apply advanced concepts of grammar to formulate correct sentences and paragraphs
3	Classify various forms of written communication
4	Develop ideas and logics for effective correspondence techniques
5	Prepare scripts for comparing / conducting programme

Module- I: (1) Presentation skills: **(8 Hours)**

(a) Oral Presentation
(b) Group Discussion/Panel Discussion
(c) Speech/Lecture
(d) Visual Presentation
(e) Use of Internet
(f) Seminar Presentation
(g) Commentary/ Reporting
(h) Language of Present functions
(i) Ability to answer& questions
(j) Exercise

Module- II: (2) Grammar in Use: **(8 Hours)**

(a) Sentence Structure
(b) Verbs-Classifications
(c) Infinitive and gerunds
(d) Passivity
(e) Conditionals
(f) Concord
(g) Recapitulation of grammatical items
(h) Exercises

Module- III : Written Communication Skill: **(8 Hours)**

(a) Forms of written communication
(b) Developing ideas and logic
(c) Correspondence Techniques
(d) Writing paragraph and complete item.
(e) Exercises

(f) Writing in different forms proposals surveys, appraisals and Reports
(g) Language and grammar required
(h) Writing article/paper/news paper/media report
(i) Exercises

Module- IV: Comparing/Conducting Programmes: (8 Hours)

(a) Positive Attitude
(b) Language /Body Language
(c) Humour
(d) Mastering the terminology
(e) Exercises

Module- V : Tutorials, assignments and presentation based on Module I to IV(8 Hours)

VOC 302: Business Software Tools- I: Web Page Design

(4 credits 100 Marks)

Course Outcomes

On completion of the course, students will be able to

1	Define and Discuss Basic architecture, hardware aspects, peripherals (memory, input/output devices) of Computers
2	Explain step by step hardware assembly of Computers
3	Compare printer categories, describe printing principles and types of scanners
4	Describe hardware features, maintenance basics and develop wi-fi network related troubleshooting skill with laptops
5	Assemble a desktop computer and install operating system/ softwares , while identifying components in Bios set-up and address problems related to installation

Module- I: (8 Hours)

A. Introduction-The World Wide Web (WWW), HTML History, Hypertext and Hypertext Markup Language, Microsoft Front Page

B. HTML Documents- Dividing the document into 2 parts, Headers, Body; Tags-Format, Representing 2 types of tag (odd and even); Elements of an HTML Document -Text Elements, Tag Elements, Special Character elements

C. Structural elements of HTML documents- Header tags; Body tags- Paragraphs, Titles, Lists (Numbered lists, Non-Numbered lists, Definition lists)

D. Formatting HTML Documents- Logical styles (source code, text enhancements, variables), Physical Styles (Bold, Italic, underlined, crossed)

Module- II: (8 Hours)

A. Managing images in html- Image format (quality, size, type, …), Importing images (scanners), Tags used to insert images, Frames

B. Tables in HTML documents- Tags used in table definition, Tags used for border thickness Tags used for cell spacing, Tags used for table size, Dividing table with lines, Dividing lines with cells; Cell types- Titles cells, Data cells

Module- III: (8 Hours)

A.Hypertext and Link in HTML Documents- URL/FTP/HTTP; Types of links-Internal Links, External Links, Link Tags, Links with images and buttons, Links that send email messages

B. Special effects in HTML documents- Text fonts, Sensitive Images, Tip tables; Page background- Variable, Fixed; Rotating messages (Marquee); Counters

Module- IV: **(8 Hours)**

A. Multimedia- Audio files and acceptable formats (*AIFF, AU, MIDI, WAVE*), Inserting audio files; Video files and acceptable formats (*MPEG, Quick Time, Video for Windows*)- Inserting video files, Screen control attributes (*WIDTH, HEIGHT, ALIGN*), Start control sttributes (*START, FILEOPEN, LOOP, LOOPDELAY, MOUSEOVER*).

B. Managing forms- Interactive forms; Creating data entry forms; Calling JavaScripts for modifying entered data; JavaScript Primer; Handling Form Output with JavaScript; Filling out HTML forms

Module- V: Tutorials, assignments and presentation based on Module I to IV(8 Hours)

References:

- **Special Edition Using Intranet HTML** / *Mark Surfas, Mark Brown and John Juge*
- **Dynamic HTML Web Magic** / *JefDouyer – Hayden development group*
- **HTML 4 for the World Wide Web** / *Elizabeth Castro*
- Writing HTML Tutorial by Maricopa Center for Learning and Instruction (MCLI)
- http://www.w3schools.com/html/

VOC 303: Statistical Tools: Probability and Statistics

(4 credits 100 Marks)

Course Outcomes:

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

1	Define and explain concepts regarding random variables
2	Classify types of data, Represent data in diagrammatic/graphical mode
3	Explain ogives and normal distribution
4	Discuss basic concepts, advantages, disadvantages , limitations of Operational Research,
5	Explain Linear Programming problems, Transportation problems, Assignment Problems and sequencing problems

Module- I: Probability and Random Variable (8 Hours)

Probability – Random variables – Moments – Moment generating function – Standard distributions – Functions of random variables – Two-dimensional R.Vs – Correlation and Regression.

Module- II: Statistics (8 Hours)

Collection of data, types of data, Classification and tabulation of data, Diagrammatic/ graphical representation of data, Measures of central Tendency for ungrouped data, Mean, median ,mode of ungrouped data, Brief revision of Tabulation of data, inclusive and exclusive type of tables, Histograms, frequency polygon, frequency curve, pie diagram, Ogives(Cumulative frequency graphs) Applications of ogives in determination of median, Relation between measures of central tendency, Introduction tonormal distribution, Properties of normal distribution.

Module- III: Introduction of Operation Research (OR), (8 Hours)

Origin and Development of OR, Scientific Method in OR, advantages and limitation of OR, Application of OR

Module- IV :Linear programming problems (LLP), (8 Hours)

Graphical methods, Simplex method, Transportation problem (TP), Assignment problem (AP).Sequencing Problem (SP), Game theory, Networking Scheduling by PERT/ CPM, Replacement Problem

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

References:

1. Richard Scheaffer, Madhuri Mulekar, James McClave, ―Probability and Statistics for Engineers‖, Cengage Learning, USA, 2010.

2. Gupta, S.C. and Kapur, V.K." Fundamentals of Mathematical Statistics ", Sultan Chand and Sons, New Delhi, 2011.

3. Fruend John, E. and Miller, Irwin, "Probability and Statistics for Engineering ―, Prentice Hall,
5th Edition, 1994.

4. Jay, L. Devore, "Probability and Statistics for Engineering and Sciences", Brooks/Cole Publishing Company Monterey, California, 1982.

5. Montgomery D.C and Johnson, L.A.," Forecasting and Time Series ", McGraw-Hill. 2005.

6. Anderson, O.D., " Time Series Analysis: Theory and practice ", I. North - Holland, Amsterdam, 1982.

7. Operation Research- K. Swarup, P. L. Gupta, M. Mohan; Sultan Chand & Son

8. Operation Research- Gupta & Kapur; Sultan Chand & Son

9. Operation Research- K. Swarup, P. L. Gupta ; Sultan Chand & Son

Semester – III

Automobile

(Skill Development Components)

Skill Development Components

Automobile

VOC 331 Machine Drawing

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Explain the Machine drawing and its conventions.
CO2	Explain Applications of screw and Fasteners.
CO3	Draw detail and assembly drawing of machine components

Course Content:

Module - I: Conventions in Machine Drawing **05 Hours**

Introduction to machine drawing, Standards used in machine drawing,conventional representation of machine components and materials, method of designatingand dimensioning metric thread, internal thread, external thread.

Module - II: Screw and Fasteners **07 Hours**

Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation,representation of threads, bolted joints, Riveted joints, locking arrangement of nuts, screws, washers, foundation boltsetc., keys, types of keys, knuckle joint.

Module - III: Limits, fits and tolerances **08 Hours**

Limits, Types oftolerances and fits, hole basis and shaft basis of fits, and geometricdimensioning and tolerance, surface texture, indication of surface roughness, methods of placingmachining symbols on orthographic views, Representation of geometrical and dimensional tolerance

Module - IV: Part and Assembly Drawing **04 Hours**

Introduction to assembly drawing, steps in making of assembly drawing, assembly drawing of footstep bearing, Knuckle joint, Flange coupling ,Flexible coupling , part drawing ofPiston,connecting rod, cross head, crank

Module –V Tutorials, case studies and presentation based on Module I to IV **06 Hours**

References:

1. Textbook of Machine Drawing, K C John, PHI publisher (2009) ISBN: 8120337212
2. Machine Drawing, by N. Siddeshswar, P. Kannaiah, VVS Shastry, Tata McGraw Hill
3. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India
4. Machine Drawing-K.L. Narayana, P. Kannaiah, KV Reddy-New Age
5. Machine drawing- N.D.Bhatt., published by R.C. Patel Charotar Book Stall Tulshi Sadan, StationRoad, Annad, India.
6. Machine drawing – P.S. Gill S.K. Kataria & Sons Delhi. ISBN: 9789350144169
7. Machine drawing – T.Jones.ISBN : 8170965969
8. Machine Drawing and Computer Graphics by Farazdak Haideri, Nirali Publication, fourth Edition, 2007

VOC 332 Thermodynamics

(02 credits – 50 marks)

Course Outcomes:

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

CO1	Explain the concept of various thermodynamic cycles and their applications
CO2	Explain Steam generators and their performance evaluation
CO3	Explain Types of fuels and the process of combustion

Course Content:

Module - I: First Law Of Thermodynamics **05 Hours**

System, thermodynamic equilibrium, state, thermodynamic property, process, cycle, zeroth law ofthermodynamics, energy, work, heat, first law of thermodynamics, ideal gases, applicationof first law of thermodynamics to closed and open systems, pressure-volume diagrams, steadyflow process, application of steady flow energy equation.

Module - II: Second Law Of Thermodynamics **05 Hours**

Limitations of first law, statements of second law of thermodynamics, heat engine, heat pump, refrigerator, Carnot cycle, Carnot theorem, entropy, temperature–entropy diagram, entropy changes for a closed system.

Module - III: Thermodynamic Cycles **07 Hours**

Basic Thermodynamic cycles, Air standard cycle, Rankine cycle, Carnot cycl, reversed Carnot cycle, T-S, P-H diagrams.

Module - IV: Fundamentals of Heat Transfer **07 Hours**

Modes of heat transfer, Fourier's law of conduction, one dimensional steady state conductionthrough plane and composite walls, cylinders and spheres. Heat transfer co-efficient, simple problems in fins, heat exchangers, Stefan Boltzmann law, Black body and Grey body radiation

Module –V Tutorials, case studies and presentation based on Module I to IV **06 Hours**

References:

1. R. K. Rajput – "A Textbook of Engineering thermodynamics"- Laxmi Publications (P) Ltd, New Delhi (2001).
2. Heat Transfer Principles and Applications, Biray K. Dutta, Printice hall of India, New Delhi (2003).
3. Thermal Engineering, R. Rudramoorthy, Tata McGraw Publishing Co. Ltd, New-Delhi(2003).
4. Engineering Thermodynamics, P. K. Nag, Tata McGraw Hill. (2005)
5. A textbook of Thermal Engineering, R. S. Khurmi, J. K. Gupta, S.Chand & company Ltd (2003)
6. Fundamentals of Engineering thermodynamics, E. Ratha Krishnan, Eastern Economy Edition-Prentice Hall of India Private Limited, New Delhi, (2000).
7. Thermodynamics: An Engineering approach, Yunus A. Cengel, Michael A. Boles, Third Edition(2002).
8. Heat transfer, Y. V. C. Rao, University press, Hyderabad (2001).

VOC 333 Automotive Petrol Engines

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Apply knowledge for identify petrol engine parts, construction and working of petrol engine.
CO2	Demonstrate of various combustion chambers and combustion process of petrol engine.
CO3	Identify different problems occurred due to in complete combustion of fuel.
CO4	Describe methods of fuel supply system, its components, their functions.
CO5	Describe the various advance system used on petrol engine to increase performance.

Course Content:

Module - I: S.I. Engine Construction and Operation **05 Hours**

Constructional details of four stroke petrol engine, working principle, air standard Otto cycle, actual indicator diagram, two stroke engine construction and operation, comparison of four stroke and two stroke engine operation, firing order and its significance. Port Timing, Valve Timing of petrol engines

Module - II: Combustion and Combustion Chambers **07 Hours**

Gasoline fuels and its properties, Combustion in SI engine; stages of combustion, flame propagation, rate of pressure rise,abnormal combustion, detonation, effect of engine variables on knock, knock rating. Combustionchambers; different types, factors controlling combustion chamber design

Module - III: SI Engine Fuel System **07 Hours**

Carburetor working principle, requirements of an automotive carburetor, starting, idling, acceleration and normal circuits of carburetors, Compensation, maximum power devices, constant choke and constant vacuum carburetors, fuel feed systems; mechanical and electrical fuel feed pumps.

Module - IV: Advance S.I. Engine Techniques **05 Hours**

Petrol injection system, MPFI system, Construction and working of TBI and PFI systems, Methods of fuel Injection: Sequential, Continuous, grouped, simultaneous injection, Comparison of carbureted engine fuel supply system with TBI and MPFI System, Sensors and Actuators, ECU, Electronic ignition systems, Variable Valve Timing

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. A Course in Internal Combustion engine, Mathur-Sharma, DhanpatRai Publication (2010), ISBN-10: 8189928465, ISBN-13: 978-8189928469
3. Internal Combustion Engines, K.K. Ramalingam, SCITECH, 2nd edition (2011), *ISBN*10: 8183711022 / *ISBN* 13: 9788183711029
4. High Speed Combustion Engines, Heldt.P.M, Oxford Publishing Co., New York, (1990).
5. 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.
6. Internal Combustion Engine Fundamental,JohnB.Heywood., McGraw-Hill, 1988.
7. Engineering Fundamentals of the Internal CombustionEngines,Pulkrabek, PracticeHall of India, 2003.
8. Automotive Engines, Ellinger.H.E, Prentice Hall Publishers (1992).
9. Advanced Engine Technology, Heinz Heister, SAE, 1995.

VOC 335 Laboratory Coursework based on Machine Drawing

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain Representation of Machine components and conventions.
CO2	Explain Representation of Fits, geometric tolerance and surface roughness on machine part.
CO3	Draw Assembly and Detail drawing of Piston- connecting rod, Knuckle joint, Rigid and Flexible Flange coupling.

Course Content:

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

1. Representation of Machine components and conventions.
2. Drawing of Screw, nut, bolt, fasteners and locking arrangements.
3. Representation of Fits, geometric tolerance and surface roughness on machine part.
4. Assembly and Detail drawing of Piston- connecting rod.
5. Assembly and Detail drawing of Knuckle joint.
6. Assembly and Detail drawing of Rigid and Flexible Flange coupling
7. Assembly and Detail drawing of Cotter joint.
8. Assembly drawing of Single plate Clutch.

VOC 336 Lab. Automotive petrol engine (AU)

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Examine Engine Construction and Operation: Constructional details of 4-stroke petrol engine. Working principle, Otto cycle and actual indicator diagram. Two stroke engine construction and operation
CO2	Describe four stroke and two-stroke engine operation. Firing order and its significance. SI Engine Fuel System: Carburettor working principle. Requirements of an automotive carburettor; Starting, idling, acceleration and normal circuits of carburettors, compensation, Maximum power devices, constant choke and constant vacuum carburettors. Fuel feed systems, Mechanical and electrical pumps. Petrol injection
CO3	Classify Cooling and Lubrication System: Need for cooling system. Types of cooling system, Liquid cooled system, Thermosyphon system, Pressure cooling system.

	Lubrication system, Mist lubrication system, Wet sump and dry sump lubrication. Properties of lubricants. Properties of coolants.
CO4	Distinguish between two stroke and four stroke petrol engine.
CO5	Summaries Combustion and Combustion Chambers: Combustion in SI engines, stages of combustion, Calculate Friction power, Brake power, Indicated power, etc.
CO6	Rearrange Heat Balance sheet for Multi-cylinder Petrol Engine, Multi-cylinder Petrol Engine, Electric Fuel Pump.

1. Dismantling of Multi-cylinder Petrol Engine
2. Demonstration of MPFI system.
3. Demonstration and Calibration of Electric Fuel Pump.
4. Draw Valve Timing Diagram for Petrol Engine.
5. Injector cleaning and Testing.
6. Spark plug cleaning and Testing.
7. Engine Decarburizing.
8. Trial on Multi-cylinder Petrol Engine (Mores Test).
9. Heat Balance sheet for Multi-cylinder Petrol Engine.

VOC 337Laboratory Coursework based on Automotive Diesel Engines

(02 credits – 50 marks)

List of Practical's:

1. Dismantling of Multi-cylinder Diesel Engine.
2. Demonstration of CRDI system.
3. Demonstration of Turbocharger and EGR system.
4. Draw Valve Timing Diagram for Diesel Engine.
5. Injector cleaning and Testing.
6. Engine Decarbonising.
7. Trial on Single cylinder Diesel Engine (Willians Line Testto calculate frictional power).
8. Heat Balance sheet for Multi-cylinder Diesel Engine.
9. Trial on willians line method to calculate frictional power.

VOC 338 Two wheeler Overhauling

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Perform Overhauling of clutch, 4 stroke engine, Two Wheeler gear box, Suspension system.
CO2	Perform replacement of two wheeler wheel bearings.
CO3	Perform carburetor tuning and emission testing.

1. Overhauling of Clutch.
2. Overhauling of 4-stroke Engine.
3. Overhauling of Two Wheeler gear box.
4. Overhauling of suspension system.
5. Replacement of wheel bearings.
6. Overhauling of Braking system.
7. Carburetor Tuning and Emission testing.
8. Demonstration of Two Wheeler Electric System.

Semester – IV

General Academic Components

Semester IV

General Academic Component

VOC 401: Industrial Ethics and Safety Management

(4 credits 100 Marks)

Course Outcomes

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

1	Define Ethics and Industrial Ethics, Moral Values, OHSAS-18001 Standard and OSHA
2	Differentiate between ethics, morality and etiquette, explain ethics at workplace, profession, leadership, Unethical Behavior, discuss Significance of Industrial Safety, Select Safety Instruments, Safety standards, discuss objectives of material Handling, Principles of material handling, Classification of hazards (Safety Hazard and Health Hazard),
3	Explain Experiment measures to ensure Industrial Safety, safety measures, demonstrate storage and Handling of Material and Equipment
4	State Safety Responsibility, prioritize Hazardous Industrial zones, analyze Industrial Safety and risk management
5	Interpret Measure safety inspection procedures (Safety audit, Safety survey, Safety survey, evaluate Possible consequences of security incidents,
6	Express Fire Extinguishers and its types

Course Contents:

Module I- Introduction to Industrial Ethics (8 Hours)

Industrial ethics, ethical issues in engineering practices(Legal, organizational, Individual), Importance of ethics and moral standards, religion and ethics, social and ethical responsibilities, moral dilemmas, profession, ethics at workplace, values, business ethics, ethical theories, spirituality, and leadership; Unethical behavior.

Module II- Introduction to Industrial Safety (8 Hours)

Overview of Industrial Safety Management , Need for Safety, Safety standards, Safety, Health and Environment Management Systems, Occupational Health and Safety Management Systems as per OHSAS-18001 Standard and OSHA ,Security Management of Industrial Plants ,Organization, Administration and Management Responsibility in the Field of Safety, Legal Aspects of Safety, Safe Working Practices ,Personal Protective Equipment and Protective Costumes, Storage and Handling of Material and Equipment, Safety in Transportation and Automotive Equipments, Electrical Safety, Electrical Shocks and Their Prevention

Module III- Industrial Hazards (8 Hours)

Mechanical Hazards, Chemical Hazards, Environmental Hazards, Radiation Hazards, Industrial noise, occupational damage, sound measuring instruments, noise networks, noise surveys, risk factors, non-ionizing radiations, effects, radar hazards, microwaves and radio waves, lasers, Air sampling instruments, common causes of industrial fires, dust sample collection devices. Industrial Psychology, Ergonomics and Accidents

Module IV- Control Measures for Industrial Hazards (8 Hours)

Safety in Hazardous Area, Industrial Safety Analysis, Risk Analysis and Risk Management, Industrial Noise and Noise Control Work Permit System ,Safety in Power Plants, Fire Prevention and Fire fighting in Plants ,Portable Fire Extinguishers ,Fire Detection, Fire Alarm and Fire Fighting Systems, Building Design and Fire Protection ,Plant Layout and Design Material, Safety during Project Construction, Safety Management of Plants During Commissioning and Maintenance ,Safety Training for Employees and Human Resource Development, Social Security in Industries, Insurance Policies for Project Construction, Operation and Maintenance, Important Ingredients of Health, Occupational Health, First Aid ,Exercises for Healthy Living. Occupational Health and Industrial Hygiene, Controlling Environmental Pollution, Environmental Guidelines for Power Plants and Infrastructure Development Energy, Conservation, Efficiency and Audit, Disaster Management.

Module V- Presentation's, case studies, Assignments, Tutorials based on Module I toIV (8 Hours)

References:

Text:

1. Slote L. handbook of Occupational safety and Health, John Willey and sons, Newyork.
2. Frank P Lees, Loss of Prevention in process industry , Vol 1 and 2, Butterworth-Heinemann Ltd , London.
3. R.K.Jain and Sunil S. Rao : Industrial Safety , Health and environment management systems, Khanna publishers, New Delhi 2006

Suggested Reading:

1. Grimaldi and Simonds, Safety management: ATTBS publishers, new Delhi 2001
2. Industrial safety and pollution control handbook; national safety council and associate publishers pvt. ltd; Hyderabad
3. Code of practice on Safety management :- PDF
4. http://www.saylor.org/books
5. The Business Ethics Workshop

VOC- 402: Business Software Tools

(4 credits 100 Marks)

Course Outcomes:

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

1	Discuss and apply CSS and Photoshop
2	Discuss and apply Dreamviewer and Flash
3	Explain and apply key concepts of CMS (Computer Management System)
4	Create different projects using CMS
5	Discuss and apply key concepts of hypertext processor

Course Contents:

Module I: CSS and Photoshop **(8 Hours)**

Introduction to CSS: Concept of CSS, Creating Style Sheet, CSS Properties, divs and spans, ids and classes, CSS Styling, Working with block elements and objects, working with Lists and Tables, internal CSS declarations, CSS formatting and alignment

CSS Advanced: CSS color, Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Image Sprites, Attribute sector, Creating page Layout and Site Designs, Embedded audio files

Module II: Dreamweaver and Flash **(8 Hours)**

Introduction to Photoshop: Creating new files, Resizing images, Image transformations, Levels & Color Balance, Cropping, The Ruler Tool, Zooming, History Panel, Saving & file formats.

Photoshop Advance: Selections, Extracting regions of an image, Combining images (basic), Introduction to layers, Layer styles, History panel, Setting up your workspace, Frames & Objects, Working with text, Text formatting, Paragraph formatting, Linked text frames.

Module III: Management System

Introduction of CMS is Web Development, Configuring a domain name and web hosting, Exploring CMS terminology, including open source, server-side, client side, Static HTML website, how CMS web pages are generated, Website strategy and planning, site mapping, content planning, Introduction of Joomla, Adding and displaying menus in Joomla, Linking menus to articles and other features Joomla

Dreamweaver: Dreamweaver basics, Setting up your workspace, Site management, Text formatting, Images & Media, Links, styles, Inserting Tables, Adding Frames, Rollovers, Putting it all together

Flash basics: Introduction to the Flash IDE, Creating a new project, Drawing simple vector shapes, Lines & Fills, Colors, Shape Tweens, Layers

Flash advance: Review symbols and instances, Review internal timelines, 3D rotation tool, Mask layers, Deco Brush, Custom mouse pointers

Module IV: PHP (Hypertext Preprocessor) (8 Hours)

Introduction, installation , syntax , variables, echo/print, data types, constant, string operators, if-else else if, switch, while, for, array, super globals, Form validation, form required Array Multi, Date and Time, Include, File open read, create / write, upload, Cookies, Sessions, My Sql-Connect, Create DB, Create Table, Insert Data, Prepare , select, delete and updates

References:

Text:

1. Thomas POW; 2010; HTML & CSS: The Complete Reference (Fifth Edition); Mc Graw Hill Education; USA.
2. Thomas Powell and Fritz Schneider; 2013; JavaScript: The Complete Reference Paperback (Third Edition); Mc Graw Hill Education; USA
3. Steven Holzner; 2008; PHP: The Complete Reference (Second Reprint); Tata Mc Graw Hill Publishing Company Limited; New Delhi
4. Graig Grannell; 2007; The Essential Guide to CSS and HTML Web Design; Apress
5. Nicholas C. Zakas (2012); Professional Javascript for Web Developers; John Willey and Sons (Third Edition)
6. Kogent Learning Solutions Inc; 2009; Dreamweaver Cs5 in Simple Steps by Dreamtech Press, New Delhi.

VOC 403: Fundamentals of Business and Accounting
(4 credits 100 Marks)

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

1	Describe overall concept of a business system, process of identification of entrepreneurial opportunities in business and process of setting up a business enterprise
2	Explain concepts, terminologies and Functioning of Financial Accounting
3	Elaborate Accounting terms, Equation and Journal
4	Explain and apply Voucher approach in accounting
5	Explain the terminologies and prepare trading and profit./loss account and balance sheets

Course Contents:

Module- I : Introduction to Business (8 Hours)

Concept, Nature and Scope of Business Enterprise; Concept of Business as a System; Business and Environment Interface; Entrepreneurial opportunities in contemporary business environment or emerging trends in business: Networking marketing, Franchising, Business Process Outsourcing, knowledge Process Outsourcing, Ecommerce and M-Commerce. Opportunity and Idea Generation - role of Creativity and Innovation. Feasibility study and preparation of Business Plan Basic considerations in setting up a Business Enterprise. Process of setting up a Business Enterprise.

Module- II : Introduction to Financial Accounting (8 Hours)

Accounting-An Introduction: Business transactions, Book-keeping, Accounting and its branches. Nature, functions and objectives of Financial Accounting. Accounting Assumptions-Accounting Concepts: Meaning, concepts: Matching, Accrual, Realisation and Dual Aspect Concept.

Module- III: Accounting Terms, Accounting Equation and Journal (8 Hours)

Accounting Terms-Accounting Equation Need of Accounting equation, Meaning and preparation of Accounting equation. Rules of Accounting -Journal Meaning, classification of journal into General journal and special journals (with examples). Incorporation of journal entries involving different accounts. Cash Book Meaning, types-Simple Cash Book, Two column Cash Book and Three column Cash Book.

Module- IV : Voucher Approach in Accounting and Financial Statements (8 Hours)

Vouchers and their preparation - Day Book and Subsidiary Day Books -Recording the vouchers into Day Books -Recording the Vouchers into Subsidiary Day Books -Ledger

Posting of Day Book -Posting of Subsidiary Day -Trial Balance -Errors and their Rectification .

Capital and Revenue - Preparation of Trading and Profit and Loss Account and Balance Sheet - Preparation of Trading and Profit and Loss A/c and Balance Sheet (with adjustments).

Module- V : Tutorials, assignments and presentation based on Module I to IV (8 Hours)

References:

1. Anthony, R.N., and J.S. Reece, *"Accounting Principles",* Richard D. Irwin, Inc.
2. Monga, j.R., *"Financial Accounting: Concepts and Applications",* Mayoor Paper Backs, New Delhi.
3. Shukla, M.C., T.S. Grewal and S.C.Gupta, *"Advanced Accounts",* Vol-I, S.Chand& Co., New Delhi.
4. Gupta, R.L. and M. Radhaswamy, *"Advanced Accountancy*", Vo!-I, Sultan Chand & Sons, New Delhi.
5. Maheshwari, S.N. and. S. K. Maheshwari, *"Financial Accounting",* Vikas Publishing House, N ew Delhi.
6. Tulsian, P.C., *" Advanced Accounting",* Tata Me Graw Hill, New Delhi.
7. *"Compendium of Statements and Standards of Accounting",* The Institute of C hartered Accountants of India, New Delhi.

Semester – IV

Automobile

(Skill Development Components)

<u>**Skill Development Components**</u>

<u>**Automobile**</u>

VOC 431 Fundamentals of Machines and Mechanism(AU)

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Define Rigid body and resistant body, Types of links, joints, gears, fly wheels, cams, Followers.
CO2	Explain Functions of governor, wheels, gears
CO3	Sketch Cam and follower diagram, cycloidal profile, involute profile, Calculate, Co-efficient of energy, Co-efficient of speed.
CO4	Distinguish between Cam And follower, Single slider and double slider crank chain.
CO5	Test different types of mechanism, single slider crank chain, old hams couplings, Ackerman's link, withworth return mechanism.
CO6	Design different types of gears, and its meshing, design cam and followers,

Module – I Introduction to Machine and Mechanism (6 Hours)

Rigid body and resistant body, Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Four bar chain, Slider crank chain, Quick Return Mechanism, Double slider crank chain, Steering gear mechanisms

Module – II Gear (6 Hours)

Introduction, Classification of gears, Functions of gears, Gear nomenclature: Center distance, Gear ratio, module, circular pitch, pitch circle, etc., Law of gearing, Forms of teeth, cycloidal profile, involute profile, path of contact, arc of contact, contact ratio, interference and undercutting

Module – III Flywheel and Governor (6 Hours)

Introduction, Functions of fly wheel, Types of fly wheels, Co-efficient of energy, Co-efficient of speed, Governor, Functions of governor, Types of governor – Principle, construction and working of Watt governor Porter governor, Hartnell governor, comparison between a fly wheel and governor

Module – IV Cams and Followers (6 Hours)

Introduction, Classification of cams, Followers and their classification, Brief description of different types of cams and followers with simple line diagram, Simple cam profile for uniform velocity, SHM and uniform acceleration and deceleration with Flat, knife edge and roller type follower.

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

(6 Hours)

VOC 432 Automobile Transmission

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Identify the components of transmission system.
CO2	Analyze the steering system.
CO3	Demonstrate the functional requirement of automobile transmission
CO4	Demonstrate the construction and working of Differential Mechanism

Course Content:

Module - I: Clutch, Gearbox, Propeller Shaft **08 Hours**

Introduction to transmission system, **(A) Clutch**- principle operation of clutch, friction material, classification of clutch and working, clutch adjustment, troubleshooting of clutch. **(B) Gearbox**- gear ratio, types of gear boxes, gear shifting, lubrication of gear box, troubleshooting of gear box, Automatic transmission **(C) Propeller shaft-** General aspects, types of propeller shaft, troubleshooting of propeller shaft

Module - II: Universal Joint, Final Drive, And Differential **05 Hours**

(A) Universal Joint- introduction, Construction and working of universal joint, types of universal joint, **(B) Final Drive**- introduction, classes of final drive, advantages, disadvantages **(C) Differential-** Introduction, construction, operation, types of differential, troubleshooting of differential

Module - III: Steering, Front Axle and Rear Axle **07 Hours**

(A) Steering system- Purpose of steering system, function, general arrangement, working of steering mechanism, steering gears, steering ratio, steering geometry, types of steering gear box, steering linkages **(B) front axle-** introduction, construction, types of front axle,

(C) Rear axle – introduction, types, causes of axle failure, rear axle noises, maintenance of rear axle, troubleshooting of rear axle

Module - IV: Chassis and suspension **04 Hours**

Introduction to chassis, classification of chassis, frame, body, vehicle dimension, introduction to suspension system, function, requirement and element of suspension system, spring, dampers, suspension systems, wheels and tyres

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

References:

1. 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.
2. Automobile Technology, Volume II by Kripal Singh, 2009
3. Automobile engineering, Dr. R.K.Singhal ISBN:9788185749488 Reprint 2015
4. Automobile engineering, Dr. R.K.Rajput ISBN:81700089913 Reprint 2015
5. Modern transmission A.W.Judge Chapmen and Hall std 1989

VOC-433: Auto-Electrical System

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Introduction to electrical system its fundamentals and starting system
CO2	Explain charging system its requirement, Generator (dynamo), Alternator etc.
CO3	Explain Troubleshooting of Generator (dynamo), Alternator.
CO4	Explain ignition system its purpose requirement etc.
CO5	Explain lighting and accessory system in automobile.

Course Content:

Module - I: Starting System **03 Hours**

Introduction to electrical system, fundamentals of electrical system, terminology in electrical system, starting system, battery, starting motor

Module - II: Charging System **07 Hours**

Introduction to charging system, requirement of a charging system, Generator (dynamo), troubleshooting of dynamo, Alternator A.C. Generator, working, constructional details. Troubleshooting of alternator

Module - III: Ignition System **07 Hours**

Introduction to ignition system, purpose of ignition system, requirement of ignition system, components of ignition system, types of ignition system, ignition timing, troubleshooting of ignition system

Module - IV: Lighting and Accessory system **07 Hours**

Introduction, main circuit of automobile electrical system, lighting system, lighting switches, indicating light, Accessories, fuel gauge, horns, direction indicator, water temperature gauge, speedometer, odometer, ventilating system, air conditioning system, troubleshooting

Module -VTutorials, case studies and presentation based on Module I to IV 06 Hours

References:

1.Automotive Engines, William H. Crouse(Author), Donald Anglin(Author), McGraw-Hill Education (ISE Editions); (1994), ISBN-10: 0071138846, ISBN-13: 978-0071138840.

2. Ken Layne , Automobile electrical system , vol I 1989 ISBN 0471617636

3.Automobile engineering, Dr. R.K.Rajput ISBN:81700089913 Reprint 2015

4. Narang GBS " Automobile Engineering Khanna publication New Delhi

VOC 434 Automobile Systems

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain Fuel system S.I. engine.
CO2	Explain Fuel system C.I. engine.
CO3	Explain Lubrication system and cooling system, necessity of engine cooling.
CO4	Explain Braking System and its type.

Course Content:

Module - I: Fuel system- S.I. engine **06 Hours**

Introduction to Carburetion and carburetors, induction system, factors influencing carburetion, distribution, simple carburetor, types of carburetor, theory of carburetor

Module - II: Fuel system- C.I. engine **06 Hours**

Introduction to fuel injection system, functional requirement of a injection system, function of fuel injection system, fuel pump and fuel injector, types of nozzle and fuel spray pattern, engine starting system, trouble shooting of fuel system, troubleshooting of carburetors

Module - III: Lubrication system and cooling system **06 Hours**

Effect of engine parameter on engine friction, determination of engine friction, lubrication and lubrication system, crankcase ventilation, necessity of engine cooling, cooling air and water requirement, specification of cooling system of an engine, troubleshooting of cooling system.

Module - IV: Braking System **06 Hours**

Introduction, necessity, function, requirement, classification, factor controlling the stop of an automobile, arrangement of brake in different vehicles, Vacuum assisted brake, Eddy current brakes, brake tester, troubleshooting

Module -VTutorials, case studies and presentation based on Module I to IV 06 Hours

References:

1.Automobile engineering, Dr. R.K.Rajput ISBN:81700089913 Reprint 2015
2. Automotive Engines, William H. Crouse, Donald AnglinDonald L. Anglin, McGraw-Hill Education (ISE Editions); (1994), ISBN-10: 0071138846, ISBN-13: 978-0071138840.
2. Automotive Engines, Ellinger.H.E, Prentice Hall Publishers (1992).
4. Advanced Engine Technology, Heinz Heister, SAE, 1995.
5. Narang GBS " Automobile Engineering Khanna publication New Delhi

VOC 435 Lab course based on Automobile Transmission

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Assemble and Dismantle the Single plate and multi plate clutch of automobile.
CO2	Diagnose and Repair faults in gearbox.
CO3	Assemble and Dismantle all types of steering gearbox
CO4	Demonstrate the construction and working of power steering system.

1. Assembly and Disassembly of Single plate clutch: Coil Spring, Diaphragm type
2. Assembly and Disassembly of Gearbox: Synchromesh, Constant Mesh type
3. Assembly and Disassembly of Suspension System
4. Demonstration of power steering system and various types of steering gearbox.
5. Assembly and Disassembly of Steering gear box
6. Demonstration of Differential gearbox
7. Demonstration of different types front and rear axles.

VOC-436 Laboratory Course based on Auto Electrical System

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain battery charging and its precaution and show how it works actually.
CO2	Explain of battery testing by different types of test show how it works actually..
CO3	Explain battery ignition system and its types show how it works actually.
CO4	Explain Electronic ignition system show how it works actually.
CO5	Explain lighting and accessory system in automobile.

Course Content:

1. Demonstration of battery charging and its precaution.
2. Demonstration of battery testing by different types of test.
3. Demonstration of battery ignition system.
4. Demonstration of Electronic ignition system.
5. Demonstration of different lighting and accessory system in automobile.
6. Demonstration of overall automobile electric wiring circuit
7. Troubleshooting of Starter Motor and Alternator

VOC-437 Laboratory Course based on Automobile System

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Define what is SI system, its working
CO2	Demonstration of MPFI system
CO3	Explain Air brake system
CO4	Demonstration of Trouble shooting of Hydraulic Break system
CO5	Demonstration of Trouble shooting of fuel system

Course Content:

1. Demonstration of SI engine fuel system.
2. Assembly and Disassembly of F.I.pump.
3. Demonstration of MPFI system.
4. Demonstration of CRDI system.
5. Demonstration of Air Brake system
6. Demonstration and Troubleshooting of Hydraulic Brake system
7. Troubleshooting of fuel system (SI and CI).

VOC-438 Laboratory Course based on Auto-CAD

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain Auto Cad user interface.
CO2	Explain commands used in Auto-Cad.
CO3	Explain difference between 2D and 3D drawings.
CO4	Draw 2D drawings of various machine components.

Course Content:

Any Six Autocad drawings of following machine/Automotive components

1. Coupling
2. Connecting Rod
3. Piston
4. Knuckle Joint
5. Crankshaft
6. Hexagonal headed bolt
7. Bracket
8. Hexagonal nut

Semester – V

General Academic Components

General Education Components

VOC 501: Personality Development and Stress Management

(04 credits – 100 marks)

Course Outcome:
On completion of the course, students will be able to –

1	Define and describe basic traits of personality, discover individual strength and weakness, and plan corrective and developmental exercises
2	Administer communication skills for debates, elocution, convincing skills etc., point out necessities for personal grooming, and compare among various modes of etiquettes
3	Identify and explain stress and its various forms, relate it with physiological and psychological illness.
4	Demonstrate necessities for stress management
5	Demonstrate measures for stress management

Module- I: Personality Development (8 Hours)

Basic traits of personality - Dress, address, gestures and manners; Self evaluation and development- identification of strengths and weaknesses; Overcoming hesitation and fear of facing the public; Corrective and developmental exercises - confidence building, role plays.

Module- II: Communication and Personal Grooming (8 Hours)

Advance communication skills- debates, elocution, persuasive communication, convincing Skills, conversations. Personal grooming and business etiquettes, corporate etiquette, social etiquette and telephone etiquette, role play and body language, impression management.

Module- III: Stress (8 Hours)

Meaning - Approaches to stress, Good Stress Vs Bad Stress, The individual and work. Manifestations of Stress - Stages of Stress, Signs of Stress at work, Personal types and Stress.
General sources of Stress - Stress and Health - Physiological and psychological illness.

Module- IV: Stress Management (8 Hours)

Stress Diary, Becoming change skilled, Adopting a healthy life style, Right attitude, Thought Awareness, Imaginary (Auto-genic Therapy), Learning to relax, Correct breathing, Value and goal planning, Time Management, General advice - The individual‘s ten Commandments for effective Stress management.

Module- V : Tutorials, assignments and presentation based on Module I to IV (8 Hours)

References:

1. Interpersonal Skills for Travel and Tourism - Jon & Lisa Burton - Longman Group Ltd.
2. Business Communication - Rayon and V. Lesikar, John D. Pettit, JR. - Richard D. Irwin, INC
3. Managing Stress, Ann Edworthy, Open University Press, Buckingham, Phildephia.
4. Organizational Stress, K.Hari Gopal, University Press.

General Academic Components

VOC 502 Operation Management

(2 Credits: 50 Marks)

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

1	Define Operation Management, Operations Strategy, Describe Basics of Work Study, Job Design and Work Measurement, Basics of ISO 14000 / 9000, Basics of Value Engineering & Analysis
2	Summarise Aggregate Planning, Scheduling, Project Management, express Supply Chain Management and Just-in-Time/Lean Operations, Classification of production system,
3	Illustrate Capacity Planning, Waiting Lines, Demand Management-models, , Total Quality Management, , Batch Sizing- Models- Optimization, Batch Scheduling-models-optimization ,
4	Explain Evolution of Production Systems Competitive Advantage and Time Based Competition
5	Discuss Product Decision and Analysis, Product Development, Process Selection, Process Design, Process Analysis, Process-Product Matrix, and Capacity Decisions
6	Develop Facility Location, Facility Layout, and Resource Planning-models

Module I Introduction to Operation Management (8 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 Decision and Analysis (6 Hours)

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

Module III Demand and Supply (8 Hours)

Demand Management-models, Resource Planning-models, Total Quality Management, Supply Chain Management and Just-in-Time/Lean Operations.

Module IV Introduction to Planning and Scheduling (8 Hours)

Aggregate Planning, Basics of MRP / ERP, Basics of Scheduling, 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 (6 Hours)

Reference text:

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 – KanishkaBedi– Oxford
8. Production & operation Management – R.C. Manocha
9. Production & operation Management – Muhlemann

VOC- 503: Business Communication

(4 Credits 100 Marks)

Course Outcomes:

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

1	Explain characteristics of successful communication, communication structure in organization
2	Apply communication as a tool to resolution of conflicts
3	State and use principles of effective writing
4	Discuss analyze and present a case study
5	Categorize communication areas and construct monologues/ dialogues for effective communication as per situation

Module- I: Introduction (8 Hours)

Meaning & Definition, Classification, Role; Characteristics of successful communication – Importance of communication in business – Communication structure in organization – Communication in conflict resolution - Communication in 31 crisis. Communication and negotiation. Communication in a cross-cultural setting. Personality and Emotion interference.

Module- II: Writing Skill and Case Analysis (8 Hours)

Principles of effective writing – Approaching the writing process systematically: The 3X3 writing process for business communication: Pre writing – Writing – Revising – Specific writing features – Coherence – Electronic writing process. Writing routine and persuasive letters – Positive and Negative messages Writing Reports, Writing memos

Different types of cases – Difficulties and overcoming the difficulties of the case method – Reading a case properly (previewing, skimming, reading, scanning) – Case analysis approaches (Systems, Behavioural, Decision, Strategy) – Analyzing the case – Dos and don‘ts for case preparation – Discussing and Presenting a Case Study

Module- III: Employment Communication and Negotiation (8 Hours)

Introduction – Composing Application Messages - Writing CVs – Group discussions – Interview skills Impact of Technological Advancement on Business Communication – Technology-enabled Communication - Communication networks – Intranet – Internet – e mails – SMS – teleconferencing – videoconferencing

Negotiation – Nature and need for negotiation – Factors affecting negotiation – Stages of negotiation process – Negotiation strategies

Module- IV: Group Communication (8 Hours)

Meetings – Planning meetings – objectives – participants – timing – venue of meetings – leading meetings. Meeting Documentation: Notice, Agenda, Resolution & Minutes. Seminars –

workshop – conferences Media management – The press release – Press conference – Media interviews Etiquette Advantage in Business Communication

Module- V : Tutorials, assignments and presentation based on Module I to IV (8 Hours)

References :

1. Business Communication : Concepts, Cases And Applications – Chaturvedi P. D, & Mukesh Chaturvedi ,2/e, Pearson Education, 2011
2. Business Communication: Process And Product – Mary Ellen Guffey, 3/e, Cengage Learning, 2002.
3. Communication – Rayudu C. S, Himalaya Publishing House
4. Business Communication – Lesikar, Flatley, Rentz & Pande, 11/e, TMH, 2010
5. Advanced Business Communication – Penrose, Rasberry, Myers, 5/e, Cengage Learning, 2004
6. BCOM – Lehman, DuFrene, Sinha, Cengage Learning, 2/e 2012
7. Business Communiacation – Madhukar R. K, 2/e, Vikas Publishing House.
8. Effective Technical Communication - Ashraf Rizvi M, TMH, 2005.
9. Business Communication - Sehgal M. K & Khetrapal V, Excel Books.
10. Business Communication – Krizan, Merrier, Jones, 8/e, Cengage Learning, 2012.
11. Basic Business Communiaction – Raj Kumar, Excel Books, 2010

General Academic Components

VOC 504 Production Engineering

(2 credits-50 Marks)

Course Outcomes:

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

1	Define Types of production systems, describe Productivity and its Importance , memorize the concept of cost- Fixed cost, Variable Cost etc.
2	Interpret Break even analysis, observe techniques of improving productivity, discuss material handling devices, judge factors affecting Site Selection, review Government Policies, demonstrate work Measurement and time Study, classify allowances,
3	Calculate of Breakeven point, Calculation of EOQ, list methods of Inventory Management, Recording techniques of Process Chart, calculation of standard time
4	Distinguish between production and productivity , selection of plant layout,
5	Describe Economic Batch Quantity, EOQ Model, recommend stores function , storage system , justify FIFO
6	Design Plant Layout, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout, modify Storage systems like One bin , Two bin system etc

Module I: Production System (6 Hours)

Definition , Types of production systems, Productivity - Importance , Measurement of Productivity, Techniques of improving productivity, Elements of cost- Fixed cost, Variable Cost, Break even analysis, Calculation of Breakeven point.

Module II: Plant Location, Plant Layout and Material Handling (8 Hours)

Plant Location - Importance of Site Selection, Factors affecting Site Selection, Government Policies, and relaxation for Backward Areas. Plant Layout - Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. Group Technology, Cellular layout. Material handling – Need, Principles and Types of material handling devices – conveyors , Hoist & cranes , forklift truck, trolleys, Pipes, Automated Guided Vehicles (AGV's) Selection of Material Handling systems and Devices.

Module III: Work Study and Work Measurement (8 Hours)

Method Study- Definition, Objectives, Procedure, Selection of work. Recording Techniques:- Process Charts – Outline process chart, Flow process chart, Two Hand process chart, Multiple activity chart, Flow diagram, String diagram, Travel chart. Micro motion study-Critical Examination, Principles of Motion Economy, Concept of ergonomics and workplace layout.

Work Measurement -Objectives, procedure, Time Study, Time Study Equipments. Stop Watch Time Study, Standard Time, Work Sampling, Analytical Estimating, Predetermined Motion Time Study, Allowances, Calculation of Standard Time, Concept of Merit Rating.

Module IV: Inventory Control (6 Hours)

Methods of Inventory Management Inventory Cost relationship, Deciding Economic Batch Quantity, EOQ Model, Calculation of EOQ, Concepts of discounts, Introduction of Material Requirement Planning. Stores Function – Storage systems – One bin , Two bin system, Material Issue Request (MIR), Bin card.FIFO

Module V- Presentation's, case studies, Assignments, Tutorials based on Module I to IV
(6 Hours)

References:

1. L.C. Jhamb, Industrial Management, Everest Publication.
2. James C. Rigs Production System, Planning, Analysis & Control, N.Y.Wiley& Sons.
3. O.P. Khanna Industrial Engineering and Management DhanpatRai& Sons.
4. P.C. Sharma Production Engineering
5. Kempster, Introduction to Jigs and Fixtures Design.
6. BaffnaSarin ,Modern Production and Operations Management
7. Terry Wireman, Total Productive Maintenance, Industrial press inc.
8. Taiichiohno, Toyota Production system, Productivity Press.

Semester – V

Automobile

(Skill Development Components)

<u>Skill Development Components</u>

<u>Automobile</u>

VOC 531 Vehicle Testing

(02 credits – 50 marks)

Course Outcomes:

CO1	Select a standard for TA and COP of a given entity in India
CO2	Perform testing of an engine for a given performance parameter
CO3	Perform testing of a vehicle for a given performance
CO4	Identify a standard being followed in testing a given vehicle, a system or an aggregate
CO5	Update for latest developments in vehicular standards

Module I: Introduction (5 Hours)

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

Module II: Engine, Fuel systems and Emissions testing (7Hours)

Laboratory testing of engine performance parameters: Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers, engine analyzers- for petrol and diesel engines, FIP calibrating and testing, Emission test for CO, HC, NOx, CO2, PM, etc. using exhaust gas analyzers, Orsat apparatus, infrared gas analyzers, Diesel smoke meter.

Module III: Vehicle Performance Testing (7Hours)

Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part load conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, Vehicle testing on chassis dynamometers: Two wheel & four wheel dynamometers, wheel alignment testing, wheel balancing, brake test, head light alignment and light intensity testing.

Module IV: Automobile testing standards (5Hours)

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

References

1) Basic of Automobile Engineering -C.P. Nakara-Dhanpatrai Publication

2) Automobile Engineering Volume 1-Dr. Kripal Singh-Standard Publisher Distributor

3) Automobile Engineering Volume 2-Dr. Kripal Singh-Standard Publisher Distributor

4) Automotive Mechanics – William H. Crouse – Tata McGraw Hill Tenth edition.

5) Automotive Mechanics – Donald L. Anglin – Tata McGraw Hill Tenth edition.

6) Automotive Electrical Equipment – P.L. Kohli - Tata McGraw Hill Tenth edition.

7) Automotive Research Association of India Research Institute of the Automotive Industry with the Ministry of Heavy Industries & Public Enterprises, Govt. of India https://www.araiindia.com/facilities_vehicle_evaluation.asp.

VOC 532 Engine Diagnostics and Troubleshooting

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Diagnoses engine faults, identify correct cause and apply remedies to remove fault.
CO2	Diagnoses cooling system faults identify correct cause and apply remedies to remove fault.
CO3	Diagnoses lubrication system faults identify correct cause and apply remedies to remove fault.
CO4	Diagnoses fuel supply system faults identify correct cause and apply remedies to remove fault.
CO5	Diagnoses electrical system faults identify correct cause and apply remedies to remove fault.

Course Content:

Module - I: Engine Troubleshooting (5Hours)

Engine causes, Failure of Engine to start, Low power and Uneven running, High oil Temperature, Improper Engine acceleration, failure of engine to idle properly, Engine stops, Engine vibrate excessively.

Module - II: Cooling and Lubrication system Troubleshooting (7Hours)

Troubleshooting of cooling system, Troubleshooting of Lubrication system, overheating, slow warm up, noisy coolant pump, thermostat fault, Low oil pressure, High oil pressure, Excess oil consumption, Defective oil filter.

Module - III: Troubleshooting of fuel supply system (6Hours)

Idling Difficulty, High fuel consumption, Lack of power, Engine splits back, Defective fuel filter, Fuel pump troubleshooting, Testing fuel pressure regulator, Fuel injector cleaning, fuel pump leaks, excessive fuel pump pressure

Module - IV: Troubleshooting of Electrical and Ignition system (6Hours)

Pre ignition, ignition delay, Magneto fails to deliver any spark, Faulty spark, Engine runs but backfires, poor contact of terminals, starter does not stop running, Wiper failure, Battery discharges quickly, Alternator noise, Starter run but pinion will not mesh, solenoid switch.

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

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.

VOC 533 Metrology

(2 credit 50 Marks)

Course outcomes:

Upon completion of this course, the Students can.

CO1	demonstrate different measurement technologies and use of them in Industrial Components
CO2	Explain correct procedure to be adopted to measure the dimension of the components.
CO3	Explain various Metrological equipments available to measure the dimensions of the components..

Course Content:

Module– I: Introduction to metrology (4Hours)

Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology- use of control chart.

Module– II: Linear and Angular Measurement (8 Hours)

Linear Measurement Instruments, Verniercalliper, Micrometer, Interval measurements: Slip gauges, Checking of slip gauges for surface quality, Optical flat, Limit gauges, Problems on measurements with gauge, go, no-go gauges,Advanced measuringinstruments: Total Station, Theodolite, Types Bevel protractor, clinometers, angle gauges, spirit levels, sine bar, Anglealignment telescope Autocollimator Applications

Module– III: Limits fits and tolerances (6Hours)

Interchangeability, selective assembly, limits, fit and tolerances, limit gauging, design of limit gauges, computer aided tolerance, hole basis system, shaft basis system.

Module– IV:Measurement of surface finish (6Hours)

Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

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

References:

1. Engineering Metrology – K.J. Hume, Macdonald and Co.(publisher) London

2. The Springer handbook of metrology and Testing, Czichos (Ed), 2011

3. The Metrology Hand book- Jay. L.Bucher (ed), American Society for Quality, 2004

4. Industrial Metrology – Smith GT, 2002,Spinger

VOC 532 A Heat, Ventilation, and Air conditioning (HVAC)

(2 Credits 50 Marks)

Course outcomes

At the end of the course, student will be able to

CO1	1. Explain the basic concepts of Heat, Ventilation, and Air conditioning.
CO2	2. Solve heating and cooling load calculations for different ambient conditions.
CO3	3. Equip themselves familiar with functions of refrigerating components.
CO4	4. Select refrigerant with less GWP and ODP
CO5	5. Explain the different types of fan and its characteristics

Module I: Air Conditioning Fundamentals (6 Hours)

Basic Air Conditioning System, Location Of Air Conditioning Components In A Car. Schematic Layout Of A Refrigeration System. Terminologies In HVAC: TR, COP, EER, SEER - Heat Exchanger And Its Types. Air Conditioning Components – Compressor, Condenser, Evaporator Expansion Valve.

Module II: Psychometric (6 Hours)

Properties Of Moist Air, Psychometric Properties. Use Of Psychometric Chart. Psychrometric Processes In Air Conditioning Equipment. Summer Air Conditioning. Winter Air Conditioning.

Module III: Load Calculation (6 Hours)

Solar Radiation – Internal Heat Gains, Humidity And Air Flow. Heating Load Estimate And Cooling Load Estimate. Psychrometric Calculations For Cooling. Selection Of Air Conditioning Apparatus For Cooling And De Humidification, Evaporative Cooling.

Module IV: Refrigerant (6 Hours)

Classification Of Refrigerants, Selection Of Refrigerants. Desirable Properties Of Refrigerant, Containers Handling Refrigerants. Tapping Into The Refrigerant Container. Ambient Conditions Affecting System Pressures.

Module V: presentation, case studies, assignments and tutorials based on module I to V

(6 Hours)

References:

1. C. P. Arora “Refrigeration and Air conditioning” – McGraw Hill Education (India) Private Limited, New Delhi

2. William H. Crouse and Donald I. Anglin - “Automotive Air conditioning” - McGraw Hill, 1983 Reference Books/Other Reading Material

3. Paul Weiser - “Automotive Air Conditioning” - Reston Publishing Co., Inc., - 1990

4. MacDonald, K.I., “Automotive Air Conditioning” - Theodore Audel series – 1978

VOC 534 Hydraulics and Pneumatics

(02 credits 50 Marks)

CO1	Explain basic properties of fluid, important principles of hydraulics with their applications and hydraulic devices used in practice
CO2	Explain construction & working of Elements of Hydraulic and Pneumatic system.
CO3	Carry out troubleshooting and maintenance of Hydraulic & Pneumatic Systems.

Course Content:

Module –I: Introduction to fluid power (05 Hours)

Classification, application in various fluids of engineering, varioushydraulic 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)

Elements of Pneumatics, Pressure control, direction control, flow control valves, pilot operated, relief, pressurereducing, quick exhaust, sequence valves, meter-in andmeter-out circuit and flow through circuit, Electro hydraulics,Types of direction control valves, Actuators – linear and rotary

Module –III: Pneumatic System elements (07 Hours)

Elements of Pneumatics, Application of pneumatics, physical principles, basic requirement of pneumatic system, Comparison with hydraulic systems, Air compressors, Pneumatic control valves, Pneumatic circuits – Basic pneumatic circuit

Module –IV: Automotive Applications, Maintenance and troubleshooting: **(05 Hours)**

Hydraulic tipping mechanism, power steering, fork lift hydraulic gear, hydro-pneumatic suspension Maintenance and trouble shooting of hydraulic & pneumatic circuits, pneumatic sensors and applications.

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

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. ShanmugaSundaram, 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

VOC 531 A Fuel Testing and Standards

(2 credits- 50 marks)

Course outcomes

At the end of the course, student will be able to

CO1	Explain the different types of fuels used in automotive industry and importance of fuel testing.
CO2	Explain Regulations and different Standards, A retrospection of fuel quality improvement and related amendments
CO3	Explain Properties of fuels influencing IC engine performance.
CO4	Explain testing methods for gasoline and diesel.
CO5	Explain testing methods for biodiesels, CNG and LPG.

Module 1: Automotive Fuels (6 Hours)

Petroleum, Diesel, CNG- sources and composition. LPG, Alcohol and biodiesels –sources and composition. Reformulated fuels and additives-Types and Use. Importance of fuel testing – An overview of the different standards available for fuel testing-EN, ASTM, ISO, JIS BIS.

Module 2: Reference and Commercial Fuels (6 Hours)

Technical Specification of Reference Fuel for Testing Vehicles -Gasoline, Diesel, CNG, LPG. Comparison of the Specification of Commercial Gasoline And Commercial Diesel For Different Bharat Stage Norms. Fuel Quality Improvement Accomplished In India, Fuel Quality Compliance Issues- Fuel Testing, Presumptive Liability, Fuel Registration And Tracking-A Comparison In Fuel Testing and Standards India, USA And Japan. Inhibiting Factors In Fuel Quality Improvement In India

Module 3: Fuel Properties. (6 Hours)

Properties Of Different Fuels-Volatility, Oxidation Stability, Octane And Cetane Rating. Calorific Value, Density, Viscosity, Carbon Residue Etc. Characteristic Requirements Of Different Fuels In IC Engines- Availability, Fuel Economy And Performance. Gasoline Quality Effects On Vehicle Emissions, Diesel Quality Effects On Vehicle Emissions-Ultra Low Sulphur Fuels

Module 4: Commercial Gasoline and Diesel Fuel Testing as Specified In BIS(6 Hours)

Method to determine Distillation temperatures, Research Octane Number (RON), Motor Octane Number (MON). Calorific value, Oxidation Stability, Sulphur content, Reid Vapour Pressure, Benzene, Aromatic Olefin and oxygen content. Method to determine Ash content, Carbon residue, Cetane number and Index. Distillation temperature, Flash point, Kinematic viscosity, density, calorific value. Test for sulphur and water content, Cold filter plug point, Copper strip corrosion, Oxidative stability, Polycyclic Aromatic Hydrocarbon

Module 5: presentation, case studies, assignments and tutorials based on module 1 to 5(6 Hours)

Reference Books/Other Reading Material

1. Keith owen, trevor coley "automotive fuels reference book" second edition, sae inc.,1995

2. "Motor vehicles act". ,2009, India

3. ARAI Tap Document "Document on Test Method, Testing Equipments and Related Procedures for Testing Type approval and Conformity of Production (COP)".,Ministry of Road Transport and High ways

4. Amit Sarin "Biodiesel Production and Properties "RSC Publishing ,2012

5. Sajid Zaman "Practical Handbook on Fuel Properties and Testing" Lambert Academic Publishing,2014

6. S.S. Thipse "Alternative fuels concepts technologies and developments" Jaico Publishing House

VOC 535 Lab course on Engine Diagnostic and Troubleshooting.(AU)

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Identify Various troubles related to engine and vehicle, identify various engine scanner available in Indian as well as other than Indian markets
CO2	Explain characteristics of automobile petrol engine and automobile diesel engine also Alternate fuel used in the vehicles.
CO3	Apply necessary remedies on Charging system, Fuel supply system, Ignition system and Electrical system.
CO4	Distinguish between C.I. Engine and S. I. Engine
CO5	Troubleshoot of various problem such as Charging system, Fuel supply system, Ignition system and Electrical system.
CO6	Modify new technical to solve Heavy fuel consumption, Reach and lean mixture, hard staring and cold starting,

Course Content:

1. Diagnosis of C.I. Engine Trouble by using engine scanner

2. Diagnosis of S.I. Engine Trouble by using engine scanner

3. To study the performance characteristics of automobile petrol engine

4. To study the performance characteristics of automobile diesel engine

5. To study the performance characteristics of automobile engine operated on alternate fuel

(CNG, LPG, Bio Diesel).

6. Troubleshooting of Charging System: Discharge Battery, Ammeter shows no charge, Ammeter shows overcharge

7. Troubleshooting of Fuel supply system: Heavy fuel consumption, Lean Mixture in high speed, Hard starting when engine is cold, Hard starting when engine is hot.

8. Troubleshooting of Ignition system: Engine misfire on one cylinder, Engine misfires irregularly on all cylinder

9. Troubleshooting of Electrical system: Dynamo is not produce voltage, Battery is not charge when engine is running, and Alternator makes noise when running.

VOC 536 Hydraulic and Pneumatic Lab

(2 Credits)

List of Practical's:

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

   Perform mini project on practical application of hydraulic and pneumatics.

VOC 535 A Engine and Fuel Testing Laboratory

Course outcomes

At the end of the course, student will be able to

CO1	Test the lubricants and fuels used for IC engines
CO2	Conduct the performance and heat balance test on IC engines using various dynamometers
CO3	Conduct the test of fuels

Course Contents

1. Morse test on petrol engines

2. Test for optimum coolant flow rate in IC engines

3. Energy Balance test on an Automotive Diesel Engine

4. Determination of flash and fire point of fuels and lubricating oil by different methods

5. Determination of viscosity of oil by different methods like, Redwood, Say bolt and Engler's Viscometer

6. Study and use of pressure pickup, charge amplifier, storage oscilloscope and signal analyzers used for IC Engine Testing

VOC 537
Major Project – Phase I

(02 credits)

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

Students are expected to go through review of literature on a particular technical aspect and/or pay industrial visit to identify a point of further study and research/investigation. The student (or group of students), thereafter, would propose a subject on basis of literature review and/or industrial orientations and will have to present a short seminar on his/her proposal to the board of examiners constituted by faculties of the department. If approved, he/she will be allowed to work on that particular project. Within a week after this approval, the student(s) will have to finalize their topic/subject of project and duly officiate it. During phase – I of Research/Industrial Project, it is expected that the student(s) will –

(i) build up a concrete fundamental of the concept on which they are going to work,
(ii) carry out thorough literature survey to find out scope of work in the particular field,
(iii) thereby, finalizing the topic of further study/investigation
(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 – VI

General Academic Components

Semester – VI

General Education Components

VOC 601: Foreign Language (German/Chinese/Japanese/Russian)

(4 Credits: 100 Marks)

Course outcomes

After completion of this course, students will be able to -

1	Effectively communicate read, write Hiragana and Katakana of Japanese scripts,
2	Explain basic kanjis
3	Can participate in simple Japanese conversation.

Module 1: Scripts in Japanese- Hiragana, katakana and introduction to Kanji**.**Self introduction, Daily used greetings,expressions used in the classroom**.**Introduction to Japanese Grammer **(10Hours)**

Module 2: Day,date,nos.,grammer related to place and time Counters **(12Hours)**

Module3; Introduction to adjectives and verbs **(12Hours)**

Module 4 ;Forms of adjectives ,verb tense forms **(12Hours)**

Module 5: Tutorials, Case studies and presentation based on Module I to IV **(02Hours)**

References:

Minna no nihongo I

Japanese for Busy People

Kyoukasho wo tsukuro

VOC-- 602: ENTREPRENEURSHIP DEVELOPMENT

(4 Credits: 100 Marks)

 Course Outcomes:

After completion of this course, students will be able to

1	Describe distinct entrepreneurial traits
2	Interpret the parameters to assess opportunities and constraints for new business ideas
3	Summarize a systematic process to select and screen a business idea
4	Design strategies for successful implementation of ideas
5	Prepare a business plan

Module I: **(8 Hours)**

Entrepreneur - meaning - importance - Qualities, nature types, traits, culture, Similarities and differences between entrepreneur and entrepreneur. Entrepreneurship and economic development - its importance, Role of entrepreneurship, entrepreneurial environment. Evolution of entrepreneurs - entrepreneurial promotion: Training and developing motivation: factors - mobility of entrepreneurs - entrepreneurial change - occupational mobility - factors in mobility - Role of consultancy organizations in promoting entrepreneurs

Module II: **(8 Hours)**

Small Business : Concept & Definition, Role of Small Business in the modern Indian Economy, Small entrepreneur in International business; Steps for starting a small industry, registration as SSI, Role of SIDBI; advantages and problems of SSIs; Institutional Support mechanism in India; Incentives & Facilities, Govt. Policies for SSIs

Module III: **(8 Hours)**

Setting MSMEs- location of enterprise - steps in setting - Problems of entrepreneurs - Sickness in small industries - reasons and remedies - Incentives and subsidies - Evaluating entrepreneurial performance - Rural entrepreneurship - Women Entrepreneurship.

Module IV: **(8 Hours)**

Project finance: Sources of finance – Institutional finance - Role of IFC, IDBI, ICICI, LIC, SFC, SIPCOT, and Commercial Bank - Appraisal of bank for loans. Institutional aids for entrepreneurship development - Role of DST, DICS, SIDCO, NSICS, IRCI, NIDC, SIDBI, SISI, SIPCOT, Entrepreneurial guidance bureau - Approaching Institutions for assistance.

Module V: **(8 Hours)**

Meeting the entrepreneurs, interviewing them and making a presentation.

REFERENCE

Text:

1. Vasanth Desai ―Dynamics of Entrepreneurial Development and Management‖ Himalaya
Publishing House, New Delhi, India, ISBN 10: 8184884974 ISBN 13: 9788184884975

2. N.P.Srinivasan & G.P. Gupta ―Entrepreneurial Development‖ S. Chand & Sons, New Delhi, India. ISBN 10: 8170148014 ISBN 13: 9788170148012

Suggested Reading:

1. P.Saravanavelu ―Entrepreneurship Development‖ Eskapee publications.
2. S.S.Khanka ―Entrepreneurial Development‖ S.Chand & Company Ltd.,
Satish Taneja ― Entrepreneur Development‖ ; New Venture Creation.

VOC 603 Production Management

(4 Credits: 100 Marks)

 Course Outcomes:

After completion of this course, students will be able to

CO1	Describe principles and decision analysis related to the effective utilization of the factors of production.
CO2	Describe the nature of how production management is carried out in an organization.
CO3	Analyze the efficiency and effectiveness of processes.
CO4	Describe the nature of products or services in the organization.

Module 1: Introduction: An overview of Production Management (9 Hours)

Production Management: Introduction and overview, Production Management Strategy framework, Understanding similarities and difference among products, goods and services, Historical evolution of production management-Changes & Challenges

Module 2: Product development & production strategy (10 Hours)

Product Strategy and integrated product development, Determining Product Concept, Determining Commonality, Requests for Deviation from Customer Requirements, Developing Design-to-Cost Goals, Determining Production Philosophy and Location, Process Strategy, Capacity Planning Decisions, Facilities Location Strategies

Module 3: System Design (10 Hours)

Facilities Layout and Material Handling Strategy, Develop Preliminary Manufacturing Plan, Identify New Manufacturing Technologies, Determine Product-Packaging Requirements, Develop Prototype Assembly Tooling, Determine Logistical Support Requirements,Group Technology, Flexible manufacturing system, Assembly line balancing, Project Management-CPM PERT, Line of Balance (LOB).

Module 4: Planning and managing operations (10 Hours)

Productivity Concepts: Quality Circle, Kaizen and other SGA, Statistical Quality Control, Maintenance Planning and Control (Reliability, availability, maintainability),Forecasting, Queueing Theory,

Module – V: Tutorials, Case studies and presentation based on Module I to IV(09Hours)

References:

- Aggarwal L.N, ParagDiwan (1997), Management of Production Systems, Global Business Press.
- Alan Muhlemann, John Oakland, Keith Lockyer (1978), Production and Operations Management, Mac Milan , India, IV Edition.
- Artiba and S.E Elmaghaby(1997), The Planning and scheduling of production Systems methodologies and Applications, Chapman & Hall.
- Aswanthappa K, Sridhar Bhatt K(2005), Production and Operations Management, Himalya Publishing House.

Semester – VI

Automobile

(Skill Development Components)

<u>**Skill Development Components**</u>

<u>**Automobile**</u>

Skill Development Components - Automobile (A)

VOC 631 Autotronics

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe the Electronics system for engine.
CO2	Demonstrate the usage of intelligent sensors such as MAP, CKP,CMP, Lambda.
CO3	Analyze the auxiliary system for electronics troubleshooting.
CO4	Scan the engine for diagnosis by using Engine scanner.

Module I: Basic Electronics (6 Hours)

Development of automobile electrical and electronic system, A short history, safe working practices, basic electrical and electronic principles, electronic components and circuits, basic tools and equipment, multimeter, use of multimeters.

Module II: Electronic system for Engine (4 Hours)

Electronic control of carburetion, Engine fueling and exhaust emissions, Electronic Ignition, Programmed Ignition, Distributorless Ignition, complete vehicle control system, interfacing technique for engine control

Module III: Electronics for Auxilliaries (6 Hours)

Lighting Circuits, Windscreen washers and wipers, lighting fundamentals, lighting circuits, electronic climate control, visual displays, electronic power steering, electronic stability programme

Module IV: Sensors (6 Hours)

Sensors for intelligent transport system, sensors for occupant safety, CKP Sensors, MAP sensors, CNP sensors, Lamda sensors, rain sensor, cruise control, braking control, traction control, steering and stability, ABS system

Module -V Tutorials, case studies and presentation based on Module I to IV (2 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

Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, TataMcGraw Hill, New Delhi.

VOC 632- Farm Equipments and Machinery

(2 Credits: 50 Marks)

Course Outcomes:

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

CO1	Describe the working of farm tractor, farm equipment's and machinery .
CO2	Students will be able to perform servicing and general repairing work of tractors, farm equipment's and machinery.

Module I: Farm Tractor **(6 Hours)**

Introduction, basic of tractor as major farm equipment, types of tractor, selection of tractor on basis of power, main parts and components of tractor, selection of tractor on basis of power, main parts and components of tractor, function of each part, electrical and electronic parts, tractor mounting and accessory, safety devices for tractors,

Module II: Farm Equipment **(4 Hours)**

Introduction to farm mechanization, scope, classification of farm machines, working attachment of tractors, Implements for intercultural operations, planters, paddy translators, for land developments and soil conservation.

Module III: Farm Machinery **(6 Hours)**

Classification of farm machines, elements of farm machinery, selection of machinery used for production of crops, tiller, special features, seed drill, seed cum fertilizer, drill equipments, calibration of seed drill, Tillage, Types of Tillage, Primary and secondary tillage, implements, cultivator function and objective of cultivators, types of cultivators, cultivator design.

Module IV: Servicing and repairing farm equipment & Machinery **(6 Hours)**

Basic testing tools for repairing and maintenance work their function, specification, study of various types tools and testing equipments, checking tractor for repair, Job card preparation, tractor dismantling and assembly, tractor repairing tools, test codes for performance of tractors and power tillers.

Module -V Tutorials, case studies and presentation based on Module I to IV (2 Hours)

References:

- Farm Machines and Equipments,C.P.Nakara, Dhanpat Rai Publication, ISBN 96991495.
- **Agricultural Machinery Management, Bello R.S, Bello.M.S,** Lambert Academic Publishing, ISBN-13:978-3659779299.
- Farm Machinery And Equipment, Harris Pearson Smith, ISBN-13:978-1446517406.
- **Agricultural Tractor & Machinery**, D.N.Sharma, Jain Brothers, ISBN-13: 978-8183601597.

VOC 633 - Transport Management and Safety Regulations

(2 Credits: 50 Marks)

Course Outcomes:

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

CO1	Explain the current development in transportation and logistics system.
CO2	Perform the critical analysis of transportation system and logistic strategy.

Module - I: Motor Vehicle Act 1989 and Amended Act 2016 (6 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 (4 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 for Public Transportation (6 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 (6 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 (2 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)

VOC 631 A Electric and Hybrid Vehicle

(2 credits- 50 marks)

Course outcomes

At the end of the course, student will be able to

CO1	Explain electric vehicle technology and electric vehicles
CO2	Explain the basics of hybrid and electric drive trains
CO3	Explain design calculations of hybrid system under study.
CO4	Explain the various vehicle power sources in hybrid vehicle technology

Module I: Electric Vehicle Propulsion and Energy Sources (6 Hours)

Introduction Electric Vehicles. Vehicle Mechanics - Kinetics and Dynamics, Roadway Fundamentals. Propulsion System Design - Force Velocity Characteristics, Calculation Of Tractive Power And Energy Required. Electric Vehicle Power Source - Battery Capacity, State Of Charge and Discharge, Specific Energy, Specific Power, Ragone Plot. Battery Modeling - Run Time Battery Model, First Principle Model. Battery Management System-SOC Measurement, Battery Cell Balancing. 2 C,D 1 1 7. Traction Batteries - Nickel Metal Hydride Battery, Li-Ion, LiPolymer Battery.

Module II: Electric Vehicle Power plant And Drives. (6 Hours)

Introduction Electric Vehicle Power Plants. Induction Machines, Permanent Magnet Machines, Switch Reluctance Machines. Power Electronic Converters-DC/DC Converters - Buck Boost Converter, Isolated DC/DC Converter. Two Quadrant Chopper And Switching Modes. AC Drives- PWM, Current Control Method. Switch Reluctance Machine Drives - Voltage Control, Current Control.

Module III: Hybrid and Electric Drivetrains. (6 Hours)

Introduction Hybrid Electric Vehicles, History And Social Importance. Impact Of Modern Drive Trains In Energy Supplies. Hybrid Traction And Electric Traction. Hybrid And Electric Drive Train Topologies. Power Flow Control And Energy Efficiency Analysis. Configuration And Control Of Dc Motor Drives And Induction Motor Drives. Permanent Magnet Motor Drives, Switch Reluctance Motor Drives, Drive System Efficiency.

Module IV: Electric and Hybrid Vehicles - Case Studies. (6 Hours)

Parallel Hybrid, Series Hybrid -Charge Sustaining, Charge Depleting. Hybrid Vehicle Case Study –Toyota Prius, Honda Insight, Chevrolet Volt. 42 V System For Traction Applications. Lightly Hybridized Vehicles And Low Voltage System. Electric Vehicle

Case Study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy Duty Vehicles

Module V: presentation, case studies, assignments and tutorials based on module I to V (6 Hours)

Reference Books/Other Reading Material

1. Iqbal Husain, "Electic and Hybrid vehicles Design Fundamentals", CRC Press, second edition 2013

2. James Larminie, John Lowry, "Electric vehicle technology Explained" second Edition, Wiley 2012

3. Ali Emadi, "Hand book of Automotive Power Electronics and Motor Drives", CRC Press 2005

4. Ali Emadi, Mehrdad Ehsani, John M. Muller, "Vehicular Electric Power Systems" Marcel Dekker, Inc., 2004

VOC 634 - Design of Automotive Components

(02 credits – 50 marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe basic concepts in design.
CO2	Describe functional requirements for different components of Automobile.
CO3	Determine static and dynamic loading on different components of Automobile.
CO4	Determine stresses generated due to loading in various components of Automobile.
CO5	Determine dimensions for various components of Automobile.

Course Content:

Module –I: Basic concepts for Design **(4 Hours)**

Stress, Strain, Types of Tension failure in metal, Hooks law, elastic constant, thermal stress, torsion, bending moment, twisting moment.

Module –II: Design of shafts, keys and couplings **(8 Hours)**

Types of shafts, shaft design on strength basis, shaft design on torsional rigidity basis, shaft in series and compound, keys, function of keys, types of keys, design of square and saddle keys, couplings, design procedure for muff coupling

Module –III: Bearings and Springs **(8 Hours)**

Classification of bearings, types of rolling contact bearings, selection of bearings, designation of bearings, bearing failure, hydrodynamic bearing, comparison of rolling contact and sliding contact bearing, mode of failure, life load relation for bearing, types of spring, spring stiffness, strain energy stored in spring, stress concentration factor.

Module –IV: Power Transmission Devices **(8 Hours)**

Belt drive, types of belt drive, belt tension, open and cross belt, chain drive, advantages and disadvantages of chain drive over belt drive, power transmission by chain and belt drive.

Module – V: Tutorials, Case studies and presentation based on Module I to IV (02 Hours)

References

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

VOC 632 A Intelligent Vehicle Technology

(2 credits- 50 marks)

Course outcomes

At the end of the course, student will be able to

CO1	Explain the intelligent vision system used in automobiles
CO2	Explain the architecture of intelligent transportation system
CO3	Explain adaptive control techniques of an autonomous vehicle.
CO4	Explain about the successful autonomous vehicle projects.

Module I: Introduction to Intelligent Vision System (6 Hours)

Vision Based Driver Assistance System –Vehicle optical Sensor, Laser Radar. Non-Contact ground velocity detecting Sensor, Road Surface Recognition Sensor. Vehicle Sensors for Electronic Toll Collection System. Components of a Vision Sensor System, Driver Assistance on Highways –Lane Recognition, Traffic Sign Recognition. Driver Assistance in Urban Traffic-Stereo Vision, Shape base analysis and Pedestrian Recognition

Module II: Vehicle Information System and Intelligent Transportation. (6 Hours)

Intelligent Transportation System (ITS) – Vision for ITS Communications. Multimedia communication in a car –Current ITS Communication Systems and Services. Vehicle to Vehicle and Road to Vehicle Communication Systems. Inter and Intra Vehicle Communication. VANETS-Devices-Optical Technologies and Millimeter Wave technologies.

Module III: Adaptive Control Techniques for Intelligent Vehicles (6 Hours)

Automatic Control Of Highway Traffic And Moving Vehicles. Adaptive Control Of Highway Traffic And Moving Vehicles. Adaptive Control –Gain Scheduling. Model Reference Adaptive Control. Self-Tuning Adaptive Control System Model - System Identification Basics, Recursive Parameter Estimation, Estimator Initialization. Design Of Self-Tuning Controllers –Generalized Minimum Variance (GMV) Control, Pole Placement Control And Model Predictive Control.

Module IV: Decisional Architechtures for Autonomous Vehicles. (6 Hours)

Control Architectures And Motion Autonomy –Deliberative Architectures, Reactive Architectures, Hybrid Architectures.. Overview Of Sharp Architecture, Models Of Vehicles. Concepts Of Sensor Based Maneuver, Reactive Trajectory Following, Parallel Parking, Platooning. Main Approaches To Trajectory Planning, Non-Holonomic Path Planning.

Module V: presentation, case studies, assignments and tutorials based on module I to V

Reference Books/Other Reading Material

1. Ljubo Vlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", ButterworthHeinemann publications, Oxford, 2001-ISBN 0 7506 5093 1

2. Ronald K Jurgen, "Automotive Electronics Handbook", Automotive Electronics Series, SAE, USA, 1998. Reference Books/Other Reading Material

3. Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei "Autonomous Vehicles Intelligent Transport Systems And Smart Technologies",Nova Publishers-2014–ISBN-978-1-63321-326-5

VOC 635 Laboratory Coursework based on Wheel Balancing and Wheel Alignment

(2 Credits: 50 Marks)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain static and dynamic balancing.
CO2	Explain Castor, Camber, Toe-in and Toe-out.
CO3	Carry out balancing of tyres.
CO4	Carry out 3D wheel Alignment of automobiles.

List of Practical:

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.

VOC 635 A Suspension system laboratory

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain Suspension system.
CO2	Explain Castor, Camber, Toe-in and Toe-out.
CO3	Carry out replacement of worn out ball joint..
CO4	Carry replacement of worn out suspension components of automobiles.

1. Remove strut and spring assembly and dissemble strut and spring.

2. Assemble strut and spring and install strut and spring assembly.

3. Install strut cartridge off car.

4. Ball joint replacement.

5. Steering knuckle removal, MacPherson strut front suspension.

6. Remove and service rear suspension strut and coil spring assembly.

VOC 636 : Laboratory Coursework based on Solid Modeling

(2 Credits: 50 Marks)

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain interface required for Computer aided design and drawing.
CO2	Explain commands used in Solid works.
CO3	Design and draw 3D objects in solid works workbench.
CO4	Perform Simulation of objects in interface.

Course Content:

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

VOC 637 Major Project – Phase II

(2 Credits: 50 Marks)

Students will have to submit major project (in continuation to Phase – I) either individually or in a group under supervision and approval of concerned teacher.

VOC 638 In-plant Training/Field work/Mini Project – IV (AU)

(2 Credits: 50 Marks)

Students will have to Undergo In-plant Training/Field work/Mini Project individually individually or in a group under supervision and approval of concerned teacher.

2017

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS) - 431004

Outcome Based Curricula

Master of Vocation

Automobile Technology

[DEEN DAYAL UPADHYAY KAUSHAL KENDRA]

Effective from July 2017 onwards

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	Research/Industrial project			
	Part 1		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

<u>Preamble:</u>

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.

<u>Program Specific Outcomes (PSO):</u>

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

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

Eligibility:

Those who have completed B.Voc. (Automobile)/ B.Sc with Automobile / B. E/ B. Tech (Automobile/ Mechanical/) 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.

<u>Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)</u>

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

the Student
SGPA = --
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.

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

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.

Attainment Assessment Mechanism:

a) Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

b) Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.
The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

c) Course Attainment Levels:

a. CO attainment is defined/set at three levels;
b. The CO attainment is based on end term examination assessment and internal assessment;
c. The Co attainment is defined at three levels in ascending order-
    i. e.g. For end term and internal examination;
    ii. Level-1: 40% students scored more than class average
    iii. Level-2: 50% students score more than class average;
    iv. Level-3: 60% students score more than class average.
d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 50% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.
e. CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

d) Program Attainment Level:

a. PO attainment is defined at five levels in ascending order;
b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);
c. The PO attainment levels are defined / set as stated below;
    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1)- Poor
    ii. Level-2: 1.0>1.5-Average
    iii. Level-3: 1.5>2.0-Good
    iv. Level-4: 2.0>2.5-Very Good
    v. Level-5: 2.5>3.0 -Excellent
d. The PO attainment target level is set/defined (say, Level-4). It implies that, the department is aiming at minimum level-4 (very good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;
e. PO Attainment= 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

The **CO-PO MATRIX** is provided in the below table **Master of Vocation (Automobile)**

Paper Code	Paper Title		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
CC 100	Constitution of India	3	*	*	*	*	*										
ATF 121	Automotive Engines	1	*	*	*	*	*										
ATF122	Automotive Transmission Systems	1	*	*	*	*	*										
ATF 123	Fuels and Combustion	0	*	*	*	*	*										
ATC 124	Automobile Control Systems	0	*	*	*	*	*										
ATC 125	Automobile Engine Components Design	1	*	*	*	*	*										
ATC 126	Automobile Air Conditioning	2	*	*	*	*	*										
CF 101	Research Methodology	3	*	*	*	*	*						*	*	*	*	*
EF 1XX	Elective Foundation (Any One) ▪ Operations Management (EF 130) ▪ Materials management (EF 131)	2	*	*	*	*	*								*	*	*
ATLF 127	Laboratory Coursework based on Automobile Engines and Engine Design (Auto-CAD)	3	*	*	*	*											
ATLF 128	Laboratory Coursework based on Automotive Transmission Systems	2	*	*	*	*											
ATLF 129	Laboratory Coursework based on Fuels and Combustion	2	*	*	*	*											
ATLC	Laboratory	0	*	*	*	*									*	*	*

130	Coursework based on Automobile Control Systems																
ATLC 131	Laboratory Coursework based on Automobile Air Conditioning	0	*	*	*	*									*	*	*
ATF 221	Transmission System Design	1	*	*	*	*	*										
ATF 222	Automobile Systems Design	3	*	*	*	*	*								*	*	*
ATF 223	Hydraulic and Pneumatic Systems	1	*	*	*	*	*								*	*	*
ATF 224	Noise and Vibration	1	*	*	*	*	*								*	*	*
ATC 225	Automobile Body Engineering	2	*	*	*	*	*								*	*	*
ATC 226	Vehicle Dynamics	2	*	*	*	*	*								*	*	*
ATLF 227	Laboratory Coursework based on Hydraulic and Pneumatic Systems	1	*	*	*	*	*								*	*	*
ATLF 228	Laboratory Coursework based on Noise and Vibration	1	*	*	*	*	*								*	*	*
ATLC 229	Laboratory Coursework based on Solid Modeling	0	*	*	*	*	*								*	*	*
ATLC 230	Laboratory Coursework based on Automobile Body Engineering	3	*	*	*	*	*								*	*	*
ATLC 231	Laboratory Coursework based on Automotive Electrical system diagnosis	3	*	*	*	*	*								*	*	*
ATR 232	Research/ Industrial Project – Phase I (Review of Literature/ Industrial Orientation, Formulation of Topic,	2	*	*	*	*	*						*	*	*	*	*

	Experimental Plan)																
ATC 321	Generic Elective – I	2	*	*	*	*	*						*	*	*	*	*
ATC 322	Generic Elective – II	3	*	*	*	*	*						*	*	*	*	*
ATGE 32X	Generic Elective – I	1	*	*	*	*	*						*	*	*	*	*
ATGE $32X_1$	Generic Elective – II	1	*	*	*	*	*						*	*	*	*	*
ATOE $32X_2$	Open Elective –I	1	*	*	*	*	*						*	*	*	*	*
ATLC 332	Laboratory Coursework based on Generic Elective I	3	*	*	*	*	*								*	*	*
ATLC 333	Laboratory Coursework based on Generic Elective – II	2	*	*	*	*	*								*	*	*
ATLE $33X_L$	Laboratory Coursework based on Generic Elective – I	1	*	*	*	*	*								*	*	*
ATLE $33X_{1L}$	Laboratory Coursework based on Generic Elective – II	1	*	*	*	*	*								*	*	*
ATR 340	Research/ Industrial Project – Phase I	3			*	*	*	*	*	*	*	*	*	*	*	*	*
ATGE 42X	Generic Elective – III	2	*	*	*	*	*							*	*	*	*
ATGE $42X_1$	Open Elective – II	3	*	*	*	*	*							*	*	*	*
ATLE $42X_2$	Laboratory Coursework based on Generic Elective - III	0	*	*	*	*	*										
ATR 430	Research/ Industrial Project – Phase III (Experimental Work Continued, Organization and Interpretation of Result, Dissertation, Presentation)	3			*	*	*	*	*	*	*	*	*	*	*	*	*

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	ATLE 427	Laboratory Coursework based on Automotive Emission and Controls

<table>
<tr><td rowspan="2"></td><td>ATGE 422</td><td>Hybrid Vehicles</td><td rowspan="2"></td><td>ATLE 428</td><td>Laboratory Coursework based on Hybrid Vehicles</td></tr>
<tr><td>ATGE 423</td><td>Automotive Safety</td><td>ATLE 429</td><td>Laboratory Coursework based on Automotive Safety</td></tr>
<tr><td rowspan="3">Open Elective-II</td><td>ATOE 424</td><td>Applied Hydraulics and Pneumatics</td><td></td><td colspan="2" rowspan="3"></td></tr>
<tr><td>ATOE 425</td><td>Industrial Robotics</td><td></td></tr>
<tr><td>ATOE 426</td><td>Advanced Electrical Drives</td><td></td></tr>
</table>

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 Livinţ , 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)