

## **UNIVERSITY VISION AND MISSION**

### **VISION**

B.S. Abdur Rahman Institute of Science & Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

### **MISSION**

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global Institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.



## **VISION AND MISSION OF THE DEPARTMENT OF AUTOMOBILE ENGINEERING**

### **VISION**

The department of Automobile Engineering endeavours to become the centre of excellence for promoting intellect, creativity research and character in an active, student – centred learning community.

### **MISSION**

- To provide quality Education to the students and to mold them as a professionals with good intellectual knowledge.
- The teaching methodology adopted here will develop our students to satisfy the need of world's scientific and humanistic enterprises.
- The learning process followed extends beyond class room teaching to activities like research, training and consultancy.
- All the members of the department including students, faculty and staff are encouraged to achieve excellence in their chosen fields and to share the responsibilities of citizenship and service in then global community.



**PROGRAMME EDUCATIONAL OBJECTIVES AND  
OUTCOMES  
B.Tech. (Automobile Engineering)**

**PROGRAMME EDUCATIONAL OBJECTIVES**

The Mission of the Automobile Engineering Program is achieved by student learning outcomes that prepare the graduate to be able to:

- Apply skills and understanding of engineering sciences with a foundation in mathematics, chemistry and physics necessary for engineering practice.
- Design and develop components, systems and products that meet specific requirements and use resources prudently in solving complex problems encountered in professional practice.
- Develop, test evaluate and execute engineering solutions to problems and projects that are practical and of a complexity encountered in professional practice.
- Design and conduct experiments; analyze results.
- Recognize and understand contemporary issues and the role of professionals in global society.
- Practice Professional and ethical responsibilities, including understanding of the societal impact of engineering solutions.
- Perform design individual and team-based project environments, providing leadership as necessary.
- Communicate and perform effectively as engineering professionals.
- Develop intellectually and technically through continued learning.
- Understand the continuing and life long learning practice.

## **PROGRAMME OUTCOMES**

The following list of educational outcomes was chosen by the department to describe what the students are expected to know or be able to do at time for graduation from the program:

- Apply fundamental concepts of mathematics to problems in engineering applications.
- Apply fundamental concepts of science to solve problems in engineering applications.
- Apply analytical skills to solve engineering problems.
- Conduct experiments; analyze data, and present results.
- Apply the knowledge gained to design a component or a system that meets the specific criteria.
- Incorporate economic, environmental, and safety consideration in a design process.
- Understand the importance of ethical and professional responsibility.
- Work on multi-disciplinary group projects to enhance interpersonal and leadership skills.
- Make an effective oral presentation of ideas on engineering design solutions.
- Prepare and present technical information effectively in a report / document form
- Communicate with others effectively in a team / group setting.
- Conduct independent research for information required in engineering problem solving.
- Be aware of the need for information required in engineering problem solving.
- Understand the need for life-long learning experience via advanced studies.
- Gain and understanding of global issues related to engineering.

**B.S.ABDUR RAHMAN  
UNIVERSITY**

B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY  
(Estd.u/s 3 of the UGC Act, 1956)

(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)  
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.



**REGULATIONS 2013  
FOR  
B.TECH. DEGREE PROGRAMMES  
(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)**





**REGULATIONS - 2013 FOR  
B.TECH. DEGREE PROGRAMMES  
(With Amendments Incorporated Till June 2015)**

**1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE**

In these Regulations, unless the context otherwise requires:

- i) **"Programme"** means B.Tech. Degree Programme.
- ii) **"Branch"** means specialization or discipline of B.Tech Degree Programme like Civil Engineering, Mechanical Engineering, etc.,
- iii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, etc.,
- iv) **"University"** means B.S.Abdur Rahman University.
- v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman University.
- vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S.Abdur Rahman University.
- vii) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman University, who is responsible for conduct of examinations and declaration of results.

**2.0 ADMISSION**

**2.1a)** Candidates for admission to the first semester of the eight semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any university or authority accepted by the University as equivalent thereto.

**2.1b)** Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the University as equivalent thereto.

## **B.Tech. Automobile Engineering**

---

**2.2** Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the University for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for plus two academic stream.

**2.3** The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the University from time to time.

### **3.0 BRANCHES OF STUDY**

**3.1** Regulations are applicable to the following B.Tech. degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

### **B.TECH. DEGREE PROGRAMMES:**

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. Food Biotechnology

### **4.0 STRUCTURE OF THE PROGRAMME**

**4.1** Every Programme will have a curriculum with syllabi consisting of theory and practical courses such as,

## **B.Tech. Automobile Engineering**

---

- i) Basic Sciences (BS)
  - ii) Humanities & Social Sciences (HS)
  - iii) Management Sciences (MS)
  - iv) Engineering Sciences Fundamentals (ESF)
  - v) Engineering Core Courses (EC)
  - vi) Professional Electives (PE)
  - vii) General Electives (GE)
  - viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.
- 4.2** Each course is normally assigned certain number of credits : one credit per lecture period per week  
one credit per tutorial period per week  
one credit for two to three periods and two credits for four periods of laboratory or practical courses  
one credit for two periods of seminar / project work per week  
one credit for two weeks of industrial training
- 4.3** Each semester curriculum shall normally have a blend of lecture courses not exceeding seven and practical courses not exceeding four.
- 4.4** For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. This minimum will be between 175 and 185 credits, depending on the program.
- 4.5** The medium of instruction, examinations and project report shall be English, except for courses on languages other than English.
- 5.0 DURATION OF THE PROGRAMME**
- 5.1** A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of a lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).
- 5.2** Each semester shall consist of a minimum of 90 working days or 450 periods.
- 5.3** Semester end examination will normally follow immediately after the last working day of the semester.

## **6.0 CLASS ADVISOR AND FACULTY ADVISOR**

### **6.1 CLASS ADVISOR**

A faculty member will be nominated by the HOD as Class Advisor for the whole class (2nd to 8th semester).

He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

However, for the first semester alone the class advisors and faculty advisors will be nominated by first year coordinator.

### **6.2 FACULTY ADVISOR**

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

## **7.0 COURSE COMMITTEE**

Common course offered to more than one discipline or group, shall have a "Course Committee", comprising all the faculty members teaching the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs), depending on whether all the faculty members teaching the common course belong to the same department / different departments.

## **8.0 CLASS COMMITTEE**

During first semester, a common Class Committee will be constituted for all branches by the Dean (Academic Affairs). During other semesters, separate Class Committees will be constituted by the respective Head of the Department of the students

**8.1** The first semester Class Committee composition will be as follows:

- i) The first semester Coordinator shall be the Chairman of the class committee

- ii) Course coordinators of all common courses.
  - iii) Faculty members of all individual courses.
  - iv) One male and one female first semester student of each class of B.Tech, program to be nominated by the first semester coordinator
  - v) All first semester class advisors and faculty advisors
- 8.2** The composition of the class committee for each branch of B.Tech, from 2nd to 8th semester, will be as follows:
- i) One senior faculty member preferably not teaching to the concerned class, appointed as Chairman by the Head of the Department
  - ii) Faculty members of individual courses
  - iii) Two students, (preferably one male and one female) of the class per group of 30 students or part thereof, to be nominated by the Head of the Department, in consultation with the faculty advisors.
  - iv) All faculty advisors and the class advisor of the class
  - v) Head of the Department
- 8.3** The class committee shall meet at least thrice during the semester. The first meeting will be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment will be decided for the first, second and third assessments. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.
- 8.4** During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.
- 8.5** The class committee, excluding the student members, shall meet within 10 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide the grades for students in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

## **9.0 REGISTRATION AND ENROLMENT**

- 9.1** Except for the first semester, every student shall register for the ensuing semester during a specified week before the semester end examination of the current semester. Every student shall submit a completed Registration form indicating the list of courses intended to be enrolled during the ensuing semester. Late registration with the approval of the Dean (Academic Affairs) along with a late fee will be permitted up to the last working day of the current semester.
- 9.2** From the second year onwards, all students shall pay the prescribed fees for the year on a specific day at the beginning of the semester confirming the registered courses. Late enrolment along with a late fee will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.
- 9.3** The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.
- 9.4** **A student should have registered for all preceding semesters before registering for a particular semester.**

## **10.1 CHANGE OF A COURSE**

A student can change an enrolled course within 15 days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

## **10.2 WITHDRAWAL FROM A COURSE**

A student can withdraw from an enrolled course at any time before the second assessment for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

## **11.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME**

A student can avail a onetime temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 or 12 semesters as the case may be. If any student is debarred for want of attendance or suspended due to any act of indiscipline it will not be considered as break of study.

A student availed break of study has to rejoin only in the same semester from where he left.

**12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER**

**12.1** A student can enroll for a maximum of 30 credits during a semester including redo courses.

**12.2** The minimum credit requirement to move to the higher semester is

- Not less than a total of 20 credits, to move to the 3<sup>rd</sup> semester
- Not less than a total of 40 credits, (20 for lateral entry) to move to the 5<sup>th</sup> semester
- Not less than a total of 60 credits, (40 for lateral entry) to move to the 7<sup>th</sup> semester

**13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS**

**13.1** Every theory course shall have a total of four assessments during a semester as given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 4	1.5 hours	15%
Assessment 2	5 to 8	1.5 hours	15%
Assessment 3	9 to 12	1.5 hours	15%
Attendance #	-	-	5%
Semester End Exam	Full course	3 hours	50%

# 76-80% - 1 Mark ; 81-85 – 2 Marks ; 86-90 – 3 Marks ; 91-95 – 4 Marks and 96-100 – 5 Marks

**13.2** Appearing for semester end examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

**13.3** Every practical course will have 60% weightage for continuous assessment and 40% for semester end examination. However, a student should have secured a minimum of 50% marks in the semester end practical examination.

- 13.4** In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the department. A progress report from the industry will also be taken into account for evaluation.
- 13.5** In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50% and remaining 50% for the project report and Viva Voce examination.
- 13.6** Assessment of seminars and comprehension will be carried out by a committee of faculty members constituted by the Head of the Department.
- 13.7** The continuous assessment marks earned for a course during his/her first appearance will be used for grading along with the marks earned in the semester-end examination / arrear examination for that course until he/she completes.

**14.0 SUBSTITUTE EXAMINATIONS**

- 14.1** A student who has missed, for genuine reasons, a maximum of one of the four assessments of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident, admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose.
- 14.2** A student who misses any assessment in a course shall apply in a prescribed form to the Head of the department / Dean within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

**15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION**

- 15.1** A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the University in approved events etc.) to become eligible to appear for the semester-end examination in that course, failing



which the student shall be awarded "I" grade in that course. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

- 15.2** The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department. Thereupon, the Dean (Academic Affairs) shall announce, course-wise, the names of such students prevented from writing the semester end examination in each course.
- 15.3** A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.
- 15.4** A student who is awarded "U" grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course during summer term / regular semester. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the semester-end (redo) examination. If any student obtained "U" grade during summer term course, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.
- 15.5** If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will be awarded "I" grade in that course.
- 15.6** The students who have not attended a single hour in all courses in a semester and awarded 'I' grade are not permitted to write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

**16.0 SUMMER TERM COURSES**

- 16.1** A student can register for a maximum of three courses during summer term, if such courses are offered by the concerned department during the summer term. Students may also opt to redo such courses during regular semesters.

- 16.2** The Head of the Department, in consultation with the department consultative committee may arrange for the conduct of a few courses during the summer term, depending on the availability of faculty members during summer and subject to a specified minimum number of students registering for each of such courses.
- 16.3** However, in the case of students who have completed eighth semester, but having arrears in the earlier semesters in a maximum of two courses, summer courses may be offered, even if less than minimum students may register for the course.
- 16.4** The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters except that there is no provision either for withdrawal from a summer term course or for substitute examination.

**17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET**

- 17.1** All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members shall meet within 10 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grade. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	--
I	--
AB	--

- "W" denotes withdrawal from the course.
- "I" denotes inadequate attendance and hence prevention from semester-end examination
- "U" denotes unsuccessful performance in the course. "AB" denotes absence for the semester-end examination.

**17.2** A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student.

**17.3** The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department and declared by the Controller of Examinations.

**17.4** Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester-end theory examination answer scripts of courses, on payment of prescribed fee, through proper application to Dean (Academic Affairs), who shall constitute a revaluation committee consisting of Chairman of the class committee as convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

**17.5** After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including Summer term (redo) courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards. GPA is the ratio of the sum of the products of the number of credits of courses registered and the points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester, including summer courses if any.

If  $C_i$  is the number of credits assigned for the  $i^{\text{th}}$  course and  $GP_i$  is the Grade Point in the  $i^{\text{th}}$  course

$$GPA = \frac{\sum_{i=1}^n (C_i)(GP_i)}{\sum_{i=1}^n C_i} \quad \text{Where } n = \text{number of courses}$$

The Cumulative Grade Point Average CGPA shall be calculated in a similar manner, considering all the courses enrolled from first semester.

"I" and "W" grades will be excluded for calculating GPA .

"U", "I", "AB" and "W" grades will be excluded for calculating CGPA

**17.6** After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA.

<b>Classification</b>	<b>CGPA</b>
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the normal 8 or 6 (for lateral entry) semesters
First Class	6.50 and above and completing the programme within a maximum of 10 or 8 (for lateral entry) semesters.
Second Class	All others

However, to be eligible for First Class with Distinction, a student should not have obtained U and I grade in any course during his/her study and should have completed the U.G. programme within a minimum period covered by the minimum duration plus authorized break of study, if any (clause 11). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

## **18.0 ELECTIVE CHOICE: OPTION TO DO PROJECT ALONE IN FINAL SEMESTER**

- 18.1** Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.
- 18.2** In the curriculum of eighth Semester, along with the project work, if two elective courses alone are listed, then the Dean (Academic Affairs) may permit a student, as per approved guidelines, on the recommendation of the Head of the department, to do a full semester major industrial project work. In such a case, the above two elective courses or any other two elective courses in lieu thereof have to be enrolled during any semester preceding or succeeding the project work, if offered.

## **19.0 PERSONALITY AND CHARACTER DEVELOPMENT**

- 19.1** All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo practical training.
- **National Cadet Corps (NCC)** will have to undergo specified number of parades.
  - **National Service Scheme (NSS)** will have social service activities in and around Chennai.
  - **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
  - **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
  - **Rotaract** will have social service activities in and around Chennai.

## **20.0 DISCIPLINE**

- 20.1** Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

**20.2** Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee, nominated by the Vice-Chancellor, for taking appropriate action.

**21.0 ELIGIBILITY FOR THE AWARD OF DEGREE**

**21.1** A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

- i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study.
- ii) no dues to the Institution, Library, Hostels
- iii) no disciplinary action pending against him/her.

**21.2** The award of the degree must have been approved by the University.

**22.0 POWER TO MODIFY**

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

**CURRICULUM AND SYLLABI FOR  
B.TECH. AUTOMOBILE ENGINEERING  
(Eight Semesters / Full Time)**

**CURRICULUM  
SEMESTER I**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB1181	Algebra, Geometry and Calculus	3	1	0	4
2	HS	ENB1181	English*				
		FRB1181	French*				
		ISB1181	Arabic*	3	0	0	3
3	BS	PHB1181	Physics	3	0	0	3
4	BS	CHB1181	Chemistry	3	0	0	3
5	ESF	GEB1101	Engineering Graphics	2	0	3	3
6	HS	SSB1182	Sociology, Ethics & Human Values	3	0	0	3
7	BS	PHB1182	Physics Lab	0	0	2	1
8	BS	CHB1182	Chemistry Lab	0	0	2	1
9	ESF	GEB1102	Basic Engineering Practices Laboratory	0	0	2	1
10	ESF	GEB1103	Computer Programming & Applications	2	0	2	3

**25**

\* Any one language

**SEMESTER II**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAB1282	Advanced Calculus	3	1	0	4
2.	BS	CHB1291	Chemistry of Materials	3	0	0	3
3.	HS	SSB1181	Introduction to Economics	3	0	0	3
4.	ESF	GEB1211	Basic Engineering Mechanics	3	1	0	4

**B.Tech. Automobile Engineering**

---

5.	ESF	EEB1283	Basic Electrical Engineering	3	0	0	3
6.	MS	MEB1211	Material Science	3	0	0	3
7.	HS	CHB1292	Chemistry of Materials Laboratory	0	0	2	1
8.	ESF	ENB1282	Written Communication	0	0	2	1
9.	BS	MEB1212	Design Appreciation Lab	0	0	3	1
10.	ESF	EEB1284	Electrical Engineering lab	0	0	3	1
							<b>24</b>

**SEMESTER III**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BS	MAB2181	Transforms and Applications	3	1	0	4
2.	BS	LSB2181	Biology for Engineers	3	0	0	3
3.	ESF	MEB2214	Fluid Mechanics	3	1	0	4
4.	ESF	MEB2102	Solid Mechanics	3	1	0	4
5.	ESF	MEB2103	Thermodynamics	3	1	0	4
6.	ESF	ECB2181	Electronics for Mechanical Systems	3	0	0	3
7.	HS	ENB2181	Oral Communication	0	0	2	1
8.	ESF	MEB2217	Fluid Mechanics and Machinery Lab	0	0	2	1
9.	ESF	MEB2105	Drafting and Modeling Lab	0	0	3	1
10.	ESF	ECB2182	Electronics and Microprocessor Lab	0	0	3	1
							<b>26</b>

**SEMESTER IV**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BS	MAB2283	Applied Numerical Methods	3	1	0	4
2.	EC	AUB2211	Automotive Chassis	3	0	0	3
3.	EC	AUB2212	Mechanics of Machinery	3	1	0	4



**B.Tech. Automobile Engineering**

---

4.	EC	MEB2213	Basic Manufacturing Processes	3	0	0	3
5.	EC	AUB2213	Mechanical Metallurgy	3	0	0	3
6.	HS	SSB2181	Law for Engineers	3	0	0	3
7.	HS	ENB2282	Confidence Building & Behavioral Skills	0	0	2	1
8.	EC	MEB2215	Mechanics Lab	0	0	3	1
9.	EC	MEB2216	Manufacturing Processes lab	0	0	3	1
10.	EC	MEB2104	Material Testing Lab	0	0	2	1
							<b>24</b>

**SEMESTER V**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	EC	AUB3101	Two and Three Wheelers	3	0	2	4
2.	EC	AUB3102	Design of Machine Elements	3	1	0	4
3.	EC	AUB3103	Petrol Engines	3	0	0	3
4.	EC	MEB3213	Metrology and Mechanical Measurements	3	0	0	3
5.	ESF	GEB3201	Environmental Science and Engineering	3	0	0	3
6.	PE		Professional Elective I	3	0	0	3
7.	HS	ENB3181	Career Building & People Skills	0	0	2	1
8.	EC	AUB3104	Computer Aided Drafting	0	0	3	1
9.	EC	AUB3105	Engine Components Lab	0	0	3	1
10.	EC	MEB3216	Metrology and Mechanical Measurements Lab	0	0	3	1
							<b>24</b>

**SEMESTER VI**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	EC	AUB3211	Diesel Engines	3	0	0	3
2.	PE		Professional Elective II	3	0	0	3
3.	EC	AUB3212	Design of Automotive Components	3	1	0	4
4.	EC	AUB3213	Automotive Electrical & Electronics	3	0	0	3
5.	HS	MSB3181	Management of Business organization	3	0	0	3
6.	PE		Professional Elective III	3	0	0	3
7.	EC	AUB3214	Fuels and Lubricants Lab	0	0	3	1
8.	EC	AUB3215	Automotive Electrical & Electronics Lab	0	0	3	1
9.	EC	AUB3216	Four Wheeler Lab	0	0	3	1
10.	EC	AUB3217	Modeling and Analysis Lab	0	0	2	1

**23**

**SEMESTER VII**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	EC	AUB4101	Vehicle Dynamics	3	1	0	4
2.	EC	AUB4102	Automotive Transmissions	3	1	0	4
3.	EC	AUB4103	Engine Management System and Emission Control	3	0	0	3
4.	PE		Professional Elective IV	3	0	0	3
5.	PE		Professional Elective V	3	0	0	3
6.	GE		General Elective I	3	0	0	3
7.	EC	AUB4104	Vehicle Maintenance Lab	0	0	3	1
8.	EC	AUB4105	Manufacturing Tech & CNC Lab	0	0	3	1
9.	EC	AUB4106	Engine Testing and Emission Lab	0	0	3	1
10.	EC	AUB4107	Fabrication Project	0	0	3	1

**24**

**SEMESTER VIII**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	PE		Professional Elective VI	3	0	0	3
2.	GE		General Elective II	3	0	0	3
3.	EC	AUB4211	Project	0	0	18	9
							<b>15</b>
<b>Total Credits:</b>							<b>185</b>

**PROFESSIONAL ELECTIVES**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>
1.	PE	AUBX01	Finite Element Methods for Automotive Applications
2.	PE	AUBX03	Modeling and Simulation of Vehicle Systems
3.	PE	AUBX04	Evaluation of Vehicle Performance
4.	PE	AUBX05	Automotive Aerodynamics
5.	PE	AUBX06	Automotive Safety Systems
6.	PE	AUBX07	Combustion Thermodynamics and Heat Transfer
7.	PE	AUBX08	Jet Engines
8.	PE	AUBX09	Alternative Energy Vehicle
9.	PE	AUBX10	Noise Vibration and Pollution Control
10.	PE	AUBX11	Composites Materials for Automobiles
11.	PE	AUBX12	Vehicle Comfort System & Ergonomics
12.	PE	AUBX13	Traffic Engineering
13.	PE	AUBX14	Fuel Cell Technology
14.	PE	AUBX15	Simulation of IC Engines
15.	PE	AUBX16	Off Road Vehicles
16.	PE	AUBX17	Surface Engineering
17.	PE	AUBX18	Advanced Material Testing & Failure Analysis
18.	PE	AUBX19	Alternate Propulsion
19.	PE	AUBX20	Tractor and Agricultural Machines
20.	PE	AUBX21	Fleet Management
21.	PE	AUBX22	Applied Hydraulics and Pneumatics
22.	PE	AUBX23	Computer Aided Design and Manufacturing
23.	PE	AUBX24	Statistics and Quality Management
24.	PE	AUBX25	Vehicle Body Engineering
25.	PE	AUBX26	Professional Ethics in Engineering
26.	PE	AUBX27	Modern and intelligent vehicle systems

**B.Tech. Automobile Engineering**

---

27.	PE	AUBX28	Motorsport Engineering
28.	PE	MEBX03	Design of Jigs, Fixtures and Press Tools
29.	PE	MEBX07	Nano Materials & Fabrications
30.	PE	MEBX09	Micro Electro Mechanical Systems (MEMS)
31.	PE	MEBX12	Process Planning and Cost Estimation
32.	PE	MEBX19	Advanced Optimization Techniques
33.	PE	MEBX20	Advanced Production Processes for Automotive Components
34.	PE	MEBX25	Advanced IC Engines
35.	PE	MEBX28	Computational Flow and Heat Transfer

**GENERAL ELECTIVES**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Offering Department</b>
1.	GE	GEBX01	Disaster Management	Civil
2.	GE	GEBX02	Nano Technology	Physics
3.	GE	GEBX03	Control Systems	EEE
4.	GE	GEBX04	Green Design and Sustainability	Civil
5.	GE	GEBX05	Knowledge Management	CSE
6.	GE	GEBX06	Appropriate Technology	Civil / Mechanical
7.	GE	GEBX07	System Analysis and Design	Mechanical
8.	GE	GEBX08	Value Analysis and Engineering	Mechanical
9.	GE	GEBX09	Optimization Techniques	Mathematics
10.	GE	GEBX10	Engineering System Modeling and Simulation	Mechanical
11.	GE	GEBX11	Supply Chain Management	CBS
12.	GE	GEBX12	Total Quality Management	Mechanical
13.	GE	GEBX13	Energy Studies	Mechanical
14.	GE	GEBX14	Robotics	Mechanical
15.	GE	GEBX15	Cyber security	IT
16.	GE	GEBX16	Usability Engineering	CSE
17.	GE	GEBX17	Industrial Safety	Mechanical
18.	GE	GEBX18	Transport Management	Automobile
19.	GE	GEBX19	Advanced Optimization Techniques	Mechanical
20.	GE	GEBX20	Plant Engineering	EIE
21.	GE	GEBX21	Project Management System	CBS
22.	GE	GEBX22	National Service Scheme	

**LIST OF COURSES FOR Ph.D**

<b>S.No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Name</b>
1.	EC	AUBZ01	Automotive Engine Management and Emission Controls
2.	EC	AUBZ02	Vehicle Vibration and Dynamics Control
3.	EC	AUBZ03	Aerodynamics for Automobile Engineers
4.	EC	AUBZ04	Automotive Safety System
5.	EC	AUBZ05	Combustion Thermodynamics and Heat Transfer
6.	EC	AUBZ06	Instrumentation and Experimental Techniques
7.	EC	AUBZ07	Vehicle Control Systems
8.	EC	AUBZ08	Vehicle Design
9.	EC	AUBZ09	Modeling of I.C. Engine Processes
10.	EC	AUBZ10	Automotive Material Characterization
11.	EC	AUBZ11	Modeling and Analysis of Vehicle Systems

**SEMESTER I**

<b>MAB1181</b>	<b>ALGEBRA, GEOMETRY AND CALCULUS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

The course is aimed at

- Developing the skills of engineering students in the basics of chosen topics of Mathematics that are imperative for effective understanding of engineering subjects.
- laying the foundation for learning further topics of Mathematics in higher semesters in a graded manner.
- enabling the learners to appreciate the important role of mathematical concepts in engineering applications.

**MODULE I MATRICES 8**

Eigenvalue Problems – Eigenvalues and Eigenvectors of a real matrix, Engineering Applications – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

**MODULE II VECTOR ALGEBRA 6**

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl.

**MODULE III THREE DIMENSIONAL ANALYTICAL GEOMETRY 8**

Direction cosines & ratios – angle between two lines – equations of a plane – equations of a straight line - coplanar lines - shortest distance between skew lines – sphere – tangent plane – plane section of a sphere – orthogonal spheres.

**MODULE IV DIFFERENTIAL GEOMETRY 7**

Curvature – Cartesian and polar coordinates – centre and radius of curvature – circle of curvature – involutes & evolutes – envelopes – properties of envelopes and evolutes.



**MODULE V MULTI-VARIATE FUNCTIONS**

**8**

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobians - Taylor's series expansion – maxima and minima – Lagrange's multiplier method.

**MODULE VI ORDINARY DIFFERENTIAL EQUATIONS**

**8**

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients, method of variation of parameters.

**L – 45; T – 15; Total Hours– 60**

**TEXT BOOKS:**

1. Veerarajan.T., "Engineering Mathematics" (5<sup>th</sup> edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., "Higher Engineering Mathematics" (42<sup>nd</sup> edition), Khanna Publishers, New Delhi, 2012.

**REFERENCES:**

1. Kreyszig, E., "Advanced Engineering Mathematics", 10<sup>th</sup> edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7<sup>th</sup> edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4<sup>th</sup> edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2<sup>nd</sup> edition, National Publishing Co., Chennai, 2003.

**OUTCOMES:**

On completion of the course the students will be able to

- solve Eigenvalue and Eigenvector problems
- solve three dimensional geometry problems.
- use differential calculus for solving problems pertaining to engineering applications.

**OBJECTIVES:**

- To expose students to the concept of flipped learning.
- To discuss a range of vocabulary and enable students to use it in academic and technical contexts.
- To facilitate students' effective use of speaking skill while exchanging ideas and making presentations.
- To help students develop listening skill for identifying accent and intonation and comprehending and analyzing the information.
- To develop reading comprehension skill and help them to infer explicit and implicit meanings.
- To hone their creative and academic writing skills.
- To expose them to the correct usage of language and help them to apply it appropriately.

**MODULE I**

**8**

L: Listening for specific information – Note-taking

S: Self introduction – Introducing one another

R: Skimming Technical passages

W: Process of writing – Writing short paragraphs

Language focus: Use of prefixes and suffixes ,Simple tense forms

**MODULE II**

**8**

L: Guessing the meaning through Intonation

S: Exchanging opinions & Agreeing and disagreeing

R: Scanning – reading news paper articles for specific information

W: Argumentative writing – Letter to the editor

Language focus: Modals, Continuous and perfect tenses, Framing questions & Question tags

**MODULE III** **7**

L- Listening to a specific topic & predicting the content

S – Getting into conversation- Gathering information

R - Reading between lines

W - Letter inviting a dignitary-Expository Writing

Language Focus: Homonyms & Collocation

**MODULE IV** **7**

L: Listening to telephonic conversation, listening for specific information (Intensive)

S: Short presentations

R: Referential and Inferential reading

W:– Letter seeking permission for industrial visit

Language focus: Subject, Verb agreement & Euphemism

**MODULE V** **8**

L: Listening to scientific podcasts – Cloze exercises

S: Personal narrations

R: Intensive reading – Interpreting graphical data.

W: Describing a process, Flow chart, Bar chart

Language focus: Passive forms, Connectives & Prepositions

**MODULE VI** **7**

L: Appreciation and critical review of popular movie--The Incredibles

S: Discussion in groups - Three Idiots

R: Extensive reading – APJ Abdul Kalam’s Wings of Fire - Reading for critical appreciation

W: Writing slogans – Rewriting a story with a different ending

Language focus: If clause, Phrasal verbs & Idiomatic expressions

**Total Hours: 45**

**REFERENCES:**

1. Carol Rosenblum Perry (2011). The Fine Art of Technical Writing. CreateSpace Independent Publishing Platform, NewDelhi.
2. Dutt,P.K Rajeevan.G and Prakash,C.L.N (2007). A Course in Communication Skills. Cambridge University Press, India.
3. Kalam,Abdul &Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and Abridged by Mukul Chowdhri). Hyderabad University Press.
4. Sen, Leena (2004). Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

**OUTCOMES:**

After completion of the course, students will have the ability to

- Explore new information from various sources and perform communicative tasks.
- Demonstrate their range of vocabulary in academic and technical contexts.
- Exchange ideas and make presentations.
- Identify, comprehend and respond to different intonation patterns.
- Infer meaning from reading texts.
- Create and construct different kinds of academic documents.
- Communicate effectively using grammatically correct expressions.

**OBJECTIVES:**

- To improve their proficiency in French language.
- To empower them for successful communication in their professional contexts.

**DOSSIER 0 FENÊTRE SUR...**

**7**

Contenus –l’alphabet - se présenter – les langues – les nationalités – les nombres de 0 à 60 – les adjectifs de nationalités – les verbes : s’appeler, être.

L’acte de parole

**DOSSIER 1 LES UNS, LES AUTRES....**

**12**

Contenus - Les salutations (formelles et informelles) - les jours de la semaine – Les articles définis – les adjectifs possessifs – la négation (ne.....pas) – les verbes : avoir.

Demander quelque chose – les mois de l’année – les nombres de 70 à 99 – les articles indéfinis – l’adjectif interrogatif (quel, quelle)

Quelques événements culturels – donner des informations personnelles – indiquer ses goûts – l’expression des goûts – les prépositions (les noms de pays).

L’acte de parole

**DOSSIER 2 ICI /AILLEURS**

**12**

Contenus – Parler de sa ville – Donner/ Demander des explications – les prépositions de lieu – articles contractés – pourquoi / parce que

Auberges de jeunesse et hôtels – s’informer sur un hébergement- quelques verbes et indications de direction – quelques formules de politesse.

Le code postal et les départements le libellé d’une adresse en France – Ecrire une carte postale – Dire le temps qu’il fait – les adjectifs démonstratifs - Formules pour commencer / terminer.

L’acte de parole

**DOSSIER 3 SOLO OU DUO**

**14**

Contenus – Les animaux de compagnie les animaux préférés des Français - parler de sa profession – les professions - les activités sportifs - les noms animaux – les verbes : aimer , adorer, détester, faire, aller.

Nouveaux mode de rencontres – caractériser une personne (physique et psychologique)– les adjectifs qualificatifs – les pronoms toniques.

Les sorties – proposer, refuser, accepter une sortie – fixer un rendez-vous – inviter – Donner des instructions – L’impératif : 2e personne – Le pronom on=nous – Les verbes : Pouvoir, vouloir, devoir.

L’acte de parole

L’examen oral

**Total Hours: 45**

**TEXT BOOK:**

1. Alter EGO I – Goyal – Langers (0 – 5 Lessons)

**OUTCOMES:**

On completion of the course,

- The students will be able to deal with their clients effectively at global level.
- Their proficiency in French Language will have improved.

**OBJECTIVES:**

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

**MODULE I PREPARATORY ARABIC**

7

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

**MODULE II FUNCTIONAL ARABIC**

7

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises



**MODULE III FUNCTIONAL ARABIC**

**8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

**MODULE IV FUNCTIONAL ARABIC**

**8**

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

**MODULE V TECHNICAL ARABIC**

**8**

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises.

**MODULE VI TECHNICAL ARABIC**

**7**

Situation communication:

Contractual work, machineries and equipments..

Computer, internet browsing.

Banking,

Exercises.

**Total Hours: 45**

**TEXT BOOK:**

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

**REFERENCES:**

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

**OUTCOMES:**

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

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

---

<b>PHB1181</b>	<b>PHYSICS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To introduce basic physics concepts relevant to Engineering and Technology students.
- To get familiarize with solving problems in basic physics.
- To acquaint applications of physics for Engineering issues.

**MODULE I PROPERTIES OF MATTER 7**

Elasticity – Stress strain diagram – Factors affecting elasticity – Twisting couple on a wire – Shaft – Torsion pendulum – Depression on a cantilever – Young’s modulus by cantilever – Uniform and non-uniform bending – Viscosity.

**MODULE II CRYSTAL PHYSICS 6**

Introduction – Space lattice – unit cell – Bravais lattices – Miller Indices for cubic crystals – Inter planar spacing in cubic lattice – Simple crystal structures – SC, BCC, FCC and HCP structures – Atomic radius, coordination number, Packing factor calculation – Crystal imperfections.

**MODULE III QUANTUM PHYSICS 7**

Black body radiation – Planck’s theory of radiation – Deduction of Wien’s displacement law and Rayleigh – Jeans law from Planck’s theory – Compton effect – Theory and experimental verification – Dual nature of matter – de Broglie’s wavelength- Physical significance of wave function – Schroedinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box.

**MODULE IV WAVE OPTICS 9**

Interference theory – Air wedge – Michelson interferometer – Diffraction – Fresnel and Fraunhofer diffraction - Polarization – Double refraction – Theory of plane polarized, circularly polarized and elliptically polarized light – Quarter wave plate, Half wave plate – Production and detection of plane, circularly and elliptically polarized lights – Photoelasticity – Photo elastic effect – Stress optic law – Effect of stressed model in a plane polariscope (qualitative) – Photo elastic bench.

**MODULE V LASER & FIBRE OPTICS**

**9**

Principle of spontaneous emission and stimulated emission - Characteristics of laser light -Einstein's A & B coefficients (derivation) – Population inversion - pumping - Nd:YAG laser – CO2 laser – Applications – Material processing and holography (construction and reconstruction of hologram)- Optical fibre – Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibers - applications – Fibre optic communication system (block diagram only)- Fibre optic sensors (displacement and pressure sensors (qualitative), Medical endoscope.

**MODULE VI ULTRASONICS AND NDT**

**7**

Ultrasonics – Production – Magnetostriction and piezo electric methods – Properties of ultrasonic waves – Detection of ultrasonic waves – Applications –Ultrasonic interferometer- Acoustical grating – SONAR – Depth of sea – Measurement of velocity of blood flow – Non Destructive Testing (NDT) methods – Ultrasonic flaw detector – A,B & C scanning methods.

**Total Hours: 45**

**TEXT BOOKS:**

1. Gaur R.K. and Gupta S.L., Engineering Physics, 8<sup>th</sup> edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2003.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2<sup>nd</sup> Edition, Scitech Publications, 2003.

**REFERENCES:**

1. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2007.
2. Charles Kittel, "Introduction to solid state physics", 7<sup>th</sup> Edition, John Wiley & sons (ASIA) Pvt. Ltd, 2008.
3. Avadhanulu M.N., "Engineering Physics", 1<sup>st</sup> Edition, S.Chand & Company Ltd., New Delhi, 2007.
4. Schiff, "Quantum Mechanics", 3<sup>rd</sup> Edition, Tata McGraw-Hill Education, 2010.
5. Rajendran V. and Marikani A., "Applied Physics for Engineers", 3<sup>rd</sup> Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2003.

**B.Tech. Automobile Engineering**

---

6. William T. Silfvast, "Laser Fundamentals", 2<sup>nd</sup> edition, Cambridge University Press, 2004.
7. Arumugam M., "Engineering Physics", 5<sup>th</sup> Edition, Anuradha Agencies, 2003.

**OUTCOMES:**

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

- Apply the knowledge of properties of matter in Engineering Mechanics and Fluid Dynamics.
- Characterize Engineering materials
- Use Lasers for Fiber Optics Technology and Material Processing
- Do non-destructive testing using Ultrasonic Techniques

**OBJECTIVES:**

To make students conversant with the

- Water specification for potable and industrial purposes and various treatment methods.
- Different engineering materials, their physico-chemical properties and specific applications.
- Concept of electrochemistry, corrosion and theories of corrosion.
- Principles of spectroscopy and applications.
- Basic principles of green chemistry and the need for green processes in industries.

**MODULE I WATER TECHNOLOGY**

**8**

Introduction – Impurities present in water – Hardness, Types of Hardness, Estimation of Hardness (EDTA method) (Problems) – Alkalinity, Estimation of Alkalinity – Disadvantages of hard water in industries – Conditioning methods: external treatment method: Ion exchange method – internal treatment: colloidal, phosphate, calgon, carbonate methods – drinking water standards (BIS) – treatment of domestic water: screening, sedimentation, coagulation, filtration, disinfection: by chlorination, UV treatment, ozonization – desalination and reverse osmosis (principle only).

**MODULE II ENGINEERING MATERIALS**

**8**

Abrasives: Moh's scale of hardness – natural abrasives: diamond, corundum, emery, garnets and quartz – artificial abrasives: silicon carbide, boron carbide.

Refractories: characteristics, classification – acid, basic and neutral refractories, properties – refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling – general method of manufacture of refractories, properties and uses of high alumina bricks, magnesite and zirconia bricks.

Nanomaterials: Definition – types of Nanomaterials; nanofilms, nanowires, carbon nanotubes, quantum dots and fullerenes (C60) – Size and shape

dependent optical, electrical, thermal and mechanical properties; Synthesis of nanomaterials – Top down and bottom up approach; Applications of nanomaterials – Catalysis, Electronics and Telecommunication, Medicines, Composites and Energy.

**MODULE III ELECTROCHEMISTRY AND CORROSION 9**

Construction of a cell – Standard and single electrode potential – electrochemical series – EMF and its measurement – Nernst equation, application and problems – Types of electrodes: standard hydrogen electrode, calomel electrode, ion selective electrode - glass electrode and determination of pH using glass electrode – polarization, overvoltage, decomposition potential (statements only) – Conductometric and potentiometric titrations.

Corrosion: Definition – Dry corrosion and Wet corrosion with mechanisms – Factors influencing corrosion.

**MODULE IV CHEMISTRY OF POLYMERS 6**

Monomers – functionality – polymer – degree of polymerization – classification – Polymerization techniques: addition, condensation and co-polymerization with example – mechanism of polymerization: free radical, cationic and anionic mechanism – thermoplastics and thermosetting plastics with examples – compounding and moulding of plastics: injection moulding and compression moulding.

**MODULE V SPECTROSCOPY 9**

Electromagnetic spectrum – absorption of radiation – electronic, vibrational, translational and rotational – intensities of spectral lines – Beer-Lambert's Law (Problems) – Colorimetric analysis: estimation of concentration of a solution – Flame photometry: theory, instrumentation (block diagram only) and application – UV-Visible spectroscopy: Principle, instrumentation (block diagram only) and simple applications – IR spectroscopy – simple applications only.

**MODULE VI GREEN CHEMISTRY 5**

Introduction – Significance – Industrial applications of green chemistry; Green technology – Latest green laboratory technique for saving experimental resources and infrastructural framework; Principles of green chemistry – R4M4

model (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking) – Life cycle analysis technique (cradle to grave approach)

**Total Hours : 45**

**TEXT BOOKS:**

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. Paul T. Anastas, John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 1998.

**REFERENCES:**

1. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.
2. Kuriacose J.C. and Rajaram J, Chemistry in Engineering and Technology, Volume1, Tata McGraw- Hill publishing company, New Delhi, 1996.
3. Puri B.R., Sharma L.R. and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Jalandhar, 2000.

**OUTCOMES:**

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

- estimate the degree of hardness and alkalinity in water and describe treatment methods for potable water.
- summarise the properties and uses of various engineering materials and choose the appropriate material for a given application.
- illustrate the different types of electrodes, calculate the emf and apply the electrochemistry principles to explain the mechanism of corrosion.
- describe the mechanism of polymerization and moulding techniques.
- explain the principles and instrumentation of various analytical techniques and adopt the suitable techniques for analysis of compounds / elements.
- outline the principles and significance of green chemistry.



---

<b>GEB1101</b>	<b>ENGINEERING GRAPHICS</b>	<b>L T P C</b>
		<b>2 0 3 3</b>

**OBJECTIVES:**

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide an exposure to the appropriate standards for technical drawings
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, pictorial views and free hand drawing
- To introduce computerized drafting

**MODULE I BASICS AND ENGINEERING CURVES 10**

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola

Special curves: Cycloid, epicycloid, hypocycloid, involutes, helix

**MODULE II ORTHOGRAPHIC PROJECTION 8**

Orthographic projection – first angle, third angle projection methods, free hand sketching of orthographic views of simple machine parts as per first angle projection. Projection of points. Commands and demonstration of drafting packages.

**MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10**

Straight lines in first quadrant – true length and true inclinations, traces – rotating line and trapezoidal methods. Projection of plane lamina in first quadrant – trace of plane.

**MODULE IV PROJECTION OF SOLIDS 10**

Projection of solids: Axis inclined to one reference plane only - prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

**MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**

**10**

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional views – true shape of sections - solids in simple position and cutting plane inclined to one reference plane only.

Development of surfaces: truncated solids - prism, pyramid, cone, cylinder, frustum of cone and pyramid.

**MODULE VI PICTORIAL PROJECTIONS**

**12**

Isometric projection: isometric scale - isometric projection and view of prism, pyramid, cylinder, cone, frustums and truncated solids.

Perspective projection: prism, pyramid, cylinder, frustums – visual ray and vanishing point methods.

**Total Hours: 60**

**TEXT BOOK:**

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 46<sup>th</sup> Edition, (2003)

**REFERENCES:**

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2006)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

**OUTCOMES:**

Students who complete this course will be able to:

- draw various views of engineering components
- graphically communicate their concepts and ideas on new designs

---

<b>SSB1182</b>	<b>SOCIOLOGY, ETHICS AND HUMAN VALUES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To describe the fundamental and basic concepts of Sociology.
- To illustrate how society evolved in India with changes in social strata.
- To explain the importance of groups, teams in industrial spheres.
- To develop the knowledge of social impact of economic liberalization and technology.
- To state some basic concepts on ethics, values and human rights.
- To develop social responsibility & human professional ethics.
- To recognize and determine the role of engineers in the economic and social development of the society.

**MODULE I FUNDAMENTALS OF SOCIOLOGY 8**

Sociology - definition, evolution, scope- Basic concepts-Social Process-Sociological theories, Social Institutions – family, economic, politics, religion, education, culture, Social Stratification , Socialization & Social Control.

**MODULE II SOCIOLOGY IN INDIAN CONTEXT 7**

Development in India– Caste & Classes – Women and Society – impact of social laws, Social Change in contemporary India – Secularism and Communalism – Social Exclusion and Inclusion.

**MODULE III INDUSTRIAL SOCIOLOGY 7**

Definition and perspectives – Industry in India – Social groups in industry – Behavior pattern, Group Dynamics – team, enhancing group behaviour. Industrial Organization - formal and informal organizations, Line and staff organizations - functions.

**MODULE IV INDUSTRIAL – SOCIETY INTERFACE 8**

Perspectives – Social responsibilities – Sociological effect on industrialization – urbanization, child labour, psychological impact, Impact of technology, Modernization – Globalization – challenges, Role of engineers.

**MODULE V ETHICS AND HUMAN VALUES**

**7**

Ethics and values – Organizational values – personal worth, ethical behavior, Professional ethics-professional rights and responsibilities, Whistle blowing, International ethics, Corruption.

**MODULE VI ENGINEERS AND SOCIETY**

**8**

Quality of life and society – engineer in economic development, Technology development – invention, innovation and diffusion, Appropriate Technology– Engineer’s contribution, Ecology and environment –Sustainable development– Role of engineers.

**Total Hours: 45**

**REFERENCES:**

1. Samir Das Gupta and Paulomi Saha, An Introduction to Sociology, Pearson, Delhi, 2012.
2. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
3. Vidya Bhushan and D.R. Sachdeva, Fundamentals of Sociology, Pearson, Delhi, 2012.
4. Deshpande, Satish, Contemporary India : A Sociological view, Viking (2002)
5. Thopar, Romila, Early India, Penguin (2003).
6. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996.
7. Haralambos, Heald R.M, Sociology Themes and Perspectives, Oxford, New Delhi-92
8. Ram Ahuja, Social Problems in India,Rawat Publications ,New Delhi

**OUTCOMES:**

On successful completion of this course,

- Students will have exposure to the fundamentals and the basic concepts of Sociology.
- Students will have gained knowledge about the reality of the society.

**B.Tech. Automobile Engineering**

---

- Students will be able to positively respond to the forces of change.
- Students will inculcate common interests of the group and adopt legitimate means to achieve them.
- Students will have knowledge about the impact of technology, modernization, and globalization.
- Students will be able to conform to the rules of the society and communicate effectively with the engineering community and with the society at large
- Students will work effectively as individuals, in teams and in multi-disciplinary settings together with the capacity to undertake holistic development of the society.

**OBJECTIVES:**

- To understand the basic concepts of properties of matter, wave optics
- To understand the properties of ultrasonic and Laser.
- To understand the crystal growth technique.
- To correlate the experimental results with the theoretical values.

**LIST OF EXPERIMENTS:**

1. Torsional Pendulum- Determination of rigidity modulus of a given wire.
2. Determination of coefficient of viscosity of a liquid by Poiseuille's method .
3. Determination of Young's modulus of a beam using non – uniform bending method.
4. Determination of a thickness of a given wire – Air wedge.
5. Spectrometer- determination of wavelength of given source by using grating.
6. Determination of velocity of ultra sonic waves – Ultrasonic Interferometer.
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of particle size using Laser.
9. Growth of crystal by slow evaporation technique.
10. Determination of angle of divergence of Laser beam.
11. Photo electric effect experiment.

**OUTCOMES:**

On completion of this course, the student will know

- Properties of matter, wave optics and quantum physics
- Properties and application of Ultrasonic and Laser
- Principle and concept of crystal growth technique.

**OBJECTIVES:**

To make students conversant with the

- estimation of hardness and TDS in water samples.
- construction of cell and determination of EMF.
- estimation of pH of solutions.
- verification of Beer Lambert's law.

**LIST OF EXPERIMENTS:**

1. Estimation of hardness in domestic water.
2. Estimation of total dissolved solids (TDS) in domestic water
3. Construction and determination of emf of a cell.
4. Determination of single electrode potential.
5. Estimation of strong acid in the industrial effluents
6. Estimation of Fe<sup>2+</sup> present in unknown sample by Potentiometry
7. Verification of Beer-Lamberts law and estimation of Cu<sup>2+</sup> present in unknown sample.
8. Estimation of Na and K present in the agricultural field.
9. Study of effect of inhibitors in free radical polymerization (Demo)

**OUTCOMES:**

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

- estimate the degree of hardness and TDS in water samples.
- construct and calculate EMF of cell.
- apply the concept of Beer lamberts law.





**OUTCOMES:**

Students who complete this course

- Should be able to appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Should be able to attend minor defects especially in items used in day to day life
- Should be aware of the safety aspects involved in using tools and instruments.



---

**MODULE VI ARRAYS AND LOOP CONTROL STATEMENTS**

**5**

Arrays – Initialization – Definition – Characteristics – One dimensional array – Two dimensional arrays - Multi dimensional arrays – Predefined streams - Operation with arrays – Sorting and searching – Structures – Operations on structures.

**LIST OF EXPERIMENTS:**

**30**

1. Computer organization –Hardware in a typical computer Identification – Booting - error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types Type conversions
5. Input/Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching

**Total Hours: 60**

**TEXTBOOKS:**

1. Ashok N Kamthane, “Computer Programming”, 2<sup>nd</sup> Edition, Pearson Education, 2012.
2. Paul J. Deitel, Deitel & Associates, “C How to Program”, 7<sup>th</sup> Edition, Pearson, Education, 2012.

**OUTCOMES:**

Students who complete this course will be able to

- Apply Modular design, logic flow and data abstraction in programming paradigm.
- Use the concepts of constructs, functions, I/O and algorithms in the programming environment.
- Develop simple real time applications using the programming constructs and algorithms.

**SEMESTER II**

<b>MAB1282</b>	<b>ADVANCED CALCULUS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVE:**

The aim of the course is to

- train the students in additional areas of Engineering Mathematics, necessary for grooming them into successful engineers. The topics will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and communication engineering.

**MODULE I DOUBLE INTEGRALS 7**

Double integration – Cartesian and Polar coordinates – change of order of integration – area as a double integral — change of variables between Cartesian and polar coordinates.

**MODULE II TRIPLE INTEGRALS AND SPECIAL FUNCTIONS 7**

Triple integration in Cartesian coordinates - change of variables between cartesian, cylindrical and spherical polar coordinates - Beta and Gamma functions.

**MODULE III VECTOR INTEGRATION 7**

Line, surface and volume integrals – Green’s, Gauss Divergence and Stoke’s theorems (without proof) – verification and evaluation of integrals using them.

**MODULE IV ANALYTIC FUNCTION 8**

Analytic function - Necessary and Sufficient condition (Proof not included) – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping ( $w = z+a$ ,  $az$  and  $1/z$ ) and bilinear transformation.

**MODULE V COMPLEX INTEGRATION 8**

Statement and application of Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s series and Laurent’s series expansion – singularities - classification – residues - Cauchy’s residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange’s linear equation – Linear partial differential equations of second and higher order with constant coefficients.

**L – 45; T – 15; Total Hours- 60**

**TEXT BOOKS:**

1. Veerarajan.T., “Engineering Mathematics “(5<sup>th</sup> edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., “Higher Engineering Mathematics” (42<sup>nd</sup> edition), Khanna Publishers, New Delhi, 2012.

**REFERENCES:**

1. Kreyszig, E., “Advanced Engineering Mathematics“, 10<sup>th</sup> edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O’Neil, “Advanced Engineering Mathematics”, 7<sup>th</sup> edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.
5. Ramana, B.V., “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., “Engineering Mathematics”, Volume 2, 2<sup>nd</sup> edition, National Publishing Co., Chennai, 2003.

**OUTCOMES:**

On completion of the course the students will be able to

- solve integrals of higher orders.
- apply vector calculus for solving engineering problems.
- solve complex differentiation and integration problems related to engineering.
- formulate practical problems in terms of partial differential equations, solve them and physically interpret the results.

**OBJECTIVES:**

To make students conversant with

- The three types of fuels available and the different processes involved in it.
- The calculations involved in calorific values and minimum air requirement for complete combustion.
- The classification, functions, mechanism and properties of lubricants.
- The classification and description of different types of batteries.
- The five types of corrosion and six methods to control it.
- The polymeric materials used in engineering applications.

**MODULE I FUELS**

**8**

Classification of fuels – Solid, Liquid and Gaseous fuel (comparison) – petroleum (refining, fractions, composition and uses) – cracking: thermal and catalytic (fixed bed and moving bed) – synthetic petrol: Fischer-Tropsch – knocking: octane number, improvement of octane number (antiknocking) – diesel engine fuel: cetane number, improvement of cetane number, biodiesel (trans-esterification) – producer gas – water gas – CNG – LPG – biogas.

**MODULE II COMBUSTION**

**7**

Combustion – calculation of minimum requirement of air (problems) – Gross and net calorific values (definition and relationship) – theoretical calculation of calorific values (Dulong's formula, problems) – Bomb Calorimeter – Boy's Gas Calorimeter (problems) – flue gas analysis by Orsat apparatus.

**MODULE III LUBRICANTS**

**6**

Lubricants and lubrication: definition, functions and classification with examples – properties: viscosity index, flash and fire point, cloud and pour point, oiliness, carbon residue, aniline point – greases: calcium, sodium and lithium based – solid lubricants – graphite and molybdenum disulphide.

**MODULE IV ENERGY STORING DEVICES AND SENSORS**

**7**

Introduction – types of batteries (primary, secondary and flow cell) primary

batteries: dry cells, alkaline batteries – secondary batteries; lead acid storage cell, nickel - cadmium cell – flow cell: hydrogen-oxygen fuel cell – lithium battery – solar cell – dye sensitized solar cell – sensors: types, working principle and applications.

#### **MODULE V CORROSION AND ITS CONTROL**

**9**

Introduction – Galvanic series – types of corrosion: galvanic corrosion, differential aeration corrosion, pitting corrosion and stress corrosion – corrosion control: cathodic protection (sacrificial anode protection method) – selection of materials and proper designing – corrosion inhibitors – Electroplating – Electrolessplating – Hot dipping (galvanizing and tinning) – Chemical conversion coatings (Chromate, phosphate, oxide coating, Anodizing).

#### **MODULE VI POLYMERIC MATERIALS**

**7**

Engineering plastics: Introduction and advantages – preparation, properties and applications of polycarbonates, TEFLON, polyurethane, nylon-6,6, Kevlar – Thermosetting resins: bakelite – polyester- vulcanization of rubber - rubber blended plastics: ABS plastics – laminated plastics: process – polymer blends and polymer alloys, FRP: glass, carbon, aramid- properties and uses

#### **TEXT BOOKS:**

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2002.
2. Puri B.R., Sharma C.R. and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 2000.

#### **REFERENCES:**

1. Wang M.N., Polymers for electronic and photonic applications, Wiley New York, 1994.
2. Bahl B.S., Tuli G.D. and Arun Bhal, Essentials of Physical Chemistry, S. Chand and Co. Ltd., New Delhi, 2003.
3. Ray G.D., Nonconventional Energy Sources.



**OUTCOMES:**

- Compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- Calculate minimum air required for complete combustion and calorific values of fuels.
- Categorize different lubricants into three types and determine its properties.
- Illustrate eight types of batteries with the aid of a diagram.
- Recognize and justify the five types of corrosion, when the situation is given. They will also be able to describe the corrosion inhibition methods and apply a few in their daily life.
- Identify eleven types of polymeric materials and relate it to their application in daily use.

---

<b>SSB1181</b>	<b>INTRODUCTION TO ECONOMICS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and exchange.
- To create an awareness about the industrial sector, markets and trade and their contribution to economic development.
- To describe the five year plans, budget, fiscal policy and taxation.
- To discuss Indian economy and justify the role of engineers in economic development.

**MODULE I INTRODUCTION 8**

Classification of economy – open and closed economy – Sectors of economy – Basic principles of Microeconomics – supply, demand and equilibrium, Elasticity of demand – Pricing models.

**MODULE II NATIONAL INCOME DETERMINATION 7**

National income concepts – GNP, GDP, disposable income; Aggregate demand and aggregate supply, Macroeconomic equilibrium - Concepts of MPS, APS, MPC APC, Inflation – Price indices - WPI, CPI and Inflation control.

**MODULE III MONEY AND BANKING 7**

Role and functions of money - Monetary System - Money market - Role of Central Bank - Monetary policy - Commercial banks - Development banks - Capital market and Debt market.

**MODULE IV INDUSTRY, LABOUR MARKET AND TRADE 7**

Public and Private sectors, Contribution to the National economy - Industrial policy - Labour market - Trade: Domestic and International trade.

**MODULE V BUDGET, POLICIES AND INDICATORS 8**

Economic development – Five year plans, Macroeconomic indicators - Central budget - Government tax- revenue and non-tax revenue, Government

expenditures - plan and non-plan expenditures – Fiscal policy – The impact of the budget on the economy.

**MODULE VI ECONOMIC GROWTH AND THE ROLE OF ENGINEERS 8**

Indian Economy – Development in the post independence era – Growth of the economy, Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Contribution of engineers to the economic growth.

**Total Hours: 45**

**REFERENCES:**

1. Vanitha Agarwal, Macroeconomics: Theory and Practice, Pearson, 2010.
2. Dwivedi D.N, Macroeconomics: Theory and Policies, 3<sup>rd</sup> edn; McGraw Hill, 2010.
3. Samuelson, Paul A., Macroeconomics, 19<sup>th</sup> edn., TMH, 2009.
4. Gupta G.S, Macroeconomics: Theory and Applications, 3<sup>rd</sup> edn; TMH, 2007.
5. R.K. Lekhi, Public Finance, Kalyani Publishers.
6. D. M. Mithani, Money, Banking, International Trade and Public Finance, Himalaya Publishing House.
7. R.R. Paul, Monetary Economics, Kalyani Publishers.
8. Benson Kunjukunju and S. Mohanan, Financial System and Financial Institutions in India, New Century Publications.
9. Raddar Datt, K.P.M. Sundharam, Indian Economy, S. Chand.
10. Gregory Mankiw, Principles of Economics, Cengage Learning.
11. Gregory Mankiw, Principles of Microeconomics, Cengage Learning.
12. Uma Kapila, Indian Economy since Independence, Academic Foundation.
13. Andrew Gillespie, Business Economics, Oxford University Press.
14. Pindyck, Rubinfeld and Mehta, Microeconomics, Pearson.
15. C.B. Gupta, Business Environment, Sultan Chand and Sons.

**OUTCOMES:**

On successful completion of this course,

- Students will have an exposure to the basic concepts of microeconomics and macroeconomics.
- Students will be able to identify the concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and exchange in their real life situations.
- Students will have gained knowledge in government budget, economic planning and its implementation.
- Students will have an overview of the economic reforms introduced in Indian economy.
- Students will be able to analyze the importance of economics and apply the knowledge they have gained in their professional pursuits.

---

<b>GEB1211</b>	<b>BASIC ENGINEERING MECHANICS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES:**

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give an exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

**MODULE I VECTOR APPROACH TO MECHANICS 7**

Introduction - Units and Dimensions - Laws of Mechanics – Lame’s theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics -Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle

**MODULE II EQUILIBRIUM OF PARTICLE 6**

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

**MODULE III EQUILIBRIUM OF RIGID BODY 6**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon’s theorem - Equilibrium of Rigid bodies in two dimensions -Examples

**MODULE IV PROPERTIES OF SURFACES 8**

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration

- T section, I section, Angle section, Hollow section by using standard formula
- Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia

**MODULE V LAWS OF MOTION 10**

- Review of laws of motion – Newton’s law – Work Energy Equation of particles
- Impulse and Momentum – Impact of elastic bodies.

**MODULE VI FRICTION 8**

- Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction – Rolling resistance –ladder friction

**Lecture 45 Tutorial :15 Total Hours: 60**

**REFERENCES:**

- 1 Beer,F.P and Johnston Jr. E.R, “Vector Mechanics for Engineers, Dynamics & Statics”, Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
- 2 Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000–
- 3 Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003

**OUTCOMES :**

On completion of this course students:

- Should be able to resolve forces, moments and solve problems using various principles and laws
- Students should be able to understand the concept of equilibrium, kinetics and kinematics and be capable of formulating the governing equations to practical problems and provide solutions for those equations

---

<b>EEB1283</b>	<b>BASIC ELECTRICAL ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

To impart knowledge on

- Basic concepts of electrical circuits and their solutions
- Principle of operation, characteristics and applications of various D.C. and A.C. machines
- Usage of the machines as drives
- Concepts of control systems and its components

**MODULE I DC AND AC CIRCUITS 10**

Introduction to DC circuits: Ohm's law - Kirchoff's law - series and parallel connections - branch currents and voltages across elements - star-delta and delta-star transformation. Introduction to AC circuits: phasor representation – real, reactive and apparent powers - 3 phase circuits - star and delta connections – simple problems.

**MODULE II DC MACHINES 9**

DC generators and DC motors: Construction – types – principle of operation - characteristics – starting and speed control – load test and performance characteristics – efficiency – applications – simple problems.

**MODULE III TRANSFORMERS 6**

Transformers: Construction – types – principle of operation - Ideal transformers – loading of transformers – equivalent circuit - voltage regulation –efficiency - simple problems.

**MODULE IV INDUCTION MOTORS 6**

Three phase Induction motor: Construction – types - principle of operation – starting and running torques – torque Vs slip characteristic – starting and speed control - simple problems.

**MODULE V INTRODUCTION TO CONTROL SYSTEMS 8**

Differential equations and transfer function of mechanical and electrical

systems – time response of first and second order systems - errors – components: servo motors and stepper motors.

**MODULE VI SOLID STATE DRIVES**

**6**

Introduction to thyristors – types – principle of operation – speed control of DC motors and Induction motors using SCRs - PWM drives – variable voltage variable frequency drives.

**Total Hours : 45**

**REFERENCES:**

1. William H.Hayt Jr, Jack E. Kemmerley, and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Sudhakar A and Shyam Mohan S P, “Circuit and Network Analysis and Synthesis”, McGraw Hill Publishing Co. Ltd., 2007.
3. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 9<sup>th</sup> Edition, 2007.
4. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Publishing Co. Ltd., 2<sup>nd</sup> Edition, 2002.
5. Cotton H, Electrical Technology, Pitman, 2004.
6. B L Theraja and A K Theraja, “A textbook of Electrical Technology”, S.Chand, 2005.

**OUTCOMES:**

On completion of this course, the student will be familiar with

- The basics of electrical circuits and their solution methods
- Usage of various DC and AC machines as drives
- Concepts of control systems.



**OBJECTIVES:**

To integrate the materials science, manufacturing and mechanics knowledge that students have from previous courses and apply it to engineering design

To impart knowledge on the structure, properties, testing and applications of materials so as to identify and select suitable materials for various engineering applications.

**MODULE I CRYSTALLOGRAPHY AND SOLID SOLUTIONS 9**

Review of crystal structure, space lattice, crystal planes and crystal directions, Numerical related to crystallography. Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram

**MODULE II HEAT TREATMENT 9**

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite. Heat treatment of steels, cast iron, stainless steel, aluminum, copper, magnesium and titanium.

**MODULE III TESTING OF METALS 9**

Testing of materials under tension, compression and shear loads – Hardness tests (Brinnell, Vickers and Rockwell) Impact test - Izod and Charpy. Tests for creep and fatigue.

**MODULE IV NEWER MATERIALS 7**

Ferrous and Non ferrous metals, Engineering Ceramics – Properties and applications, Composites, Shape Memory Alloys, Smart materials, Nanocrystalline Materials, Super alloys, Intermetallics, Biomaterials.

**MODULE V MATERIAL SELECTION 6**

Factors influencing materials selection: mechanical properties, physical properties, manufacturing techniques, cost, Case studies.

**MODULE VI FAILURE ANALYSIS 5**

Wear and Corrosion Failures- Factors Influencing Failures, Analysis of Failures. Failure Analysis Techniques, simple case studies.

**Total Hours: 45**

**REFERENCES:**

- 1 Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
- 2 Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.
- 3 Materials Selection in Mechanical Design Fourth Edition Michael F. Ashby Butterworth-Heinemann 2011
- 4 Engineering Materials 1 An Introduction to their Properties and Applications Second Edition by Michael F. Ashby and David R. H. Jones Butterworth-Heinemann Reprint 2002
- 5 Kenneth G. Budinski, Michael K. Budinski, "Engineering Materials, Properties and Selection", Pearson Education, 8<sup>th</sup> Edition, 2005
- 6 Introduction to Physical Metallurgy by Sydney Avner , Mc Graw Hill Ltd

**OUTCOMES:**

On completion of this course students should :

- Be able to describe the structure and classify engineering materials.
- Understand properties and behavior of engineering materials.
- Know about the modes of failure (ductile/brittle fracture, fatigue, creep and corrosion) of engineering materials.
- Know how to use information sources to select materials for engineering uses.

**OBJECTIVES**

- To make students conversant with the practical experiments relevant to the theory.

**EXPERIMENTS:**

1. Determination of dissolved oxygen in the given water sample
2. Study of corrosion of a metal in different corrosive mediums
3. Electrodeposition of a metal over an article
4. Determination of flash and fire point of a lubricant using Pensky-Marten's apparatus
5. Determination of cloud and pour point of a lubricant.
6. Preparation of biodiesel using trans-esterification method.
7. Determination of calorific value of a fuel using Bomb calorimeter
8. Preparation of a polymer (Nylon6,6/Bakelite)
9. Determination of viscosity average molecular weight of polymer

**OUTCOMES:**

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

- calculate the dissolved oxygen present in water sample, molecular weight of the polymer and calorific value of a fuel.
- determine flash, fire, cloud and pour point for lubricants
- prepare biodiesel and a polymer.

---

<b>ENB1282</b>	<b>WRITTEN COMMUNICATION</b>	<b>L T P C</b>
		<b>0 0 2 1</b>

**OBJECTIVES:**

- To help students identify content specific vocabulary and learn its usage.
- To teach them formal and informal expressions in business communication.
- To expose them to reading for specific purposes, especially in business contexts.
- To expose them to the process of different kinds of formal writing.
- To train them in using the nuances of writing in corporate correspondence.
- To train them in writing effective applications with résumé and reports.

**MODULE I** **4**

Introduction - process of writing – ABC of academic and professional writing  
– Instructions and recommendations  
Reading business related texts for specific information.

**MODULE II** **4**

Format and conventions of writing email, memo & fax.  
Writing email (Case study), memo, fax, agenda and minutes of the meeting  
(using mobile applications)

**MODULE III** **6**

Format and conventions of writing agenda and minutes of the meeting  
Letter Writing--Calling for an interview & letter of inquiry

**MODULE IV** **6**

Writing letter of application and Résumé - Different types – Functional,  
Chronological  
Writing one's résumé using Wikispaces

**MODULE V** **6**

Reporting an incident, writing a feasibility report, and progress report &  
discipline specific reports

Reading a case study (industry specific) – collaborative writing using Wikispaces

**MODULE VI**

**4**

Writing Statement of purpose– Assessing one’s strengths and weaknesses & self and peer evaluation of strengths.

**Total Hours: 30**

**REFERENCES:**

1. Riordan,D (2013). Technical Report Writing Today. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J.(2012). Writing that Works: Communicating Effectively on the Job . Bedford/St. Martin’s. Eleventh Edition.
3. Garner, B.A. (2013). HBR Guide to Better Business Writing (HBR Guide Series). Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). Business Correspondence and Report Writing. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). Academic and Professional Writing for Teachers. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.

**OUTCOMES:**

On completion of the course, the students will have the ability to

- Create different types of academic and professional documents by using the three stages of writing.
- Identify content specific vocabulary and also use them in appropriate contexts.
- Use formal and informal expressions in real life situations.
- Demonstrate reading skills with reference to business related texts.
- Compose written correspondence effectively in work place contexts.
- Write effective letter of applications, résumé and reports.

---

<b>MEB1212</b>	<b>DESIGN APPRECIATION LABORATORY</b>	<b>L T P C</b>
	<b>(Common for Mechanical, Aeronautical and Automobile Engineering)</b>	<b>0 0 3 1</b>

**OBJECTIVES:**

- To appreciate the use of various mechanisms involved in engineering products
- To gain the knowledge through experience of handling of engineering products
- To understand reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting
- To know the importance of team working skills

**STUDY EXERCISE:**

1. Study of Standard Components

**PRACTICAL EXERCISE:**

Do the teardown process on following Engineering products, and also can be aware of

- Identification of the components
  - Functions of the components
  - Mechanisms involved
  - Material and manufacturing process involved
1. 2 Stroke petrol engine
  2. 4 Stroke petrol engine
  3. Reciprocating Compressor / blower/ Rotary Compressor
  4. Axial and radial piston pump
  5. Gear pump and vane pump
  6. Reciprocating pump (single and multi acting)
  7. Centrifugal pump (Mono block, Coupled type) and submersible pump
  8. Fixed reduction gear box
  9. Valves

10. Work holding devices
11. Mechanical components in electronic devices (CDD, HDD and printer)
12. Fuel feed pump and carburetor
13. Transmission system for diesel engine
14. Front axle and Steering
15. Rear axle and Differential

**OUTCOMES:**

On completion of the course, the students

- Would have understood the importance of design features in various engineering components.
- Will have awareness about single product meets multiple functions.
- Would have gained confidence in abilities to handle various engineering products and kindle own creativity and ideation.
- Enhanced team working skills.

**OBJECTIVES:**

- To understand, simulate and verify Thevenin's and Norton's theorem.
- To understand and verify the characteristics of various Electrical Machines
- To understand the three phase Power Measurement in AC circuits.

**LIST OF EXPERIMENTS:**

1. Verification of Thevenin's theorem and Norton's theorem using MATLAB
2. Open circuit characteristics and Load Characteristics of Self Excited DC Generator
3. Load Test on DC Shunt and DC Series Motor
4. Load Test on Single Phase Transformer
5. Load Test on Three Phase Induction Motor
6. Measurement of 3 phase power using 2 wattmeter method

**OUTCOMES:**

At the end of the course, the student should be able to:

- Construct and simulate any given simple electric circuits and verify theorems using MATLAB
- Study and understand the performance of Electrical Machines
- Measure the three phase power.



**SEMESTER III**

<b>MAB 2181</b>	<b>TRANSFORMS AND APPLICATIONS</b>	<b>L T P C</b>
	<b>(Common to all branches)</b>	<b>3 1 0 4</b>

**OBJECTIVES:**

The course aims to

- develop the skills of the students in the areas of boundary value problems and transform techniques.
- acquire knowledge on different transforms like Laplace Transform, Fourier Transform and Z-Transform.

**MODULE I LAPLACE TRANSFORM 8**

Laplace transform – sufficient condition – Transforms of elementary functions - Properties – Transforms of Derivatives and Integrals – Initial and Final Value Theorem - Transform of Periodic functions - Inverse transforms - Convolution Theorem.

**MODULE II FOURIER SERIES 7**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range sine series – Half-range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

**MODULE III BOUNDARY VALUE PROBLEMS 8**

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

**MODULE IV FOURIER TRANSFORM 7**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**MODULE V Z -TRANSFORM AND DIFFERENCE EQUATIONS 7**

Z-transform - properties – Inverse Z-transform – Convolution theorem - Formation of difference equations.

**MODULE VI APPLICATIONS OF TRANSFORMS**

**8**

Applications of Laplace Transform in solving linear ordinary differential equations - Second order with constant coefficients, Simultaneous First order equations– Applications of Z–transform in solving difference equations using Z–transform.

**Total Hours: 60**

**TEXT BOOKS:**

1. Veerarajan.T., “Engineering Mathematics“, 5<sup>th</sup> Edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., “Higher Engineering Mathematics”, 42<sup>nd</sup> Edition, Khanna Publishers, New Delhi, 2012.

**REFERENCES:**

- Kreyszig .E., “Advanced Engineering Mathematics“, 10<sup>th</sup> Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
- Peter V. O'Neil, “Advanced Engineering Mathematics”, 7<sup>th</sup> Edition, Cengage Learning, 2011.
- Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4<sup>th</sup> Edition, Jones and Bartlett publishers, Sudbury, 2011.
- Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.
- Ramana B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

**OUTCOMES:**

- Find general solutions of first order separable ordinary differential equations.
- Find the Laplace transform of a function from the definition of a Laplace transform.
- Find the Laplace transform of the exponential, cosine and sine functions.
- Carry out arithmetic operations for complex numbers.
- Convert complex numbers between Cartesian and exponential form.
- Apply the chain rule to partial differentiation.
- Apply gradient vectors to find directional derivatives.

**OBJECTIVES:**

The aim of the course is to introduce basic biological concepts to the engineering students to promote cross-breeding of ideas. In particular,

- To provide an overview of cell structure and function.
- To give basic idea on biochemistry related to biological aspects.
- To introduce genes, their structure, inheritance and about living organisms.
- To give an understanding on metabolism, respiration, etc.
- To inform students of engineering about the interface of biology and engineering.

**MODULE I BASICS OF CELL STRUCTURE AND FUNCTION 7**

Cells as unit of life – basic chemistry of cell – cell structure and functions – Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, nucleus, chromosomes- cell division – mitosis, meiosis.

**MODULE II BIOCHEMISTRY 8**

Biomolecules – introduction – pH and biological buffers – carbohydrates-mono, di, oligo and polysaccharides, lipids- phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglanin – proteins – types – glycoproteins, lipoproteins – structures - primary, secondary, tertiary and quarternary – Nucleic acids – RNA – Types – tRNA, mRNA, giRNA, miRNA, DNA – rDNA, gDNA, cDNA.

**MODULE III GENETICS 7**

Genes – structure and functions – behavior, dominance and epigenetics, evolution – inheritance – reproduction and gene distribution – genome of living organisms – plants – bacteria and viruses – animals – humans, genetic engineering and cloning.

**MODULE IV MICROBIOLOGY 8**

Microbiology – basis of microbial existence – microbial diversity – classification

**B.Tech. Automobile Engineering**

---

and nomenclature of micro-organisms- impact of microorganisms in industry, agriculture and health, industrial microbiology – primary and secondary screening of micro-organisms, fermentation processes, bioreactors, microbial ecology – microbial bio-remediation – epidemiology and public health.

**MODULE V METABOLISM 7**

Metabolic processes – bio-membranes, diffusion, absorption, osmo-regulation, photosynthesis, respiration, digestion and excretion.

**MODULE VI BIOLOGY AND ENGINEERS 8**

Application of biology in engineering– living things as the solutions (bionics) – living things as models (biometrics) – bio-technology – biomedical engineering – effect of human action on living things – right balance – bioinformatics – bionanotechnology – sensors, biosensors, biochips-ethics in biology.

**Total Hours : 45**

**REFERENCES:**

1. Johnson, Arthur T., "Biology for Engineers", CRC Press, FL, 2011.
2. Campbell and Reece, "Biology", Pearson, Benjamin Cummins Pub. 8<sup>th</sup> edition, 2008.
3. Scott Freeman, "Biological Sciences", Prentice Hall, 2002.

**OUTCOMES:**

After finishing this course students will be able to

- understand basics of biological processes, composition of cell contents
- understand applications of microbes in industrial manufacturing of proteins, antibodies and antibiotics.
- understand cloning and genetic engineering
- identify the genes in different genome (plants, microbes, animals, human) and compare the genes by bioinformatics approaches

---

<b>MEB2214</b>	<b>FLUID MECHANICS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES:**

- To introduce the concepts of fluid statics viscosity and buoyancy.
- To make the students to understand the basic laws namely, mass momentum and energy.
- To study the various losses in flow through pipes and estimate these losses.
- To introduce the construction, working and analysis of fluid machinery.

**MODULE I BASIC CONCEPTS AND PROPERTIES 10**

Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapor pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

**MODULE II FLUID KINEMATICS AND FLUID DYNAMICS 11**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net - fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation - applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's -  $\pi$  - Theorem-applications - similarity laws and models.

**MODULE III INCOMPRESSIBLE FLUID FLOW 10**

Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's)

**MODULE IV FLOW THROUGH PIPES 9**

Hydraulic and energy gradient - flow through pipes - Darcy -weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel- power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

**MODULE V HYDRAULIC TURBINES**

**10**

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

**MODULE VI HYDRAULIC PUMPS**

**10**

Pumps-definition and classifications - Centrifugal pump: classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitation in pumps - rotary pumps: working principles of gear and vane pumps

**Total Hours: 60**

**TEXT BOOKS:**

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5<sup>th</sup> edition), Laxmi publications (P) Ltd, New Delhi, 1995
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (7<sup>th</sup> edition), 1995.
3. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers,1992

**REFERENCES:**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. White, F.M., "Fluid Mechanics", Tata McGraw-Hili, 5<sup>th</sup> Edition, New Delhi, 2003.
3. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
4. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hili, 2<sup>nd</sup> Edition, 2004.

**OUTCOMES:**

- Be able to understand the behavior of fluids.
- Understand the various laws and application of these laws into fluid machineries.
- Understand the various losses in flow through pipes and the methods to determine these losses.

**OBJECTIVES:**

- To gain knowledge of simple stresses, strains and deformation in components.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.
- The study would provide knowledge for use in the design courses

**MODULE I STRESS STRAIN AND DEFORMATION OF SOLIDS 10**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

**MODULE II BEAMS - LOADS AND STRESSES 12**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

**MODULE III TORSION 8**

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts.

**MODULE IV BEAM DEFLECTION 10**

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method.



**MODULE V APPLICATION OF TORSION AND BEAM DEFLECTION 10**

Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads.

Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

**MODULE VI ANALYSIS OF STRESSES IN TWO DIMENSIONS 10**

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr’s circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

**Total Hours: 60**

**TEXT BOOK:**

1. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co, Third Edition, 2002.

**REFERENCES:**

1. Popov E.P, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, 1997.
2. Nash W.A, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
3. Timoshenko S.P, Elements of Strength of Materials, Tata McGraw-Hill, New Delhi 1997.
4. Ryder G.H, Strength of Materials, Macmillan India Ltd., Third Edition, 2002.
5. Ray Hulse, Keith Sherwin & Jack Cain, “Solid Mechanics”, Palgrave ANE Books, 2004.
6. Singh D.K “Mechanics of Solids” Pearson Education 2002.
7. Kazimi S.M.A, Solid Mechanics, Tata McGraw-Hill Publishing Co, New Delhi, 1981.

**OUTCOMES:**

- Should have gain knowledge of simple stresses, strains and deformation in components.
- Should have understood the effect of stresses and deformations on component dimensions and shape.
- They should have gained basic knowledge for use in the design courses

---

<b>MEB2103</b>	<b>THERMODYNAMICS</b>	<b>L T P C</b>
	<b>(Use of standard Steam tables, Mollier diagram, Psychrometric chart is permitted)</b>	<b>3 1 0 4</b>

**OBJECTIVES:**

- To gain knowledge on the concept of systems and energy transfer
- To understand analyze and apply the basic laws of thermodynamics
- To understand the principle of steam power cycle and its improvement
- To understand thermodynamic relations and their significance
- To gain knowledge on the properties of moist air and psychrometric processes

**MODULE I BASIC CONCEPT AND FIRST LAW 10**

Basic concepts - concept of continuum, macroscopic approach, types of thermodynamic systems. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

**MODULE II SECOND LAW, ENTROPY AND AVAILABILITY 10**

Second law of thermodynamics – Kelvin’s and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot theorem, absolute entropy, availability, Concept of Exergy analysis.

**MODULE III PROPERTIES OF PURE SUBSTANCE AND VAPOUR PROCESSES 10**

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes.

**MODULE IV STEAM POWER CYCLES 10**

Standard Rankine cycle, Modified Rankine cycle, cycle improvements - reheat cycle and regenerative cycle. Simple problems.

**MODULE V GAS MIXTURES AND THERMODYNAMIC RELATIONS 10**

Gas mixtures – properties of ideal and real gases, equation of state, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, Amagut law, T-ds equations, Maxwell's relations, Clausius Clapeyron equations, Joule – Thomson coefficient.

**MODULE VI PSYCHROMETRY 10**

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, simple problems.

**Total Hours: 60**

**TEXT BOOKS :**

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.
2. Cengel, "Thermodynamics An Engineering Approach", 3<sup>rd</sup> Edition – 2003, Tata McGraw Hill, New Delhi.

**REFERENCES :**

1. Holman.J.P., "Thermodynamics", 3<sup>rd</sup> Edition McGraw-Hill, 1995.
2. Natarajan. E., "Engineering Thermodynamics" Anuragam Publications, Chennai, 2012.
3. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Sri Vastava R.C, Saha S. K, Jan A. K, "Thermodynamics" Prentice Hall of India, New Delhi, 2004.

**OUTCOMES:**

The student should be able to

- conceptualize and apply the laws of thermodynamics to any real life situation
- design and analyze steam power cycles
- synthesize and utilize thermodynamic relations for practical problems solving
- design and analyze air- conditioning problems

---

<b>ECB 2181</b>	<b>ELECTRONICS FOR MECHANICAL SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study the characteristics of semiconductor devices such as diodes, transistors and their applications
- To study fundamentals of digital logic circuits
- To study 8085 microprocessors and its interfacing with other peripheral devices.

**MODULE I SEMICONDUCTORS AND RECTIFIERS 6**

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction and its application - Zener diode.

**MODULE II TRANSISTORS AND AMPLIFIERS 8**

Bipolar junction transistor- CB, CE, CC configuration and characteristics- Field effect transistor:Configuration and characteristic-SCR, DIAC, TRIAC, UJT-Characteristics and simple applications.

**MODULE III DIGITAL ELECTRONICS 9**

Number systems- Binary Arithmetic Operations-Boolean Algebra-Logic gates-Karnaugh map:SOP,POS.

**MODULE IV COMBINATIONAL and SEQUENTIAL CIRCUITS 8**

Combinational Circuits: Half and full adders- Magnitude Comparator- Sequential circuits: Flip Flops: SR, JK, D and T FF- Truth tables and circuits-Shift Registers

**MODULE V 8085 MICROPROCESSOR 7**

Architecture of 8085-Pin configuration- Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

**MODULE VI INTERFACING AND APPLICATIONS OF MICROPROCESSOR 7**

I/O Interfacing: I/O mapped I/O and Memory mapped I/O - Intel 8255 PPI.- Applications of microprocessor: Stepper motor control & traffic light control.

**Total Hours : 45**

**TEXT BOOKS:**

1. Milman and Halkias, "Integrated Electronics", Tata McGraw-Hill publishers,1995.
2. Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 1998.

**REFERENCES:**

1. Malvino and Leach, "Digital Principles and Applications", Tata McGraw-Hill,1996]
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd, 1994
3. Douglas V.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, 1999.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits" First Edition, Tata McGraw-Hill, 1999.

**OUTCOME:**

- Working principles and characteristics of various semiconductor devices
- Different digital logic circuits : Combinational and sequential circuits
- Architecture of 8085, its features and programming for specific application

**OBJECTIVES:**

- To empower students with soft skills for employability.
- To help students speak effectively.
- To expose them to a range of business contexts through podcasts for learning appropriate expressions and using them effectively.
- To enable them to make effective presentations.
- To help them learn persuasive and negotiating skills.
- To train them in deliberating on current affairs efficiently by participating in group discussions.
- To prepare them for job interviews.

**MODULE I**

**4**

Training in soft skills-Importance of Oral Communication, rubrics for evaluation, Verbal and non-verbal communication, One-minute presentations & Just a minute (JAM)

Paralinguistic features - Listening to short conversations and monologues for relevant information.

**MODULE II**

**6**

Role-play, Selling a product , marketing skills (Case study on advertisements)

Listening to Business English podcast, Negotiation, persuasion and marketing skills

**MODULE III**

**4**

Deliberation on social and scientific issues & Debates (Peer and Faculty feedback)

Viewing video samples on debates, TED Talks



**MODULE IV** **4**

Pair work- Think, pair and share activity-analyzing & Problem solving

Listening for specific information and taking short notes

**MODULE V** **6**

Discussion etiquette -Assigning different roles in a GD (Peer and Faculty feedback)

Goal setting, Assessing one's strengths and weaknesses & SWOC Analysis

**MODULE VI** **6**

Mock interview (Peer and Faculty feedback) - Types of Job Interview – Telephone Interview, Stress Interview (Case study)

Listening to interviews for understanding speakers' opinions

**Total Hours: 30**

**REFERENCES:**

1. Hancock, Mark (2012). English Pronunciation in Use. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). Study Speaking: A Course in Spoken English for Academic Purposes (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). Personality Development. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). English and Soft Skills. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.

**OUTCOMES:**

On completion of the course, students will be able to

- Apply various soft skills to deal with any professional situation.
- Speak English intelligibly, fluently and accurately.
- Use a range of expressions appropriate to the situations.
- Make effective presentations.
- Use persuasive and negotiating skills for marketing products.
- Deliberate on current affairs with confidence.

**OBJECTIVES:**

- To learn about the various measurements of fluid parameters
- To verify the laws of fluid mechanics
- To study the performance of various pumps and turbines.

**LIST OF EXPERIMENTS:**

1. Comparison of Coefficient of Discharge of given Orifice meter and venturimeter.
2. Calibration of Rota meter.
3. Determination of friction factor for the given set of pipes
4. Performance study of centrifugal pumps / Submersible pumps.
5. Determination of maximum efficiency for the given reciprocating pump.
6. Characteristic curves for Gear pump / Vane pump.
7. Determination of maximum power at constant speed / constant load for an impulse turbine.
8. Performance characteristic of Reaction turbine.
9. Impact of jet on flat and curved vanes.
10. Verification of Bernoulli's theorem.
11. Performance test on a jet pump.
12. Flow visualization :- Laminar and Turbulent flows

**Total Hours : 30**

**OUTCOMES:**

- Students will learn the parameters important for measuring the fluid flows.
- They will be able to run and calculate the performance of the pumps and turbines

**OBJECTIVES:**

- Able to Explain how computer technology is revolutionizing drafting, design, and engineering.
- Able to Describe the basic features and operation of a computer-aided drafting program.
- Able to Explain the various commands used to create objects in CAD.
- Able to Describe the tools used to modify CAD drawings.
- Able to Identify the various display functions used in CAD programs.
- Able to Describe the typical components in a CAD program Help system.
- Able to Explain the importance of CAD file management and identify common storage techniques.
- Able to List different types of CAD software and their applications.

**DRAWING STANDARDS**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

**INTRODUCTION TO DRAFTING SOFTWARE**

Drawing, Editing, Dimensioning, Plotting Commands, Layering concepts, Limits, Fits and Tolerances.

**PREPARATION OF 2-D DRAWINGS**

Orthographic views of standard machine components: Brackets, V Blocks, Stop Block, Screw threads and Threaded fasteners.

**ASSEMBLY DRAWING**

Shaft Couplings: rigid, flexible

Joints - Cotter joints, knuckle joints, Hook's joints.

Bearings - Journal - Footstep thrust or Collar bearing, Plummer block.

**B.Tech. Automobile Engineering**

---

Engine parts - Stuffing box, Connecting rod. Valves safety valve, relief valve, non-return valve.

Machine tool components - Drill jig, Tool post, machine vice, screw jack.

**Total Hours:45**

**REFERENCES:**

1. R.W.Lueptow, M.T.Snyder, J.Steger, Graphics Concepts with Pro/Engineer, Prentice Hall, 2001
2. S.A. Sorby, Solid Modeling with I-DEAS, Prentice Hall, 2000.
3. J.A. Leach, AutoCAD 14 Instructor, WCB McGraw Hill, 1998.
4. N.N., Mechanical Desktop R3 Tutorial, Autodesk Inc., 1998.
5. N.N., Mechanical Desktop Getting Started, Autodesk Inc., 1998.
6. G.R.Bertoline, et.al., Technical Graphics Communication, WCB McGraw-Hill, 1997
7. A.Tizzard, An Introduction to Computer-aided Engineering, McGraw-Hill, 1944.
8. F.E. Giesecke, et.al., Engineering Graphics, Prentice Hall, 2000.
9. O. Ostrowsky, Engineerign Drawing with CAD Applications, ELBS Pub., 1993

**OUTCOMES:**

- Demonstrate proper visualization in various views of three-dimensional object by producing a multi-view drawing.
- Identify, select and apply the sectional view that is appropriate to show interior features for dimensioning.
- Calculate and apply tolerancing and the relationship between mating parts on assembly drawings.
- Through calculation, select various appropriate purchased parts for diverse applications.

---

<b>ECB2182</b>	<b>ELECTRONICS &amp; MICROPROCESSOR LAB</b>	<b>L T P C</b>
	<b>(Common to Mechanical &amp; Automobile)</b>	<b>0 0 3 1</b>

**OBJECTIVES:**

- To study the characteristics of various electronic devices.
- To learn the usage of microprocessor and controllers for various operations.

**NAME OF THE EXPERIMENT**

- i. VI characteristics of PN Junction Diode
- ii. VI characteristics of Zener Diode
- iii. Characteristic of CE Transistor
- iv. Characteristics of JFET
- v. Characteristics of Uni Junction Transistor
- vi. Study of Logic Gates (Basic Gates)
- vii. Half Adder and Full Adder
- viii. Shift Register
- ix. Ripple counter
- x. bit addition, subtraction
- xi. Multiplication and division
- xii. Maximum and Minimum of block of data
- xiii. Sorting and block transfer
- xiv. Stepper Motor Interfacing
- xv. Traffic light controller

**OBJECTIVES:**

Students will be able to

- analyze the characteristics of various electronic devices.
- apply microprocessors and controllers for various operations.

**SEMESTER IV**

<b>MAB2283</b>	<b>APPLIED NUMERICAL METHODS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVE:**

- This course gives a complete procedure to solve problems in engineering numerically, where analytical method fails to give solution.

**MODULE I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 7**

Linear interpolation methods (method of false position) – Newton’s method – Statement of Fixed Point Theorem – Fixed point iteration:  $x=g(x)$  method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverse of a matrix by Gauss Jordan method – Eigenvalue of a matrix by power method.

**MODULE II INTERPOLATION AND APPROXIMATION 7**

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton’s forward and backward difference formulas.- Relations between operators ( $E, \nabla, \mu, \Delta, \Delta'$ )

**MODULE III NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 8**

Derivatives from difference tables – Divided differences and finite differences – Numerical integration by trapezoidal and Simpson’s 1/3 and 3/8 rules – Romberg’s method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson’s rules.

**MODULE IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 8**

Numerical solution of first and second order ordinary differential equations by Taylor series method - Euler Method - Modified Euler’s Method - Runge – Kutta Method of order four.

**MODULE V NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8**

Milne’s Predictor and Corrector Method – Adam’s Predictor-Corrector Method

- Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

**MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS**

**7**

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

**Total Hours: 60**

**TEXT BOOK:**

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, “Numerical methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003.

**REFERENCES:**

1. Grewal, B.S., “Numerical methods in Engineering and Science”, 7<sup>th</sup> edition, Khanna Publishers, 2007
2. C.F.Gerald, P.O.Wheatley, “Applied Numerical Analysis” Pearson Education, New Delhi 2002.
3. P. Dechaumphai, N. Wansophark, “Numerical Methods in Engineering”, Narosa Publications, 2012.

**OUTCOMES:**

At the end of the course students will be able to

- Solve system of equations and eigen value problem of a matrix numerically.
- Use interpolation and find intermediate values for given data.
- Find numerical solution of differential equations in engineering problems.

---

<b>AUB2211</b>	<b>AUTOMOTIVE CHASSIS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To Study the constructional details and mechanism of drive line, Structures, Steering, Braking and Suspension Systems of Automobiles
- To solve the Problem related to Steering Mechanism, Propeller Shaft, Braking and Suspension Systems

**MODULE I INTRODUCTION AND FRAME, STEERING SYSTEM 6**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames

**MODULE II FRONT AXLE AND STEERING SYSTEMS 7**

Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe-in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over-Steer and Under-Steer, Reversible and Irreversible Steering, Power-Assisted Steering.

**MODULE III PROPELLER SHAFT AND FINAL DRIVE 8**

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi-axled vehicles, Differential principle and types, Differential housings, Non-Slip differential, Differential locks, Final drive of Crawler Tractors.

**MODULE IV AXLES AND TYRES 8**

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three-Quarter Floating and Semi-Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.



**MODULE V SUSPENSION SYSTEM**

**8**

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi-Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details, Design of Leaf and Coil Springs.

**MODULE VI BRAKING SYSTEM**

**8**

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Loading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Actuators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power-Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Anti-Lock Braking System, Constructional Details. Traction control, Hill assist, Engine brakes (alias Jake brake)

**Total Hours: 45**

**TEXT BOOKS:**

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2006
2. R.K. Rajput, A Text-Book of Automobile Engineering, Laxmi Publications Private Limited, 2007
3. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

**REFERENCES:**

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13<sup>th</sup> Edition, Butterworth, London, 2005.
3. Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.

**OUTCOME:**

- Be able to understand and analyze various subsystems like drive line, Structures, Steering, Braking and Suspension Systems of Automobiles

**OBJECTIVES:**

- To understand the layout of linkages in the assembly of mechanisms and machines.
- To study the principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To analyze the kinematics of machineries such as cam, toothed gearing and gear trains.
- To understand the kinematic aspects of friction involved in machineries such as belts, clutches and brakes
- To learn about the fundamentals of Vibration and Dynamics

**MODULE I MECHANISMS**

**11**

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

**MODULE II FRICTION**

**10**

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

**MODULE III GEARS**

**10**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains – Determination of speed and torque

**MODULE IV CAMS**

**9**

Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

**MODULE V BALANCING**

**10**

Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

**MODULE VI VIBRATION**

**10**

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

**Total Hours: 60**

**TEXT BOOKS :**

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co., New Delhi, 2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

**REFERENCES :**

1. Rao,J.S and Dukkupati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

**OUTCOMES:**

- Students will be able to understand the fundamentals of mechanisms and their applications

**B.Tech. Automobile Engineering**

---

- Students will be able to analyze the kinematic properties of mechanism such as displacement , velocity and acceleration.
- Students will be able study and analyze machinery such as cams and gears kinematically.
- Students will be able to understand the influence of friction in machines such as belt drives, clutches and brakes.
- Will have knowledge to analyze the different types of Vibration

---

<b>MEB2213</b>	<b>BASIC MANUFACTURING PROCESSES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture

**MODULE I METAL CASTING PROCESSES 8**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting — Lost Wax process – Pressure die casting – Centrifugal casting — Sand Casting defects - Inspection methods.

**MODULE II FABRICATION PROCESS 8**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percussion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – Tig welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding — Flame cutting – Weld defects – Brazing and soldering process — Filler materials and fluxes

**MODULE III BULK DEFORMATION PROCESSES 7**

Hot working and cold working of metals – Forging processes – Open and close die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Flat strip rolling – Types of Rolling mills – Shape rolling operations – Tube piercing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Principle of rod and wire drawing – Equipments used.

**MODULE IV SHEET METAL FORMING PROCESSES 7**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test

methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Explosive forming – Magnetic pulse forming – Peen forming – Super plastic forming – Process characteristics

**MODULE V POWDER METALLURGY**

**7**

Introduction – Methods of powder production – Compaction of metal powders – Equipment – Compaction – Sintering- Secondary and finishing operation – Application – Selective Laser Sintering – Economics of powder metallurgy.

**MODULE VI FORMING AND SHAPING OF PLASTICS**

**8**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods

**Total Hours: 45**

**REFERENCES:**

1. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promoters Pvt Ltd., Mumbai, 2007
2. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2006
3. B.S.MegendranParashar & R.K..Mittal, Elements of Manufacturing Processes, Prentice Hall of India, 2003.
4. P.N. Rao, Manufacturing Technology, Tata McGraw-Hill Publishing Limited, IInd Edition, 2009
5. P.C. Sharma, S. Chand and Company, A Text Book of production technology, Xth Edition, 2008
6. Begman, John Wiley & Sons, Manufacturing Process, VIIIth Edition, 1999.

**OUTCOMES:**

- Gain comprehensive knowledge about different manufacturing processes.

---

<b>AUB2213</b>	<b>MECHANICAL METALLURGY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To expose the students with various constitutions of alloys and its effects on adding with steel and also processing of materials.
- To impart the ability to investigate, analyze and provide solutions to problems arising from metallurgical and materials engineering processes.
- To develop an overall sound knowledge of metallurgical and materials engineering

**MODULE I METALLURGICAL FUNDAMENTALS AND CONSITUTION OF ALLOYS 8**

Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Constitution of alloys – Solid solutions, substitutional and interstitial.

**MODULE II PHASE DIAGRAMS 7**

Phase diagrams- Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Lever Rule, Iron – Iron carbide equilibrium diagram- Development of Microstructure in Iron–Carbon Alloys

**MODULE III FERROUS AND NON FERROUS METALS 8**

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA - maraging steels – cast Irons- Gray, White malleable, Spheroidal Graphite. Copper and its alloys– Aluminium and its alloys - microstructure, properties and applications.

**MODULE IV HEAT TREATMENT 7**

Full annealing, normalising, hardening and tempering of steel, Austempering, martempering, Isothermal transformation diagrams, Continuous Cooling Transformation Diagrams, case hardening- carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening. Hardenability-Jominy end quench test

**MODULE V STRENGTHENING MECHANISMS**

**8**

Grain size strengthening, Solid solution strengthening, Strain hardening, Recovery Recrystallization, Grain Growth, Martensitic strengthening, Yield point phenomenon, dispersion strengthening, fibre strengthening, precipitation strengthening- simple problems

**MODULE VI POWDER METALLURGY**

**7**

Pressure compaction- Isostatic pressing, powder rolling, forging and extrusion, explosive compaction. Sintering, Hot pressing and Hot Isostatic Pressing , vacuum sintering, finishing operations – sizing, coining, repressing and heat treatment, Processing of nano materials

**Total Hours:45**

**TEXT BOOK:**

1. Sydney H Avner, "Introduction to Physical Metallurgy", 2/E Tata McGraw Hill Book Company, 2007.

**REFERENCES:**

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007.
2. Raghavan. V. "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 5<sup>th</sup> Edition 2007.
3. Kenneth G. Budinski and Michael K. Budinski "Engineering Materials", PHI / Pearson Education, 8<sup>th</sup> Edition, 2007.
4. George E. Dieter, "Mechanical Metallurgy", McGraw Hill, 2007.

**OUTCOME:**

- On completion of the course a student should be capable of participating effectively in the main areas of the metallurgical and materials industry.



**OBJECTIVES:**

- To describe the Indian Constitution and Governance of our country.
- To explain human rights, local and International and redressal mechanism.
- To discuss the important aspects of Corporate laws.
- To state the importance of industrial and labour laws of our country.
- To present the laws on contracts and arbitration.
- To state the importance of laws related to intellectual property.

**MODULE I INDIAN CONSTITUTION**

**7**

Constitution – meaning and history – making of constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Equality and social justice, Directive principles, Constitutional amendments.

**MODULE II GOVERNANCE AND POWERS VESTED**

**7**

Union executive, Legislature – Union – State and union territories, Union and state relations, powers vested with parliament and state legislature, emergency provisions - People’s Representations Act – Election Commission – Election for parliament and state legislature, Judiciary.

**MODULE III HUMAN RIGHTS**

**7**

Human rights – meaning and significance, International law on human rights, Covenant on civil and political rights; Covenant on Economic, social and cultural rights – protocol, UN mechanism and agencies, watch on human rights and enforcement – role of judiciary and commission, Right to information Act 2005 – evolution – concept – practice.

**MODULE IV CORPORATE AND LABOUR LAWS**

**7**

Corporate laws – meaning and scope – laws relating to companies, Companies Act 1956 – collaboration agreement for Technology transfer, Corporate liability – Civil and criminal – Industrial employment (standing orders) Act 1946, Industrial Disputes Act, 1947, Workmen’s Compensation Act 1923, The Factories Act, 1948 – Industry related other specific laws.

**MODULE V CONTRACTS AND ARBITRATION**

**9**

Types of contract – standard form of contracts - General principles under Indian Contract Act, 1872 – protection against exploitation – judicial approach to contracts, Arbitration and conciliation – meaning, scope and types, model law, judicial intervention, International commercial arbitration – arbitration agreement, arbitration tribunal – powers and jurisdiction, enforcement and revision, Geneva Convention, Awards, Confidentiality.

**MODULE VI LAWS RELATED TO IPR**

**8**

IPR – meaning and scope, International Convention – Berne and Parrys Conventions, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator, Securing of International patents.

**Total Hours: 45**

**REFERENCES:**

1. Jain M.P, Indian Constitutional Law, Wadhwa & Co., (2005)
2. Subhash G. & Kashyap, Our Constitution : An introduction to India's Constitution and Constitutional Law, National Book Trust, 3<sup>rd</sup> edn., India (2001)
3. Agarwal H.D., International Law and Human Rights, Central Law Publications, (2008).
4. Meena Rao, Fundamental Concepts in Law of Contract, 3<sup>rd</sup> edn., Professional offset, (2006).
5. Ramappa, Intellectual Property Rights Law in India, Asia Law House (2010)
6. Avtar Singh, Company Law, Eastern Book Co., (2007).
7. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House.
8. Acts : Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

**OUTCOMES:**

On successful completion of the course

- Students will be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- Students will have developed knowledge in judiciary, human rights, cultural, social and political rights.
- Students will have synthesized knowledge about the corporate and labour laws, contracts, arbitration and laws related to Intellectual Property Rights.

---

<b>ENB2282</b>	<b>CONFIDENCE BUILDING AND BEHAVIORAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>SKILLS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**(Common to all Branches)**

**OBJECTIVE:**

- To enable the students to develop communication skills for verbal communication in the work place.

**TOPICS OUTLINE:**

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

**LAB ACTIVITIES:**

- Introduction: Soft skills definition, examples
- Verbal communication: Case study, communication and discussion o Prepared speech
  - o Impromptu speech
  - o Debate: Case studies - Attitude and Behavior: role play and exploration o Ability to ask for help – communication and team work
- MANNERS AND ETIQUETTE o Organization and Planning o Time keeping
  - o Conduct in workplace o Conscientiousness o Work output
  - o Professionalism
  - o Motivation
- OWNERSHIP OF TASKS
- Adaptability/flexibility

**Total Hours : 30**

**Assessment:**

The assessment will be continuous and portfolio based. The students must produce the record of the work done through the course of the semester in

the individual classes. The portfolio may consist of a) the individual task outline and activities, b) worked out activities c) Pre-designed sheets which may be provided by the Faculty member. The portfolio will be used by the Faculty member for assessment. The course coordinator in consultation with the course committee shall decide at the beginning of the semester, the number of exercises, method of assessment of each and the weightage for the end semester assessment.

**OUTCOMES:**

The students should be able to:

- Develop verbal communication skills
- Debate with other students confidently
- Communicate effectively their ideas

**OBJECTIVE:**

- Measure forces due to dynamic imbalance of a rotating shaft.
- Compute magnitudes and locations of balancing masses in two given planes.
- Implement balancing masses.
- Measure forces after balancing and assess the effectiveness of the balancing design

**LIST OF EXPERIMENTS:**

1. Governors - Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorised Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficients for multidegree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of torsional frequencies for compound pendulum and flywheel –system with lumped Moment of inertia
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

**Total Hours:45**

**OUTCOMES:**

- Ability to analyze kinematics of the three-dimensional particle motion in various coordinate systems: cartesian, natural and cylindrical.
- Understanding of the concepts of displacement, velocity and acceleration as vectors and how to determine them.
- Understanding of the notion of a force as a vector.
- Ability to understand concepts of kinetic, potential and mechanical energies and the concept of a conservative force.
- Understanding of the concepts of power and mechanical efficiency.
- Ability to analyze particle dynamics
- Ability to make a right decision related to a choice of the system of particles whose motion is to be studied.
- Ability to correctly draw the free-body diagram (FBD) for the system.
- Ability to write and solve Newton equations of motion for the system.
- Ability to use concepts of angular displacement, angular velocity and angular acceleration.
- Ability to draw a FBD for a system of rigid bodies.
- Ability to determine mass moment of inertia for some simple body geometries.
- Ability to use principles derived from Newton's second law, including Work & Energy.

**OBJECTIVES:**

- To study the various components of machines like Lathe, Shaper and drilling machine
- To study the various Tools and work holding equipments used in basic manufacturing processes
- To practice on the various operations that can be performed in basic manufacturing process that includes lathe, shaper and drilling machine
- Students develop the knowledge of product development phases and experience working in teams to design and construct product prototypes.
- Introduction of Lathe, Shaper and Drilling Machines – Components of machines, cutting tools and work holding devices, Cutting tool nomenclature and chip formation

**LIST OF EXPERIMENTS:**

**Lathe**

1. Facing, Plain turning and step turning and Taper Turning
2. Single start V thread and knurling operation.
3. Drilling, Boring and internal thread cutting.

**Shaper**

4. Machining V Block and Slotting internal keyway cutting

**Drilling**

5. Five holes at a given pitch circle on a plate (Boring center hole, drilling and tapping in five holes)

**Sheet Metal**

6. Making of tray and funnel from sheet metal

**Moulding**

7. Preparation of sand mould of dumble and flange



**Smithy practices**

8. Round to hexagon and making a U bend from a straight rod.

**Project work**

9. Combined Skill (Each team has to make two components.)

**Total Hours : 45**

**OUTCOMES:**

- To have knowledge on common basic machining operations
- To equip with the practical knowledge required in the core industries.

**OBJECTIVES :**

- To study the microstructure of various materials.
- To study and record various test methods.
- To correlate the results for application.

**METALLURGY LAB EXPERIMENTS**

1. Metallographic Examination-Demonstration and Practice
  - a. Study of metallurgical microscope.
  - b. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
  - c. Selections of etchants for various metals and alloys.
2. Identification of microstructures of Plain Carbon Steel, Tool Steel, Gray C.I, SG Iron, Aluminium, Brass, Bronze.
3. Heat treatment: Annealing, normalizing, hardening and tempering of steel-Hardness and its microstructure.
4. Study of microstructure of welded (HAZ) and cast component.
5. Hardenability test - Jominy End quench test.

**MATERIAL TESTING LAB EXPERIMENTS**

1. Tension test.
2. Compression test.
3. Torsion test.
4. Deflection test .
5. Impact test .
6. Double shear test.

**Total Hours : 30**

**REFERENCES:**

1. ASTM E3 - 01(2007) e1 Standard Guide for Preparation of Metallographic Specimens
2. ASTM E407 - 07 Standard Practice for Microetching Metals and Alloys
3. ASTM E7 - 03(2009) Standard Terminology Relating to Metallography

**OUTCOME:**

- To gain practical exposure in interpretation and analysis of microstructure of various materials

**SEMESTER V**

<b>AUB3101</b>	<b>TWO AND THREE WHEELERS</b>	<b>L T P C</b>
		<b>3 0 2 4</b>

**OBJECTIVES:**

- To know and understand the constructional details, operating characteristics and design aspects of two wheelers and three wheelers.
- To learn about working principle and different types engine, transmission system used in two wheeler sand three wheelers
- To impart knowledge to the students in the principles of working and operation and of various barking systems.
- To impart knowledge to students about working principles of electrical and electronic subsystem and sensors are using in two wheeler sand three wheelers.

**MODULE I INTRODUCTION 5**

Development; Classification and layout of two wheelers (Motorcycles; scooters mopeds) and Three wheelers; (Auto rickshaws,pickup van and delivery van) applications and capacity – goods and passengers; study of technical specifications of Two and Three wheelers;

**MODULE II POWER TRAIN 10**

Selection of engine for two wheeler and three wheeler; Design considerations for two wheeler and three wheeler power plants; requirements for lubrication; cooling; starting; Recent engine developments; Clutch – requirements; different types used in two and three wheelers; need of primary reduction; selection of transmission – gear transmission; gear shift mechanism; belt transmission; automatic transmission (Continuous Variable Transmission – CVT); final drive and differential for three wheeler;

**MODULE III STEERING AND SUSPENSION 7**

Steering geometry; steering column construction; steering system for three wheelers; controls on handle bar of two wheelers. suspension requirements; design considerations; Front and rear suspension systems for two and three wheelers. Springs and shock absorbers.

**MODULE IV BRAKES, WHEELS AND TYRES 8**

Design consideration of brake; types of brakes: disc; drum; braking mechanism: mechanical; hydraulic and servo; wheel types, ABS in two wheelers, Front and rear brake link lay-outs: Spoked wheel, cast wheel and Disc wheel; Tyre requirements for two and three wheelers and its types.

**MODULE V FRAMES AND BODY 7**

Types of frame; construction; loads acting on frame; design consideration; materials; types of three wheeler bodies; layout; aerodynamic; aesthetic and ergonomics considerations for body work; side car; RTO regulations.

**MODULE VI ROAD PERFORMANCE 8**

Handling characteristics; driver and pillion seating arrangement; ergonomics and comfort; road holding and vehicle stability; gyroscope effect; riding characteristics; safety arrangements; Racing bikes – special requirements.

**Total Hours : 45**

**TEXT BOOK:**

1. Irving,P.E., Motor cycle Engineering, Temple Press Book, London.

**REFERENCES:**

1. The Cycle Motor Manual, Temple Press Ltd., London.
2. Marshall Cavensih, Encyclopedia of Motor cycling,20 Volumes,New York and London.
3. Bryaut,R.V., Vespa Maintenance and Repair series.
4. Raymond Broad, Lambretta – A practical guide to maintenance and repair.

**PRACTICAL SESSION: Hours: 30**

1. Port timing diagram and Port area measurement for Two wheeler (Scooter) Engine and Three Wheeler (Auto rickshaw) Engine.
2. Dismantling and Assembling of two stroke petrol Engine (Zentap) with cubic capacity compression ratio and brake power measurements.
3. Dismantling and Assembling of four stroke petrol engine with cubic capacity compression ratio and brake power measurements.

**B.Tech. Automobile Engineering**

---

4. Two and Three wheeler lightning and rooting system inspection and maintenance.
5. Inspection and Testing of Battery for various load condition including measurement of specific gravity.
6. Inspection service and Maintenance of Two and Three wheeler.
7. Removal refitting of wheels and tyres and measurement of aspect ratio and other dimension of the tyre.
8. Inspection and Measurement of pollution is Two and Three wheeler.
9. Actual compression ratio measurement of four stroke petrol Engine (150 cc).

**OUTCOMES:**

- Knowledge to the students in the constructional details of various types of two and three wheelers
- Able to understand the working of various types of engines and transmissions systems
- Knowledge about different types braking systems.
- The student will have a comprehensive knowledge about the functioning of two wheelers and three wheelers

---

<b>AUB3102</b>	<b>DESIGN OF MACHINE ELEMENTS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES:**

- To familiarize the various steps involved in the chassis design process.
- To learn to use standard practices and standard data.
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use catalogues and standard machine components.

**MODULE I INTRODUCTION 10**

Classification of design - Engineering materials and their physical properties as applied to design Selection of materials - Factors of safety in design -Endurance limit of materials - Determination of endurance limit for ductile materials - Rankine's formula- Design for variable loading – Soderberg, Goodman and Gerber relations.

**MODULE II DESIGN OF SHAFTS 10**

Introduction - Material and design stresses - Design of axles - Design of shafts on the basis of strength -Design of shaft on the basis of rigidity - Design of hollow shafts.

**MODULE III DESIGN OF SPRINGS 10**

Design of close coiled helical spring subjected to axial loading- Torsion of helical springs - Design of leaf springs - Laminated leaf springs – semi-elliptical leaf spring.

**MODULE IV GEAR DESIGN 10**

Design considerations - strength of gear teeth - Lewis equation – Terminology of gears Dynamic tooth load - Design of spur gears - helical gears - bevel gears and worm gears.

**MODULE V CLUTCH DESIGN 10**

Principle of operation- Types of friction materials- Single plate clutch- Multiplate clutch- Cone clutch- Energy dissipated due to clutch slip and the time required to reach full speed from rest during the acceleration period.

**MODULE VI DESIGN OF BEARINGS**

**10**

Design of journal bearings - Ball and Roller bearings - Types of Roller bearings- Bearing life - Static load capacity - Dynamic load capacity - Bearing material- Boundary lubrication - Oil flow and temperature rise.

**Total Hours: 60**

**TEXT BOOKS:**

1. Jain,R.K., "Machine Design", Khanna Publishers, 1992.
2. Sundararaja Murthy, T.V., "Machine Design", Khanna Publishers, New Delhi,1991.
3. Bhandari,v.B., "Design of Machine Elements", Tata McGraw Hill PublishingCo. Ltd., New Delhi, 1990.

**REFERENCES:**

1. Hall Allen,S. & other, "Machine Design", Schaum publisher Co., 1982.
2. Sigley, "Machine Design", McGraw Hill,1981.
3. Design Data Book", PSG College of Technology, Coimbatore,1992

**OUTCOMES:**

- The student will be capable of designing chassis components.
- The student can design shaft, spring, gear, clutch and bearings.
- The students can evaluate the various forces, stresses and strains acting on the different machine elements.
- The students will be capable of evaluating the shape and dimensions of a component to satisfy functional and strength requirements.



---

<b>AUB3103</b>	<b>PETROL ENGINES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To learn the working principles and constructional details of petrol engines
- To learn about the auxiliary systems of automotive petrol engines

**MODULE I ENGINE CONSTRUCTION AND OPERATION 8**

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. Variable Cam timing , Twin independent Cam shafts

**MODULE II SI ENGINE FUEL SYSTEM 8**

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 fuel feed pumps. Petrol injection, MPFI. Inlet Air compression(Super charging), Gasoline Turbo Direct Injection

**MODULE III IGNITION SYSTEM 7**

Types and working of battery coil and magneto ignition systems, relative merits and demerits, centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, electronic ignition systems. Ignition distributor

**MODULE IV COOLING SYSTEM 7**

Need for cooling system, Types of cooling system: air cooling system, liquid cooling system, forced circulation system, pressure cooling system.

**MODULE V LUBRICATION SYSTEM 7**

Lubrication system; mist, wet sump lubrication system, properties of lubricants

**MODULE VI COMBUSTION AND COMBUSTION CHAMBERS 8**

Combustion in SI engine; stages of combustion, flame propagation, rate of

**B.Tech. Automobile Engineering**

---

pressure rise, abnormal combustion, detonation, effect of engine variables on knock, knock rating. Combustion chambers; different types, factors controlling combustion chamber design.

**Total Hours : 45**

**TEXT BOOKS:**

1. Ganesan.V., "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L.Mathur and R.P.Sharma, "A course in Internal combustion engines", Dhanpat Rai & Sons Publications, New Delhi, 2001.
3. K.K.Ramalingam, "Internal Combustion Engines", Scitech Publications, Chennai, 2000.

**REFERENCES:**

1. Heldt P.M., "High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1975.
2. Obert E.F., "Internal Combustion Engines Analysis and Practice", International Text Books Co., Scranton, Pennsylvania - 1988.
3. William H.Crouse, "Automotive Engines", McGraw-Hill Publishers, 1985.
4. Ellinger H.E., "Automotive Engines", Prentice Hall Publishers, 1992.
5. John B.Heywood, "Internal Combustion Engine Fundamental", McGraw-Hill, 1988.
6. Pulkrabek "Engineering Fundamentals of the Internal Combustion Engines", Practice Hall of India, 2003.

**OUTCOME:**

- Students will gain knowledge about the working and constructional detail of petrol engines

---

<b>MEB3213</b>	<b>METROLOGY AND MECHANICAL</b>	<b>L T P C</b>
	<b>MEASUREMENTS</b>	<b>3 0 0 3</b>

**OBJECTIVES:**

- To learn about the various linear and angular measuring instruments of various accuracies and ranges
- To learn about measuring systems for parameters like force, torque and temperature

**MODULE I MEASUREMENT CONCEPT 8**

Definition of metrology, General Concepts of measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration, interchangeability, traceability. Statistical concepts: Mean, Range, Variance and Standard deviation

**MODULE II LINEAR & ANGULAR MEASUREMENT 7**

Linear measuring instruments: Slip gauges, Tool Maker's microscope, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: -Sine bar, bevel protractor-Taper angle measurements-

**MODULE III FORM MEASUREMENT 7**

Form measurement- Measurement of screw threads- floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method- straightness, flatness and roundness measurements- surface finish-surface roughness tester.

**MODULE IV LASER AND ADVANCES IN METROLOGY 7**

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications.- computer aided inspection. Machine Vision systems - principle and functions.

**MODULE V FORCE, TORQUE AND TEMPERATURE MEASUREMENT 8**

Response of Measuring System: Amplitude, Frequency and Phase - Force,

torque measurement- mechanical, pneumatic, hydraulic and electrical type-  
Flow measurement-Temperature measurement- bimetallic strip, pressure  
thermometers, thermocouples, electrical resistance thermister.

**MODULE VI VIBRATION AND ACOUSTIC MEASUREMENT**

**8**

Vibration measurement - Vibrometers and accelerometers, test methods and  
calibration- Acoustic Measurement- AE Parameters, principles of acoustic  
emission techniques ,- Advantages, limitations and applications.

**Total Hours: 45**

**TEXT BOOKS :**

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 1994.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.

**REFERENCES :**

- Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 1984.
- Beckwith T.G, and R.D.Marangoni, "Mechanical Measurements", Addison Wesley, 1999.
- Donald D Eckman, "Industrial Instrumentation", Wiley Eastern, 1985.
- ASTM, "Hand book of industrial metrology" Prentice Hall of India,1988.
- ASNT, "Nondestructive testing handbook Emission" Volme.5- Acoustic emission testing,1994.

**OUTCOMES:**

- Have sound knowledge about the various fundamental principles of measurement
- Capable of selecting suitable measurement technique for various applications

**OBJECTIVES:**

- To explore the salient features and processes that characterise the rocks, soils, water and their interconnectivity with the atmosphere through bioelement cycling
- To rationalise the biological environment at the level of cell, the population, the community ,ecosystem and the biome
- To get sensitized with the impacts of human activity on the natural environment and with the methods to conserve it
- To study the impacts of human activity on water and air and to identify the steps to conserve
- To find out an unique solution for the environmental crisis in the developing and developed countries
- To learn about the assessments of the impacts with the help of NGOs and public and to proceed to a sustainable living

**MODULE I PHYSICAL ENVIRONMENT 8**

Earth's surface - the Interior of Earth – Plate Tectonics – Composition of the Crust: Rocks – formation and types, Soils – formation and components – soil profile.

Atmosphere – structure and composition – weather and climate – tropospheric airflow

Hydrosphere – water budget – hydrological cycle – Rainwater and precipitation, River Water and solids, Lake Water and stratification, Seawater and solids, soil moisture and groundwater.

Bioelement cycling – The Oxygen cycles – the carbon cycle – the nitrogen cycle – the phosphorous cycle – the sulfur cycle sodium, potassium and magnesium cycles.

**MODULE II BIOLOGICAL ENVIRONMENT**

**7**

Cellular basis of life – prokaryotes and eukaryotes – cell respiration – photosynthesis – DNA and RNA – genetically modified life

Population dynamics – population – population growth – survival and growth curves – population regulation – future of human population

Biological communities - Five major interactions: competition, predation, parasitism, mutualism and commensalism – Concepts of habitat and niche – natural selection – species richness and species diversity – ecological succession and climax.

Ecosystem and Biomes – Food Chains and food webs – biomagnifications – ecological pyramids - Trophic levels – Energy flow in ecosystem – ecosystem stability – Terrestrial and aquatic biomes.

**MODULE III IMPACTS ON NATURAL RESOURCES AND CONSERVATION**

**9**

Biological resources – nature and importance – direct damage – introduced species – Habitat degradation, loss and fragmentation – Values of biodiversity – hotspots of biodiversity, threats to biodiversity- endangered and endemic species of India- conservation of biodiversity, in-situ and ex-situ conservation

Land Utilization – past patterns of land use – Urban and Industrial development – deforestation, salinisation, soil erosion, and desertification – Modern Agriculture and Impacts

Waste management – types of solid wastes: domestic, municipal, industrial and e-wastes - disposal options – reduce, recovery, reuse – waste minimization, cleaner production technology.

**MODULE IV IMPACTS ON WATER AND AIR AND CONSERVATION**

**8**

Water pollution – organic oxygen demanding wastes – anthropogenic phosphate and eutrophication - Ground water contamination – Usage of fertilizer and pesticides– acid rain –acid mine discharges – toxic metals – organochlorines – endocrine disrupting substances- treatment process – Rain water harvesting and watershed management- manmade radionuclide's – thermal pollution

Atmospheric pollution – primary and secondary pollutants – anthropogenic, xenobiotic, synergism, sources and sink, residence time, levels and impacts of major pollutants – processes leading to smog, acid rain, global warming, stratospheric ozone depletion - Noise pollution and abatement.

**MODULE V IMPACTS ON ENERGY AND CONSERVATION,  
ENVIRONMENTAL CRISIS 8**

Energy – Renewable and non renewable energy resources – thermal power plants – nuclear fuels, fossil fuels, solar energy, wind energy, wave energy, tidal energy, ocean thermal energy, hydropower, geothermal energy, biomass energy

Environment crisis – state of environment in developed and developing countries- managing environmental challenges for future – disaster management, floods, earthquake, cyclone and landslides.

**MODULE VI ENVIRONMENTAL IMPACT ASSESSMENT AND  
SUSTAINABILITY 5**

Environmental Impact Assessment – Impacts: magnitude and significance – steps in EIA – methods – precautionary principle and polluter pays principle – role of NGOs and Public – value education –Environment protection act (air, water, wild life) and forest Conservation act Concept of Sustainability – Sustainable Development – Gaia Hypothesis - Traditional Knowledge for sustainability.

**Total Hours: 45**

**TEXT BOOKS:**

1. Environmental Science (The Natural Environment and Human Impact), Andrew R. W. Jackson and Julie M. Jackson, Pearson Education Limited, Harlow, Essex, England, 2000.
2. Environmental Science (Working with the Earth), G Tyler Miller, Jr., Thomson Brooks/Cole, 2006.

**REFERENCES:**

1. Physical Geology, Earth Revealed, David McGeary and Charles C Plummer, WCB McGraw Hill, 1998.

**B.Tech. Automobile Engineering**

---

2. Sustainability: A Philosophy of Adaptive Ecosystem Management, Bryan G. Norton, 2005.
3. Environmental Impact Assessment, Larry W. Canter, McGraw-Hill, 1996.
4. The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity, James Lovelock, Penguin UK, 2007.

**OUTCOMES:**

After the completion of the course the student should be able

- To differentiate the rock and the soil and to recognise the pivotal importance of bioelement cycling
- To examine the biological environment both at the microscopic and biome levels
- To analyse the role played by the urban and industrial development that change the pattern of land use
- To judge the level of air and water pollution
- To discriminate renewable energy from non renewable energy and to discuss about the environmental crisis prevailing
- To assess the human impacts on environment and to appreciate the sustainable living



---

<b>ENB3181</b>	<b>CAREER BUILDING &amp; PEOPLE SKILLS</b>	<b>L T P C</b>
	<b>Common to all branches</b>	<b>0 0 2 1</b>

**OBJECTIVE:**

- To prepare the students for building their competencies and career building skills.

**COURSE OUTLINE:**

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

**LAB ACTIVITIES:**

- Preparation for the placement
  - o Group discussions: Do's and Don'ts – handling of Group discussions – What evaluators look for.
  - o Interview – awareness of facing questions – Do's and Don'ts of personal interview.
  - o Selection of appropriate field vis-à-vis personality / interest.
  - o Preparation of Resume–Objectives, profiles vis-à-vis companies requirement.
  - o Enabling students to prepare for different procedures / levels to enter into any company – books / websites to help for further preparation.
  - o Technical interview – how to prepare and face it.
- Workplace skills
  - o Presentation skills o Oral presentations
  - o Technical presentations o Business presentations o Technical writing
  - o Interpersonal relationships – with colleagues - clients – understanding one's own behavior – perception by others.

**ASSESSMENT:**

As the course is practical one, it will be assessed using a portfolio based assessment. The students must in consultation with the Faculty member, plan a portfolio of evidence for the above mentioned activities. The students must develop a résumé or résumés that promote own ability to meet specific job requirements and plan their portfolio in a format appropriate to industry they wish to target. The case studies will contain direct observation of the candidate developing career plans, résumés and skills portfolio, reflect written or oral questioning to assess knowledge and problem-solving activities to assess ability to align career aspirations with realistic career goals. The course coordinator in consultation with the course committee will decide the number of exercises and mark to be awarded for each beside the weightage for the end semester assessment.

**Total Hours:30**

**OUTCOMES:**

The course will help the students to

- Develop team work skills
- Take part effectively in various selection procedures followed by the recruiters.

**OBJECTIVES:**

- To familiarize with the various codes and specifications of BIS concerned with engineering Drawings
- To learn about Limits, Fits and Tolerances
- To learn to generate part models assembly of various machine components and systems using modeling packages
- To generate part and assembly models of actual Mechanical Products

**INTRODUCTION TO AUTO CAD**

**9**

Getting into Auto CAD. Drawing Editor, Menus, Co-ordinator systems, Creating adrawing. Line input methods, Angle measures, Circle-5 methods, Unity commands.Organising a Drawing Area: Limits, Zoom all, Drawing Aids, Grid, Shape, Ortho,Function keys, Entity creation, Arc, Point, Polygon, Donut, Trace, Ellipse. EditingCommands: Erase, Object selection methods, U, Oops, Redo, Move, Copy, Mirror,Rotate, Scale, Array.Two-Dimensional geometrical construction curves – Projection of points – Projection of solids – Three dimensional views of simple solids.

**MODELING SOFTWARE APPLICATION**

**36**

Introduction of Modelling Software, Formatting of 2D and 3D objects.3D Part Modeling – Protrusion, cut, sweep, draft, loft, blend, rib, round, chamferEditing-Move, Pattern, Mirror Assembly- Creating assembly from parts-assembly constrains Conversions of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning Introduction to Surface Modeling Introduction to File import, Export – DXF, IGES, STL, STEP 3D Modeling of machine elements like Flanged coupling, screw, jack etc.,

**NOTE: Any one of the 3D MODELING softwares like Pro/E, IDEAS, CATIA UNIGRAPHICS, AutoCAD to be used**

**Total Hours: 45**

**REFERENCES:**

1. Bhatt .N.D. and Panchal.V.M. "Machine Drawing", Charotar Publishing House, 388001, 38<sup>th</sup> Edition, 2003.
2. K.R. Gopalakrishnan., "Machine Drawing", 18<sup>th</sup> Edition, 2004.
3. P.S.G. Design Data Book
4. Ellen Finkelstein, "AutoCAD 2004 Bible", Wiley Publishing Inc, 2003.
5. Sham Tikoo, "AutoCAD 2002 with Applications", Tata McGraw-Hili Publishing Company, New Delhi, 2002.

**OUTCOMES:**

The student will be capable of

- Generating solid models and 2-D Drawings of Products adhering to standards
- Generating part models assembly of various machine components and systems using modeling packages.
- Evaluating various codes and specifications of BIS concerned with engineering Drawings.

**OBJECTIVES:**

Students should be able to understand the following

- Concepts and construction of 2 stroke and 4 stroke engines
- Construction and working of Intake , Exhaust , Ignition cooling and lubrication systems
- The significance of dimensional variation of cylinder bore, crankshaft, camshaft and connecting rod.

**List of Experiments cylinder**

1. Dismantling study and assembling of 4 cylinder SI engine  
Measure the bore stroke, cubic capacity and compression ratio of a given 4 cylinder petrol engine. Compare the significance of cubic capacity with power. Identify the name, function and material of the components .
2. Dismantling study and assembling of 4 cylinder CI engine  
To calculate the clearance volume and compression ratio of a 4 cylinder diesel engine. Measure the pressure in the cylinder at the end of compression stroke. Draw the motoring curve. Identify the name, function and material of the components.
3. Dismantling study and assembling of 2 stroke SI engine  
Measurement of 2 stroke SI engine specifications Identification of Name function and material of of the components. Understanding of the following - scavenging and short circuiting process, air cooling system.
4. Study of intake systems  
Carburettor, TBI, MPFI and GDI for SI engine and DI, IDI and CRDI systems for CI engine. Identify the Name of components function material etc. Measurement of injector performance, Measurement of runner length of manifold and its significance.
5. Study of Exhaust systems  
Exhaust system components like catalytic combater muffler, Identification of

- name of components function and material. Measurement of runner length of exhaust manifold and its significance.
6. Study of Ignition systems  
Battery coil, magneto and Electronic Ignition systems. Identification of name and function material. Measurement of density of Electrolyte .
  7. Study of cooling systems  
Identification of name, function and material of the components. Measurement of discharge of water pump at various speed.
  8. Study of lubrication systems  
Identification of Name, function and material of the components. Measurement of discharge of oil pump at such pressure for difference speeds.
  9. Measurement of dimensional variation of cylinder block and gudgeon pin  
Measurement on cylinder block – cylinder bore, crankshaft bore and camshaft bore for taper and ovality  
Measurement of gudgeon pin, diameter and taper  
Analysis of the impact of dimensional variation on engine performance
  10. Measurement of dimensional variation of Crankshaft, camshaft, connecting rod  
Measurement of crankshaft journal and pin for taper and ovality  
Measurement of camshaft journal taper and ovality and cam lift.  
Measurement of connecting rod big end and small end bores for taper and ovality.  
Analysis of the impact of dimensional variation on engine performance

**PROJECT TITLES:**

1. Selection and coupling of suitable I.C. Engine to run a system
2. Measurement of Air intake and calculation of volumetric efficiency
3. Measurement of fuel intake and calculation of energy of the fuel metered
4. Making a working model of CDI system
5. Measurement of Exhaust pressure and calculation of exhaust quantity
6. Working model of Electronic ignition system

7. Working model of lubrication system
8. Working model of cooling system
9. Working model of Rocker arm mechanism
10. Working model of a CRDI system
11. Working model of a MPFI system
12. Working model of variable valve timing.
13. Energy recovery from exhaust system
14. Turbo charger model.

**OUT COMES:**

Students should be able to

1. Select suitable engines for different applications
2. Analyze the effect of various parameters on engine performance
3. Suggest modification to improve engine performance
4. Analyze the cause for poor or drop of performance of engine
5. Perform tests to tune the performance of engine components

---

<b>MEB3216</b>	<b>METROLOGY AND MECHANICAL</b>	<b>L T P C</b>
	<b>MEASUREMENT LAB</b>	<b>0 0 3 1</b>

**OBJECTIVE:**

- To gain the skill of using all measuring instruments and measuring systems to get the accurate measurements.

**LIST OF EXPERIMENTS:**

1. Calibration and Error analysis of measuring Instruments.
2. Measuring Instrument Fabrication:  
Fabrication of 0.2 mm accurate simple vernier caliper. Fabrication of 0.2 mm accurate simple Micrometer. Fabrication of simple strain guage load cell etc. Fabrication of simple strain guage load cell etc.
3. Complete all measurements including intricate internal details of the given component using standard equipments and by other measuring procedures (Quick setting compounds, moulds etc.).
4. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical).
5. Measurement of angle using Sine bar / Sine Center / Toolmakers microscope / Slipguage.
6. Measurement of taper using standard balls / rollers.
7. Measurement of straightness and flatness.
8. Measurement of thread parameters.
9. Measurement of gear parameters.
10. Measurement of radius and surface roughness.
11. Measurement of Temperature.
12. Measurement of Displacement, Force and Torque.
13. Measurement of Acoustic Emission.
14. Scanning the surface using Coordinate Measuring Machine (CMM).
15. Measurement using vision system.
16. Mini Project Performing various measurements for a reengineering component.

**Total Hours: 45**



**OUTCOMES:**

- Students able measure various parameters like force ,Temperature and Torque etc.,
- Able to use CMM and vision system suitably to get accurate measuring results.

**SEMESTER VI**

<b>AUB3211</b>	<b>DIESEL ENGINES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES :**

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

**MODULE I DIESEL ENGINE BASIC THEORY 8**

Diesel engine construction and operation. Two stroke and four stroke diesel engines. Diesel cycle – Fuel-air and actual cycle analysis. Diesel fuel. Ignition quality. Cetane number. Laboratory tests for diesel fuel. Standards and specifications.

**MODULE II FUEL INJECTION SYSTEM 8**

Requirements – solid injection. Function of components –common rail direct injection - Jerk and distributor type pumps. Pressure waves, Injection lag. Unit injector. Mechanical and pneumatic governors. Fuel injector, Types of injection nozzle, Nozzle tests. Spray characteristics. Injection timing. Pump calibration. Pilot injection.

**MODULE III AIR MOTION, COMBUSTION 7**

Importance of air motion – Swirl, squish and turbulence, Swirl ratio. Fuel air mixing. Stages of combustion. Delay period – factors affecting delay period. Knock in CI engines. Comparison of knock in CI & SI engines.

**MODULE IV COMBUSTION CHAMBERS 7**

Direct and indirect injection combustion chambers. Air cell chamber. Combustion chamber design – objectives – Different types of combustion chamber. Combustion chamber. Combustion chambers for Homogeneous charge compression ignition systems – Dual and alternate fueled engine systems.

**MODULE V SUPERCHARGING AND TURBOCHARGING 7**

Necessity and limitation – Charge cooling. Types of supercharging and turbocharging – Relative merits. Matching of turbocharger. Inter cooler, Inseries Twin turbo

Automotive and stationary diesel engine testing and related standards – Engine power and efficiencies – performance characteristics. Variables affecting engine performance – Methods to improve engine performance – Heat balance – Performance maps. Hot testing of engines, Dynamometer type, Chassis dynamometer for emission test

**Total Hours: 45**

**TEXT BOOKS:**

1. Mathul M.L. and R.P. Sharma, Internal Combustion Engines, Dhanpa Rai Publication, Delhi, 2010.
2. Ganesan,V., Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi, 1994.

**REFERENCES:**

1. Heldt,P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 1985.
2. Obert,E.F., Internal Combustion Engine analysis and Practice, International Text Book Co., Scranton, Pennsylvania, 1988.
3. Maleev,V.M., Diesel Engine Operation and Maintenance, McGraw Hill, 1974. Dicksee,C.B., Diesel Engines, Blackie & Son Ltd., London, 1964.

**OUTCOMES:**

- Able to know the working of diesel engine systems and parts of various subsystems.
- Able to know the difference of petrol engine fuel injection systems and others.

---

<b>AUB3212</b>	<b>DESIGN OF AUTOMOTIVE COMPONENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data

**MODULE I GENERAL CONSIDERATIONS IN ENGINE DESIGN 10**

Auto Design –Some aspects of design - Modelling – Creative design – Designer – Design procedure – Effect on a design – Basic requirements – Classification of designs – Principles of good economic design.

**MODULE II DESIGN OF PISTON 10**

Piston qualities, Materials for piston- Design of piston- Types of piston rings, Design of piston ring- Design of piston pin.

**MODULE III DESIGN OF OTHER ENGINE COMPONENTS 10**

Design of camshaft- Valve design, Design of crankshaft- Design of crank pin- Design of connecting rod.

**MODULE IV DESIGN OF FLYWHEEL 10**

Determination of the mass of a flywheel for a given co-efficient of speed fluctuation, Engine flywheels stresses of rim of flywheels, Design of hubs and arms of flywheel - Turning moment diagram- Balancing of flywheel.

**MODULE V DESIGN OF ENGINE SYSTEMS 10**

Design of fuel injection system- Requirements of fuel injection system, Work of injection Design of Carburettor- Air flow, Fuel flow, Design of supercharging- Design of Governor.

**MODULE VI DESIGN OF GEAR BOX 10**

Purpose of gear box- Gear ratio- Gear box design- Gear boxes with different speed gears- Three speed gear box- Four speed gear box.

---

**Total Hours: 60**

**REFERENCES:**

1. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, NewYork
2. Engine Design – Giles J. G., Liffle Book Ltd.
3. Engine Design – Crouse, Tata McGraw Publication, Delhi
4. I.C. Engine - Maleev V. L., McGraw Hill Book, Co.
5. I. C. Engine – L. C. Litchy, International Student Edition
6. Design of Automotive Engine – A. Kolchin and V. Demidov
7. I. C. Engine – Heywood
8. SAE Handbooks

**OUTCOMES:**

- The student will be capable of designing various engine components.
- The student can design piston, camshaft, crankshaft and flywheel.
- The students will be capable of evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- The students can evaluate the various forces, stresses and strains acting on the different engine components.

**OBJECTIVES :**

- To learn about working principle and different types battery used in automobile.
- To impart knowledge to the students in the principles of operation and construction details of various Automotive starting system and charging systems
- It has ignition, lighting and wiring. This provide fundamental knowledge to students
- To impart knowledge to students about working principles of electrical and electronic subsystem and sensors are using in automobile.

**MODULE I    BATTERIES    6**

Principle and construction of lead-acid battery. Characteristics of battery, rating, Capacity and efficiency of batteries. Various tests on battery condition, charging methods. Details of modern storage batteries.

**MODULE II    STARTING SYSTEM AND CHARGING SYSTEM    8**

Condition of starting Behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units. Care & maintenance of starter motor, Starter switches. Function, Components of DC and AC Charging System for Automobile, construction, operating principle, characteristics, charging circuit controls – cut out, relays, voltage and current regulators, troubleshooting

**MODULE III    IGNITION SYSTEM    8**

Types, construction & working of battery coil and magneto ignition systems. Relative merits, centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, Electronic Ignition system. Digital ignition system.

**MODULE IV    LIGHTING SYSTEM AND WIRING CRCUTE    9**

Head light dazzling & preventive methods. Standard lighting sources; energy demand; headlight and its construction; head light beam; headlight dazzle; anti-dazzle

devices; bulbs and wattages; headlight adjustments; fog lamps; side and tail light; brake warning lights; LED lighting system; electrical switches; indicating and wiring devices; electrical pumps; heater and defrosters; latest trends; wiring and installation; auto cables; cable colours; cable connectors; wiring harnesses; circuit breakers; fuses; printed circuits; plastic fibre optics; trouble shooting

**MODULE V SENSORS, ACTUATORS AND CONTROLS**

**8**

Types of sensors ; location in a vehicle, and working; Sensors ; speed sensors, Temperature sensors, flow sensors, pressure sensors, Solenoids, stepper motor, relay; ECM control functions, micro controllers for automobile, electro chemical capacitors, electronic stability control, seatbelt sensors, cruise control, electric valve actuators, integrated starter alternator. tyre pressure monitor.

**MODULE VI ACCESSORIES**

**6**

Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, air bag electrical diagram, Horn, Wiper system, Trafficator, wiring system. (Accessories) - Parking assist, Electronic brakes, Power window, automatic lock controls, GPS and Satellite navigation.

**Total Hours: 45**

**TEXT BOOK:**

1. Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London.

**REFERENCES:**

1. Young,A.P. & Griffiths,L., Automobile Electrical Equipment, English Language Book Society & New Press.
2. Vinal,G.W., Storage Batteries, John Wiley & Sons Inc., New York. Crouse, W.H., Automobile Electrical Equipment, McGraw Hill Book Co. Inc., New York.
3. Spreadbury,F.G., Electrical Ignition Equipment, Constable & Co. Ltd.,London.
4. Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi.
5. Automotive Hand Book, Robert Bosch, Bently Publishers.

**OUTCOMES:**

- Learn about working principle and different types battery used in automobile.
- knowledge to the students in the principles of operation and constructional details of various Automotive starting system and charging systems.
- Fundamental knowledge to students about starting and ignition systems.
- The student will have a comprehensive knowledge about the functioning of automotive electrical and electronics.



---

**MSB3181 MANAGEMENT OF BUSINESS ORGANISATION**      **L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To give an exposure to principles of management and organizational structures.
- To introduce concepts of operation and material management.
- To provide an understanding of management of human resources.
- To impart some basic knowledge on marketing, pricing and selling.
- To give an overview of accounting and management of finance.

**MODULE I PRINCIPLES OF MANAGEMENT** **7**

Functions of management - Planning - Organizing - Staffing - Direction - Motivation - Communication - Coordination - Control, organizational structures - Line - Line and staff - Matrix type, functional relationships - Span of control, Management by Objectives (MBO) - Forms of Industrial ownership.

**MODULE II OPERATIONS MANAGEMENT** **8**

Introduction to operations management - Functions of production/operations management - Types of production, Overview of facility location - Lay out planning, introduction to production planning and control, work study, quality assurance, lean manufacturing and six sigma, plant maintenance and management.

**MODULE III MATERIALS MANAGEMENT** **8**

Materials Planning - Types of inventory, Purchasing function - Source selection - Negotiation - Ordering, Stores management - Functions - Types of stores - Overview of inventory control, Introduction to newer concepts: MRP-I – MRPII - ERP - JIT.

**MODULE IV HUMAN RESOURCE MANAGEMENT** **7**

Human Resource Management - Objectives - Role of Human Resource Manager - Manpower planning - Selection and placement - Training – Motivation - Performance assessment - Introduction to grievances handling and labour welfare.

**MODULE V MARKETING MANAGEMENT**

**7**

Marketing - Concept and definition - Elements of marketing mix - PLC – Steps in new product development - Pricing objectives and methods – Advertising types/media - Steps in personal selling - Sales promotion methods – Distribution channels: functions, types.

**MODULE VI FINANCIAL MANAGEMENT**

**8**

Financial management functions - Introduction to financial accounts, financial performance - Profit and loss account statement - Balance sheet, budgetary control - Meaning - Uses - limitations - Types of costs - Basics of depreciation methods -Break-even analysis - Meaning - Assumption - Uses and limitations, working capital - Meaning and relevance - Use of operating ratios.

**Total Hours: 45**

**REFERENCES:**

1. Bhushan Y.K., "Fundamentals of Business Organisation and Management", Sultan Chand & Co., 2003.
2. Banga & Sharma "Industrial Engineering & Management", 11<sup>th</sup> Edition, Khanna Publications, 2007.
3. Khanna, O.P., "Industrial Engineering & Management", Dhanpat Rai Publications, 2004.
4. S.N.Maheswari "Principles of Management Accounting", 16<sup>th</sup> Edition, S.Chand & Company Ltd, 2007.

**OUTCOMES:**

After doing the course,

- the students would have gained basic knowledge of the concepts of management and the functions of management.
- the students would have learnt fundamentals of the functional areas of management viz., operations management, materials management, marketing management, human resources management and financial management.

**OBJECTIVES:**

- To understand the fuel quality and constituents
- To understand viscosity of liquid fuels
- To examine the flash and fire point of fuels

**LIST OF EXPERIMENTS:**

1. Study of International and National standards for fuels and lubricants.
2. Study of Octane and Cetane Number of fuels.
3. Testing of fuels - Ultimate analysis, proximate analysis
4. ASTM distillation test of liquid fuels
5. Aniline Point test of diesel
6. Calorific value of liquid fuel.
7. Calorific value of gaseous fuel.
8. Reid vapour pressure test.
9. Flash and Fire points of petrol and diesel.
10. Copper strip Corrosion Test
11. Cloud & Pour point Test.
12. Temperature dependence of viscosity of lubricants & Fuels by Redwood Viscometer.
13. Viscosity Index of lubricants & Fuels by Saybolt Viscometer
14. Ash content and Carbon Residue Test
15. Drop point of grease and mechanical penetration in grease.

**Total Hours: 45**

**OUTCOMES:**

- Students could able find properties of fuel
- Students able to find viscosity of give liquid fuels
- Students able measure the calorific value given liquid and gaseous fuel

---

<b>AUB3215</b>	<b>AUTOMOTIVE ELECTRICAL AND</b>	<b>L T P C</b>
	<b>ELECTRONICS LAB</b>	<b>0 0 3 1</b>

**OBJECTIVE:**

- To study the working principle of the various electrical and electronic control devices used in automobile.

**LIST OF EXPERIMENTS:**

1. Verify logic gates (AND,OR, NAND, NOR, EX-OR)
2. Study of revolution counter circuit
3. Study of control of DC motors
4. Lab VIEW basic programming (tank level control)
5. Implementation of half adder and full adder
6. Study of IC 555 timer for motor control
7. Characteristics of Silicon controlled rectifier (SCR)
8. Addition and Multiplication of 8 bit numbers using 8085
9. Stepper motor control using 8051.
10. Temperature monitoring using Lab VIEW
11. Heating and ventilation control using Lab VIEW.

**Total Hours: 45**

**OUTCOME:**

- Students able to understand the working of various electronic and control devices used in automobiles.

**OBJECTIVES:**

- The course enables the students to study the different types of chassis and its components.
- To familiarize and understand the constructional arrangements of different chassis system.
- To study the different Components are mounted in chassis and its measurement.

**LIST OF EXPERIMENTS:**

- 1) Study of front wheel geometry and wheel alignment.
- 2) Study of front axle, Constant Velocity joints and find what type of it is.
- 3) Study of rear axle with differential and find the axle ratios.
- 4) Study of various types of gear box used in four wheeler and find the gear ratio of given gear box.
- 5) Study of various types of steering system used in four wheelers and find the steering ratio.
- 6) Study of various types of steering gear box used in four wheelers and find gear ratio.
- 7) Study of various types of braking system used in four wheelers.
- 8) Study of transfer case used in all wheel and four wheel drives.
- 9) Study of various types of clutches used in four wheelers.
- 10) Study of drive train of four wheelers.
- 11) Study of construction of main frames of truck and car.
- 12) Study of different types of fuel feed pumps and fuel delivery system.
- 13) Study of Electrical System-Battery, Wiring, Lighting, Controls, Charging Battery, Entertainment, Starter motor, Viper motor, centralised locking etc.
- 14) Study of safety modules used in four wheelers.

**OUTCOME:**

- Able to understand the working of various subsystems of various types of automobiles.

---

<b>AUB3217</b>	<b>MODELING AND ANALYSIS LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVES:**

- To train the students for developing 2D, 3D and solid model of various components of automobiles.
- To train the students to analyze the characteristics of various structures under load of automotive components

**LIST OF EXPERIMENTS:**

1. Two dimensional mechanisms.
2. Forward Vehicle Dynamics Two dimensional mechanisms and vehicle analysis.
3. Working Model 2D
4. Introduction to 3D vehicle design SOLIDWORKS.
5. Mechanisms, Door, Auto Body.
6. suspensions Simulations
7. Vehicle vibrations principles
8. Drive train dynamics
9. energy and momentum Forces and Moments 2D and 3D Computer models
10. Finite Element Modeling (FEA) and failure analysis Stress, deformation calculations

**Total Hours: 30**

**OUTCOME:**

- Able to develop the models of various subsystems and analyze these systems under various load conditions

**SEMESTER VII**

<b>AUB4101</b>	<b>VEHICLE DYNAMICS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVE:**

- To study the sources of vibrations and methods to reduce these vibrations for improving passenger comfort.

**MODULE I VIBRATION BASICS 8**

Fundamentals of vibration, Sources of vibration, single degree of freedom, two degree of freedom, multidegree freedom, free, forced and damped vibrations, magnification factor, transmissibility.

**MODULE II VERTICAL DYNAMICS 11**

Design, analysis of passive, semi active and active suspension, Influence of suspension stiffness, suspension damping, and tyre stiffness. Pneumatic suspension system.

**MODULE III LONGITUDINAL DYNAMICS 11**

Load distribution, calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road. Over steer, under steer, effect of braking.

**MODULE IV LATERAL DYNAMICS 11**

Steady state handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Effect of suspension on cornering.

**MODULE V WHEELS AND TYRES 10**

Types of wheel, wheel wobble, wheel shimmy, wheel balancing - recent, statics, dynamic - tyre - requirements, types, testing dynamics, characteristics, power consumed by a tyre.



**MODULE VI DYNAMIC VEHICLE CONTROL TECHNIQUES**

**9**

Suspension Control techniques. Anti lock braking control, stability control, Traction control, Bicycle Model, cruise control.

**Total Hours: 60**

**TEXT BOOKS:**

1. Singiresu S. Rao, Mechanical Vibrations (5<sup>th</sup> Edition), Prentice Hall, 2010
2. Giri N.K – Automotive Mechanics, Khanna Publishers, 2002.
3. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley
4. J. Y. Wong, Theory of Ground Vehicles, 3<sup>rd</sup> Edition, Wiley-Interscience, 2001

**REFERENCES:**

1. Heldt.P.M -"Automotive Chassis"- Chilton Co., New York- 1992
2. Ellis.J.R - "Vehicle Dynamics"- Business Books Ltd., London- 1991
3. Giles.J.G.Steering - "Suspension and Tyres", Illiffe Books Ltd., London- 1998
4. Ham B, Pacejka - Tyre and Vehicle Dynamics - SAE Publication - 2002.
5. Gillespie T.D, "Fundamentals of Vehicle Dynamics", SAE USA 1992.

**OUTCOMES:**

- Analyse the data about Vibrations and modify methods to reduce these vibrations for improving passenger comfort.
- Demonstrate practical skills about suspension, wheels and tyre dynamics control systems.

---

<b>AUB 4102</b>	<b>AUTOMOTIVE TRANSMISSION</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES:**

- To know about the various components in transmission system and drive line units of automobiles.
- To know about the working principle of transmission system and hydrodynamic transmission.
- The students able to know about the various automatic transmission systems in a vehicle.
- The students able to know the applications of automatic transmission in a vehicle.
- To know about the hydrostatic drive principle and working of electric drive in a vehicle.

**MODULE I CLUTCH AND GEAR BOX 10**

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate and multiplate clutch, centrifugal clutch. Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchronesh gearboxes – Determination of gear ratios for vehicles

**MODULE II HYDRODYNAMIC TRANSMISSION 10**

Fluid coupling-working principle and Constructional details, Torque capacity and Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-working principle and constructional details, performance characteristics.

**MODULE III EPICYCLIC GEARBOXES 10**

Requirements of Epicycle gear system, Epicycle gearbox working and operation and Constructional details. Principle of Planetary gear trains - Wilson Gear box, Hydraulic Control system for Automatic Transmission.

**MODULE IV AUTOMATIC TRANSMISSION APPLICATIONS 10**

Need for automatic transmission, Chevrolet “Turboglide” Transmission,

Continuously Variable Transmission (CVT) – Types and Operations of a typical CVT and applications.

**MODULE V HYDROSTATIC TRANSMISSION 10**

Hydrostatic drive- various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive.

**MODULE VI ELECTRIC DRIVE 10**

Electric drive, layout of electric drive, types- Principle of early and modified Ward Leonard Control system-Advantages & limitations. Comparison of early and modified ward Leonard control system. Hybrid vehicle, fuel cell powered vehicle and solar powered vehicle.

**Total Hours: 60**

**TEXT BOOKS:**

1. Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
2. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
3. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
4. A Text book of Auto Transmission and Electrical systems by K.S Raghu Ram.
5. Automotive Transmissions Fundamentals, Selection, Design and Application-2011. Naunheimer, H., Bertsche, B., Ryborz, J., Novak, W.

**REFERENCES:**

1. SAE Transactions 900550 & 930910.
2. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
3. Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains construction", McGraw Hill, 1976.
4. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002

**OUTCOMES:**

- The students will be able to know the constructional and working principle of various types of clutch and gearbox.
- The students can analyze the design ratio of gear box used in a automobile vehicle.
- The Students will be able to evaluate the various types of automatic transmission used in automobile vehicle.
- The students will understand the constructional and working principle of hydrostatic, hydrodynamic transmission and electric drive used in a vehicle.

---

<b>AUB4103</b>	<b>ENGINE MANAGEMENT SYSTEM AND EMISSION CONTROL</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the principle of electronic engine management systems.
- To know the location and working of various sensors and actuators.
- To have an understanding about the management SI and CI engines.
- To understand about engine pollutant formation and effects.
- To know about the control of emission in SI and CI engines.
- To have knowledge about emission test procedures, norms, cycles and measuring instruments.

**MODULE I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 6**

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

**MODULE II SENSORS AND ACTUATORS 8**

Sensors for throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure, actuators, various types of actuators.

**MODULE III MANAGEMENT OF SI AND CI ENGINES 9**

Layout and working of SI engine management systems. Group and sequential injection techniques. TBI, MPFI and GDI systems. electronic ignition system, Electronic spark timing control. Diesel injection, Pilot, main, advanced post injection and retarded post injection techniques.

Electronically controlled Unit Injection system. Layout of the common rail fuel injection system.

**MODULE IV CI EFFECTS AND FORMATION OF POLLUTANTS 6**

Emission from automobiles, transient emission, effect of pollutants, global warming, formation of pollutants in SI engines, formation of pollutants in CI engines. Noise pollution and control.

**MODULE V CONTROL OF EMISSIONS FROM SI AND CI ENGINES 8**

Design and operating variables, in-cylinder emission control techniques such as ignition timing, air injection, injection timing, water injection, ammonia injection EGR, engine out emission control techniques, PCV system, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, Two stroke engine pollution control.

**MODULE VI EMISSION MEASUREMENT 8**

NDIR, FID, Chemiluminescent analyzers, Gas chromatograph, smoke meters, emission standards, driving cycles – USA, Japan, Euro and India. Test procedures, SHED Test, chassis dynamometers, dilution tunnels, sound level meter.

**Total Hours: 60**

**TEXT BOOKS**

1. Tom Weather Jr and Cland C.Hunter, "Automotive Computers and Control System", Prentice Hall Inc., New Jersey, 1984.
2. William B.Ribbens Butterworth, Heinemann,"Understanding Automotive Electronics", 5<sup>th</sup> Edition, 1998.
3. Jeff Hartman, "How to tune and Modify Automotive Engine Management System"Motor books, 2013.
4. Ganesan.V., "Internal Combustion Engines", Tata McGraw-Hill Publishing Co.,New Delhi, 2003.
5. M.L.Mathur and R.P.Sharma, "A course in Internal combustion engines",Dhanpat Rai & Sons Publications, New Delhi, 2001.

**REFERENCES**

1. Robert Bosch , "Diesel Engine Management", Wiley Publications, 2006
2. Robert Bosch , "Gasoline Engine Management", Wiley Publications, 2006

**B.Tech. Automobile Engineering**

---

3. Robert N Brady, "Automotive Computers and Digital Instrumentation", A reston Book, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
4. Bechtold, "Understanding Automotive Electronics", SAE, 1998
5. John B.Heywood, "Internal Combustion Engine Fundamental", McGraw-Hill, 1988.

**OUTCOMES:**

- Should be able identify the requirement and analyze the components of engine management system.
- Should be able to identify various sensors in EMS and link the actuators.
- Should be able to decide the sensors requirement for ignition and injection system.
- Should be able demonstrate the effect of pollutants and find means to reduce the effect.
- Should be able to analyze the effect of design and operating parameters on emission and select suitable control devices.
- Should be able to select the driving cycles and measurements for the requirement

**OBJECTIVES:**

- To study the various maintenance the reconditioning of vehicle parts.
- To train the structures in identifying the fault and rectification.

**STUDY EXPERIMENTS:**

1. Study and layout of an automobile repair, service and maintenance shop.
2. Safety aspects with respect to man, machine and tools.
3. General procedures for servicing and maintenance schedule.

**LIST OF EXPERIMENTS:**

1. Minor and major tune up of gasoline and diesel engines.
2. Calibration of Fuel pump.
3. Cylinder reboring - checking the cylinder bore, Setting the tool and reboring.
4. Fault diagnosis and service of transmission system
5. Removal and fitting of tire and tube.
6. Fault diagnosis and service of braking system
7. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
8. Wheel alignment procedure for servicing and maintenance.
9. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system etc
10. Fault diagnosis and service of vehicle air conditioning system
11. Practice the following:
  - i. Air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
  - ii. Wheel bearings tightening and adjustment.
  - iii. Adjustment of head lights beam.
  - iv. Fault diagnosis and service of driveline system

**Total Hours: 45**



**TEXT BOOK:**

1. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal, Jayesh P.Maniar. 2014
2. A Practical Approach to Motor Vehicle Engineering and Maintenance 3<sup>rd</sup> Edition by Allan Bonnick.
3. Vehicle Service Manuals of reputed manufacturers
4. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
5. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
6. Automobile electrical manual a comprehensive guide by Haynes manual car repair

**OUTCOMES:**

- Ability to identify the faults and knowledge on maintenance.
- Able to understand the reconditioning and repairing of various component and subsystems of vehicles

---

<b>AUB4105</b>	<b>MANUFACTURING TECH &amp; CNC LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>

**OBJECTIVES :**

- To understand the various mechanisms available in the, milling ,gear hobbing and grinding machines.
- To know the various tools and work holding devices used in machining processes
- To practice the basic machining operations performed in the special purpose machines
- To have knowledge about product manufacturing phases and experience working in teams to manufacture a product.
- To know the application of various CNC machines

**LIST OF EXPERIMENTS:**

- Milling Machines
  1. Milling Polygon Surfaces
  2. Keyway Milling
- Grinding / Polishing
  3. Surface Grinding
  4. Cylindrical Grinding
- Machining Components for Assembly of different fits.
  5. Bush and Shaft
  6. Step turning with drilling using capstan lathe
- Gear Machining
  7. Gear Milling
  8. Machining using CNC vertical machining
  9. Machining using CNC turning tap
- Project work
  10. Combined Skill (Each team has to make one simple product)

**Total Hours: 45**

**OUTCOMES:**

- Select suitable machining operations for automobile components
- Equip with good practical knowledge required in the core industry
- Able to write CNC program for particular machining operations

**OBJECTIVES**

- To study the various performance characteristics of both petrol and diesel engines
- To measure the various constituents of exhaust.

**LIST OF EXPERIMENTS:**

1. Study and use of IC engine testing Dynamometers.
2. Study of 2 and 4 wheeler chassis Dynamometers.
3. Study and use of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for IC engine testing.
4. Performance study of petrol engine at full throttle and part throttle conditions.
5. Performance study of diesel engine both at full load and part load conditions.
6. Morse test on petrol and diesel engines.
7. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in IC engines.
8. Head balance test on a Automotive diesel engine.
9. Engine tuning for performance improvement.
10. Testing of 2 and 4 wheelers using chassis dynamometers.
11. Study of NDIR Gas Analyser and FID.
12. Study of Chemiluminescent NOx analyzer.
13. Measurement of HC, CO, CO<sub>2</sub>, O<sub>2</sub> using exhaust gas analyzer.
14. Diesel smoke measurement.

**Total Hours : 45**

**REFERENCES:**

1. Giles, J.G., Vehicle Operation and performance, Illiffe Books Ltd., London, 1989.
2. BIS Code Books, IS-10000 series, 1988.

**OUTCOMES:**

Students will be able to test the dynamometers and signal analyzers

- to gain practical knowledge in smoke meter, gas analyzer, FID and NDIR.
- analyze the petrol and diesel emission with suitable instruments
- able to know recent EURO and BS emission standards.

.

**OBJECTIVES:**

- To provide scope for combining various design and manufacturing knowledge and skills learnt towards product realisation.

**COURSE DETAILS:**

The students will design and fabricate a small system and subsystem and present the design produce, analysis and manufacturing method as a project report along with the product realised.

**OUTCOME:**

Will have the ability to design and fabricate small systems and subsystems.

**PROFESSIONAL ELECTIVES**

<b>AUBX01 FINITE ELEMENT METHODS FOR AUTOMOTIVE APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand about the concept of Continuum Mechanics
- To Study about the 2D and 3D parametric elements
- To know the static and dynamic problems in FEA

**MODULE I INTRODUCTION 7**

Basic concepts of finite element method. Review of various approximate methods in structural analysis, Stiffness and flexibility matrices for simple cases. Direct stiffness method- plane truss idealization, joint forces and displacements. Formulation of governing equations and convergence criteria.

**MODULE II DISCRETE ELEMENTS 7**

Use of bar and beam elements in structural analysis. Computer implementation of procedure for these elements. 1D problems with second order equations, weak formulations-Examples from solid mechanics and heat transfer.

**MODULE III CONTINUUM ELEMENTS 7**

Classification of C0 C1 continuous problems, parameter functions and its properties – completeness and compatibility condition. Different forms of 2D elements and their applications for plane stress, plane strain and axi-symmetric problems. Consistent and lumped formulation. Use of local coordinates. Numerical integration.

**MODULE IV ELEMENTS 8**

Isoparametric quadrilateral elements-Shape functions for rectangular elements, Isoparametric mapping for quadrilateral elements, Numerical integration for quadrilateral elements, Four node quadrilateral element for 2DBVP, Eight node serendipity element for 2D BVP

**MODULE V FEA IN THERMAL ANALYSIS 8**

Finite element analysis of 2D steady state thermal analysis-Galerkin approach-General two dimensional heat conduction-Axisymmetric heat conduction-

Triangular, Quadrilateral elements-Simple problems using three noded triangular only.

**MODULE VI FEA IN STRUCTURAL ANALYSIS**

**8**

Finite element analysis of plane elasticity 2D problems-Introduction to theory of elasticity-plane stress-plane strain and Axisymmetric formulation-Element matrices using energy approach-Simple problems using three noded triangular element only.

**Total Hours : 45**

**TEXT BOOKS:**

1. Segerlind.L.J., "Applied Finite Element Analysis ", Second Edition, John Wiley and Sons Inc., New York, 1984.

**REFERENCES:**

1. Bathe.K.J. and Wilson.E.L., " Numerical methods in finite elements analysis", Prentice Hall of India Ltd, 1983.
2. Cook.R.D., "Concepts and Applications of Finite Element analysis ", 3<sup>rd</sup> Edition, John Wiley & Sons, 1989.
3. Krishnamurthy.C.S., " Finite Elements analysis ", Tata McGraw Hill, 1987.
4. Ramamurthi.V., " Computer Aided Design in Mechanical Engg. ", Tata McGraw-Hill, 1987.

**OUTCOMES:**

- Upon successful completion of this course, the student will be able to understand:
- Numerical methods involved in Finite Element Theory Definition of truss, beam, membrane, plate, and continuum elements
- Formulation of planar one-dimensional (truss and beam) elements having linear, quadratic, and cubic shape functions
- Global, local, and natural coordinates
- Formulation of planar, plane stress two-dimensional elements (rectangular and quadratic quadrilateral elements)



**B.Tech. Automobile Engineering**

---

- Formulation of 3-dimensional elements (four-node tetrahedral and eight-node brick elements)
- Direct formulation and basic energy and weighted residual formulation of finite elements
- Procedures for performing and verifying FEA using commercial FEA software

---

<b>AUBX03</b>	<b>MODELING AND SIMULATION OF VEHICLE SYSTEMS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To gather knowledge about mathematical modelling technique adopted for different vehicle systems.
- To learn various modelling software and its application in automobile.
- To learn the modelling and simulation technique applies in Automobile.
- To gain knowledge of the different types of simulation software's automotive application and application of FEA techniques related to automobile

**MODULE I COMPUTER FUNDAMENTALS AND TYRE 8**

Introduction, Computer fundamentals, An overview of CAD and analysis. Introduction to the modelling and simulation methods of vehicle systems- Fundamental of tyre principles, Vehicle tyre performances in various surfaces, Cornering characteristics of vehicle, Introduction working model two dimensional tyre model.

**MODULE II COMPUTER DRAFTING AND MODELLING 7**

Fundamental of 2D and 3D drafting. Introduction - 3D geometry - Surface types - Conventions - Attributes - Geometry - Examples of surface modelling - Solid modelling. Vehicle Kinematics, Multi body vehicle system design, Introduction to 3D vehicle design- Mechanisms-various Auto body panels, Introduction to Nastran2D, Nastran4D.

**MODULE III VEHICLE FRAME AND STEERING SYSTEMS 7**

Vehicle Frame - loads, moments and stresses on frame members - Computer aided design of leaf springs - Coil springs and torsion bar springs. Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering, Steering Mechanisms, steering mechanisms design and analysis.

**MODULE IV SUSPENSION AND FRONT AXLE 7**

Suspension computer models & simulations using MATLAB/Simulink, Fundamental concepts of vehicle vibrations principle. Bumper design

computer model - moments and stresses at different sections of front axle.  
Determination of bearing loads at Kingpin bearings.

**MODULE V CLUTCH AND GEAR BOX 8**

Torque capacity of clutch, design of four speed gear boxes. Drive train model, computer modelling using MATLAB/Simulink-Analysis of loads

**MODULE VI CRASH AND REAR AXLE 8**

Vehicle Collision analysis, Fundamental law of motion, energy and momentum forces and moments 2D and 3D computer models for calculation of impact forces. Computer aided design of propeller shaft. Modelling of final drive. Roll overs analysis, Modelling and analysis of axles. Introduction to the ADAMS vehicle design software. Finite Element modelling (FEA) and failure analysis stress. Deformation calculation.

**Total Hours: 45**

**Term work**

- Two and three dimensional tyre model
- 3D vehicle design mechanisms, various Auto body panels
- Suspension model and simulations using MATLAB/Simulink
- Computer aided design of propeller shaft and final drive gearing.
- Finite Element modelling(FEA) and failure analysis
- Individual vehicle design project.

**TEXT BOOKS:**

1. Dean Avern, " Automobile Chassis Design ", Illiffe Books Ltd, 1992.
2. Radhakrishnan.P. and Kothandaraman.C.P., "Computer Graphics and Design", Dhanpal Rai & Sons, Delhi 1990.

**REFERENCES:**

1. Heldt.P.M., " Automotive Chassis", Chilton Co., New York, 1992.
2. Steeds.W., "Mechanics of Road vehicles", Illiffe Books Ltd., London, 1990.
3. Giles.J.G., Steering, "Suspension and tyres", Illiffe Books Ltd., London, 1988.

**B.Tech. Automobile Engineering**

---

4. Newton, Steeds & Garret, "Motor vehicle", Illiffe Books Ltd., London, 1982.
5. Heldt.P.M., "Torque converter", Chilton Book Co., New York, 1982.
6. Ramamurthi.V., "Computer Aided Design in Mechanical Engg"., Tata McGraw Hill, New Delhi, 1987.
7. Naim A Kheir system modeling and computer simulation Marcel Dekker Inc 1996
8. Hatmut Bossel Modeling and simulation Volume 1
9. Michael Blundell,Damian Harty –The multibody systems approach to vehicle dynamics Elsevier 2004
10. Gui Rong Liu S S Quek The finite element method:A Practicalcourse Butterworth Heinemann 2003

**OUTCOME:**

At the completion of this course the students should be able to

- Apply the concepts of analysis the various vehicle system performances.
- To mathematical model the different vehicle systems.
- To solve different types of simulation problems for automotive application and application of FEA techniques related to automobile
- Able to discuss the approach for predicting vehicle performance and to simulate and analyze vehicle performance as well. Through teaching and specific experiments.

---

<b>AUBX04</b>	<b>EVALUATION OF VEHICLE PERFORMANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the minimum power requirement for vehicle propulsion and significance of aerodynamic drag forces related to vehicle performance. To acquire knowledge about the transmission and engine system performance analysis for ground vehicles.
- To expose the modern control system evaluation for engine, steering, suspension and brake systems.
- To provide knowledge about various types of testing methods used for validating the vehicle design.

**MODULE I VEHICLE PERFORMANCE 7**

Vehicle performance estimation and prediction, Aerodynamic drag, methods of estimation of resistance to motion, power requirement for propulsion, Power plant characteristics & transmission related requirements, arrangement of power train, vehicle acceleration, maximum speed, and gradability drive systems comparison, handling and ride characteristics on different road surfaces.

**MODULE II VEHICLE TRANSMISSION 7**

Vehicle Transmission performance: Characteristics and features of friction clutches, mechanical gear transmission and Epicyclic gear boxes, fluid coupling & torque converters. Brake efficiency measurement

**MODULE III ENGINE PERFORMANCE 7**

Operational performance: Engine performance and operating characteristics at full load and part load condition, fuel economy, effect of vehicle condition, tire and road condition, traffic condition and driving habits on fuel economy.

**MODULE IV VEHICLE CONTROL SYSTEMS 8**

Vehicle Control Systems, Braking arrangements and Characteristics, weight transfer, steering arrangements, rigid & independent suspension, roll centre, torsion bar, stabilizer, and radius bar. Drive by wire technology, vehicle safety

**MODULE V TESTING AND VALIDATION**

**8**

Vehicle performance Testing: Laboratory testing – Testing of major components of vehicle like clutch, suspension, braking, steering etc., Engine testing- noise vibrations, emission, power & fuel consumption, brake testing on the road.

**MODULE VI VEHICLE TESTING**

**8**

Vehicle testing on chassis dynamometers, Road and Track testing, Initial inspection, running in and durability, extensive driving, maximum speed & acceleration, handling and ride characteristics on different road surfaces, ride comfort, corrosion testing.

**TERM WORKS**

- Estimation of power requirement for vehicle propulsion considering Aero dynamic describe the ride characteristics for different road surfaces. Also compute maximum acceleration with respect to speed
- Analyse the performance and characteristic of transmission system for different friction values
- Engine testing for finding the performance characterises and on road fuel consumption measurement
- Brake Efficiency measurement and Noise and vibration measurement in passenger compartment
- Study of chassis dynamometer for vehicle performance testing and study of vehicle component testing

**Case Studies**

- Study the Automatic Transmission system performances for different speed and Load conditions
- Study the engine performance characterises for various load and speed condition
- Evaluation human ride comfort characteristics for ISO class A to Class E road surfaces

**Total Hours : 45**

## REFERENCES

1. Gousha H.M., "Engine performance diagnosis & Tune up shop manual"
2. J.G. Giles, "Vehicle Operation & performance".
3. W.H. Crouse & D.L. Anglin, "Motor vehicle inspection".
4. SAE Transactions papers – 831814 / 820346 / 820371 /820375
5. CIRT &VRDE Manuals

## OUTCOMES:

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

- Estimate the power requirement for vehicle propulsion by considering aerodynamic effects and the ride characteristics analysis for different road surfaces. Also able to compute maximum acceleration with respect to vehicle speed
- Possess the knowledge to investigate the performance of transmission system and brake efficiency measurement.
- Developed Engine testing for finding performance Characterizes.
- Apply the knowledge of modern control methods to control the steering, suspension and braking systems.
- Validate the vehicle design with vehicle performance testing, component testing in chassis dynamometer. Vibration and Noise measurements in passenger compartment.

---

<b>AUBX05</b>	<b>AUTOMOTIVE AERODYNAMICS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The students able to study the basics of Automotive Aerodynamics in a automobile vehicle. The student can impart knowledge in the performance of the vehicle.
- The students able to know the resistance of motion, rolling and grade resistance.
- The students can impart knowledge in the aerodynamic drag and pressure occurs in an automobile vehicle.

**MODULE I INTRODUCTION 5**

Scope - historical development trends - Fundamental of fluid mechanics - Flow phenomenon related to vehicles -External & Internal flow problem - Potential of vehicle aerodynamics.

**MODULE II RESISTANCE AND PERFORMANCE OF VEHICLE 5**

Resistance to vehicle motion – Air, Rolling and Grad resistance - Performance – Fuel consumption and performance

**MODULE III AERODYNAMIC DRAG OF CARS 8**

Cars as a bluff body - Flow field around car - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic development - low drag profiles.

**MODULE IV ANALYSIS OF DRAG OF CARS 7**

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

**MODULE V VEHICLE HANDLING 10**

The origin of forces and moments on a vechile - side wind problems - methods to calculate forces and moments - vehicle dynamics Under side winds - the effects of forces and moments - Characteristics of forces and moments - Dirt



accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

**MODULE VI WIND TUNNELS FOR AUTOMOTIVE AERODYNAMIC 10**

Introduction - Principle of wind tunnel technology - Limitation of simulation - Stress with scale models – full scale wind tunnels - measurement techniques - Equipment and transducers - road testing methods – Numerical methods.

**Total Hours: 45**

**TEXT BOOK:**

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

**REFERENCES:**

1. Pope. A., "Wind Tunnel Testing", John Wiley & Sons, 2<sup>nd</sup> Edition, New York, 1974.
2. Automotive Aerodynamic : Update SP-706, SAE, 1987.
3. Vehicle Aerodynamic, SP-1145, SAE, 1996.

**OUTCOMES:**

- Demonstrate knowledge and understanding of the essential facts, concepts and principles of incompressible flows including vortices and viscous effects, boundary layers, wing and diffuser aerodynamic characteristics.
- Demonstrate understanding of how aerodynamics affects the motorsport vehicle design and operation
- Demonstrate a critical awareness of the wind tunnel techniques used to analyse motorsport aerodynamic problems and apply these techniques and concepts to develop solution strategies for relevant wind tunnel simulations
- Demonstrate competence in analysing and evaluating the low speed aerodynamic characteristics of representative vehicles and components using acquired wind tunnel data, data sheets and fundamental principles

---

<b>AUBX06</b>	<b>AUTOMOTIVE SAFETY SYSTEMS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The students will have good exposure in automotive safety aspects including the understanding of the various safety equipments.
- The students able to know the design of body for safety, dimensions of a body and about the impact of a vehicle.
- The students also able to know about the safety systems in a vehicle and deformation behavior of a vehicle.

**MODULE I INTRODUCTION 7**

Design of the body for safety, energy equation, engine location and vehicle size and structure. Energy-absorbing bumpers, bumper design for safety and vehicle seating positions.

**MODULE II VEHICLE SAFETY 8**

Deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction.

**MODULE III SAFETY CONCEPT 7**

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

**MODULE IV SAFETY EQUIPMENTS 8**

Seat belt, collapsible steering column, tiltable steering wheel system, Air bags, Antilock braking system, Adaptive cruise control system and Stability control systems. Automatic parking system.

**MODULE V COLLISION WARNING AND AVOIDANCE 8**

Collision warning system, causes of rear end collision, front and rear vehicle object detection system, Automatic braking system, Lane departure warnings system.

**MODULE VI COMFORT AND CONVENIENCE SYSTEM**

**7**

Steering and mirror adjustment, Central locking system, Tyre pressure control system, Rain sensor system, Environment information system.

**Total Hours: 45**

**TEXT BOOKS**

1. Bosch, "Automotive Handbook", 8<sup>th</sup> Edition, SAE publication, 2011.
2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.

**REFERENCES:**

1. Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc.,
2. Automotive Safety Handbook Volume 325 of R: Society of Automotive Engineers by Ulrich Seiffert, Lothar Wech

**OUTCOMES:**

- The student will understand how the vehicle's structure absorbs impact in a crash.
- The student will be familiar in various systems that enhance vehicle safety, passenger Comfort, recent technologies in automobile field etc.
- The student will be able to Identify and locate the most important parts of a vehicle.
- The student able to describe the purpose of the fundamental automotive system

---

<b>AUBX07</b>	<b>COMBUSTION THERMODYNAMICS AND HEAT TRANSFER</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To Study the Combustion Thermodynamics and Heat Transfer
- To study the normal combustion of SI engine
- To study heat transfer from the engine and miscellaneous heat transfer

**MODULE I INTRODUCTION TO COMBUSTION PROCESSES 6**

Combustion in premixed and diffusion flames - Combustion process in IC engines.

**MODULE II NORMAL COMBUSTION IN SI ENGINES 5**

Stages of combustion - Flame propagation - Rate of pressure rise - Cycle to cycle variation

**MODULE III ABNORMAL COMBUSTION IN SI ENGINES 6**

Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion.

**MODULE IV COMBUSTION AND KNOCK IN CI ENGINES 11**

Droplet and spray combustion theory - stages of combustion - delay period - peak pressure - Heat release – Gas temperature - Diesel knock.

**MODULE V HEAT TRANSFER IN IC ENGINES 11**

Basic definitions - Convective heat transfer - Radiative heat transfer - Heat transfer, temperature distribution and thermal stresses in piston - Cylinder liner - Cylinder head - fins and valves.

**MODULE VI EXPERIMENTAL INVESTIGATION OF COMBUSTION AND HEAT 6**

Photographic studies of combustion processes - P-q diagram in SI and CI engines. Anemometry – Temperature measurement in piston - cylinder liner - cylinder head and engine valves.

**Total Hours: 45**

**TEXT BOOKS:**

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.
2. Cengel, "Thermodynamics An Engineering Approach", 3<sup>rd</sup> Edition – 2003, Tata McGraw Hill, New Delhi.

**REFERENCES:**

1. Holman.J.P., "Thermodynamics", 3rd Edition McGraw-Hill, 1995.
2. Natarajan. E., "Engineering Thermodynamics" Anuragam Publications, Chennai, 2012

**OUTCOMES:**

On completion of this module the student will

- Be able to analysis combustion process of given engine
- Be able to analysis heat apportion of given engine
- Be able to photographic analysis of give automobile engines

---

<b>AUBX08</b>	<b>JET ENGINES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the principles of operation of Jet Engines
- To Understand the design principles of aircraft power plants
- To study in detail about gas turbines, ramjet, fundamentals of rocket propulsion and chemical rockets

**MODULE I FUNDAMENTALS OF GAS TURBINE ENGINES 7**

Illustration of working of gas turbine engine - The thrust equation - Factors affecting thrust - Effect of pressure, velocity and temperature changes of air entering compressor- Methods of thrust augmentation - Characteristics of turboprop, turbofan and turbojet - Performance characteristics.

**MODULE II SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES 8**

Internal flow and Stall in subsonic inlets - Boundary layer separation - Major features of external flow near a subsonic inlet - Relation between minimum area ratio and external deceleration ratio - Diffuser performance - Supersonic inlets - Starting problem on supersonic inlets - Shock swallowing by area variation - External deceleration - Models of inlet operation.

**MODULE III COMBUSTION CHAMBERS 8**

Classification of combustion chambers - Important factors affecting combustion chamber design - Combustion process - Combustion chamber performance - Effect of operating variables on performance - Flame tube cooling - Flame stabilization - Use of flame holders - Numerical problems.

**MODULE IV NOZZLES 7**

Theory of flow in isentropic nozzles - nozzles and choking - Nozzle throat conditions - Nozzle efficiency - Losses in nozzles- Over expanded and under - expanded nozzles - Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces - Thrust reversal

**MODULE V COMPRESSORS 7**

Principle of operation of centrifugal compressor - Work done and pressure

rise - Velocity diagrams - Diffuser vane design considerations - Concept of prewhirl, rotation stall and surge - Elementary theory of axial flow compressor - Velocity triangles - degree of reaction - Three dimensional - Air angle distributions for free vortex and constant reaction designs - Compressor blade design - Centrifugal and Axial compressor performance characteristics.

**MODULE VI SUPERSONIC INLETS AND NOZZLES**

**8**

Supersonic inlets - starting problem on supersonic inlets - shock swallowing by area variation - external declaration - models of inlet operation. Convergent nozzles and choking - over expanded and under - expanded nozzles - ejector and variable area nozzles - interaction of nozzle flow with adjacent surfaces - thrust reversal.

**Total Hours: 45**

**TEXT BOOK:**

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison - Wesley Longman INC, 1999.

**REFERENCES :**

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine" - Third Edition - 1983.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.

**OUTCOMES:**

- An understanding of quasi-one-dimensional flow;
- An understanding of the generation of thrust in air-breathing engines and rockets.
- An ability to carry out simple performance analysis of subsonic and supersonic inlets.
- An ability to carry out overall performance calculations of turbojets, turbofans and turboprops

---

<b>AUBX09</b>	<b>ALTERNATIVE ENERGY VEHICLE</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- To acquire knowledge of alternate fuels
- To understand the changes in the engine design for handling
- To understand various energy systems for use in the automobiles.

**MODULE I INTRODUCTION 6**

Estimation of petroleum reserve “World Energy Scenerio, Energy Survey of India” – Need for alternate fuel – Availability of alternate fuels.

**MODULE II ALCOHOLS 9**

Properties as engine fuels, alcohols and gasoline blends, performance in SI engine. Methanol and gasoline blends – Combustion characteristics in engines – emission characteristics.

**MODULE III NATURAL GAS, LPG, HYDROGEN AND BIOGAS 9**

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

**MODULE IV VEGETABLE OILS 10**

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

**MODULE V ELECTRIC POWERED VEHICLES 6**

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

**MODULE VI SOLAR POWERED VEHICLES 5**

Layout of a solar vehicle – advantage and limitations – Specifications – System component, Electronic control system for Solar powered vehicles.

**Total Hours: 45**



**TEXTBOOK:**

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.
2. Maheswar Dayal, Energy today & tomorrow, I & B Horishr India, 1982.
3. Bechtold, R.L., Alternative Fuels Guide Book, SAE, 1997.

**REFERENCES**

1. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
2. Alcohols and motor fuels progress in technology, Series No.19, SAE Publication USA 1980.
3. SAE Paper Nos.840367, 841156, 841333, 841334.
4. The properties and performance of modern alternate fuels – SAE Paper No.841210.

**OUTCOMES:**

- Students use language to understand, develop and communicate ideas and information with others.
- Students select, integrate and apply numerical and spatial concepts and techniques.
- Students recognize when and what information is needed, locate and obtain it from a range of sources and evaluate, use and share it with others.
- Students use, select and apply technologies.
- Students describe and reason about patterns, structures and relationships in order to understand, interpret, justify and make predictions.

---

<b>AUBX10</b>	<b>NOISE, VIBRATION AND POLLUTION CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To acquire knowledge of Noise Vibration and Pollution Control for handling them and understand various use in the automobiles.

**MODULE I INTRODUCTION TO VIBRATION 7**

Introduction, Causes and effects of vibration, vibration terminology, Equation of motion- Energy method, Rayleigh's method etc., Harmonic and periodic motions, Vibration standards, Single-DOF Free Vibrations, Multi-DOF Free Vibrations.

**MODULE II VIBRATION INSTRUMENTATION AND ANALYSIS 8**

Vibration measurements – Vibration measurement parameters (displacement, velocity & acceleration), instrumentation –electrodynamics exciters – impact hammers, piezoelectric accelerometers, signal conditioning and amplification, filters, preamplifiers and power amplifiers, real time analysis, FFT analysis, structural frequency response measurement, modal testing of beams, Modal parameter (natural frequency, mode shape and damping) estimation techniques Relevance of vibration analysis, introduction to experimental modal analysis, Structural modal analysis, mode shapes, Euler's beam equation for natural frequency, Calculation of natural frequencies - Rayleigh method, Stodala method, machine diagnostics through vibration analysis.

**MODULE III INTRODUCTION TO NOISE AND NOISE MEASUREMENT 8**

Introduction, causes, effects, basic terms, Noise characteristics, Sources of noise, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises, wave equation, noise standards etc.

Sound and Noise parameters, propagation of sound & noise in various machinery's, noise measuring parameters, noise level measurement techniques, Noise level interpolation and mapping, noise measuring instruments.

**MODULE IV NOISE CONTROL**

**7**

Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management, Road vehicle noise standards, Sound absorption by porous materials, silencer and suppression systems, Sound absorption, sound insulation, acceptance noise levels

**MODULE V POLLUTANT FORMATION AND AFTER TREATMENT**

**7**

Introduction, Pollutants, sources, formation of HC and CO in SI engines, NO formation in SI and CI engines, Particulate emission from SI and CI engines, Smoke Emission in CI engines. Effect of operating variables on emission formation.

Introduction, physical conditions and exhaust gas compositions before treatment, catalytic mechanism. Thermal reactions, installation of catalyst in exhaust lines, NOx treatment in diesel engines. Diesel trap oxidizers.

**MODULE VI POLLUTANT MEASUREMENT AND CONTROL**

**8**

NDIR analyzers, thermal conductivity and flame ionization detections, analyzers for NOx, gas chromatograph, Orsat apparatus, smoke meters - spot sampling and continuous indication types like Bosch, Hartridge.

Pollution control in SI and CI engines, design changes, optimization of operating factors, exhaust gas recirculation, fuel additives to reduce smoke and particulates.

**Total Hours: 45**

**TEXT BOOKS:**

1. N. L. Meirovitch, Elements of vibration Analysis, Mc Graw Hill New York, 1986.
2. J.P. Den Hartog, Mechanical Vibration, 4th edition, Mc Graw Hill, New York 1985
3. Irwin & Garf, Industrial Noise & Vibration Control.
4. Mechanical Vibration – S. S. Rao, New Age International (P) Ltd., New Delhi
5. Mechanical Vibration Analysis, P. Srinivasan, Tata McGraw Hill Pub. New Delhi
6. Springer and Patterson, Engine Emission, Plenum Press, 1990.

7. W.M. Crouse and A.L. Anglinm, Automotive emission control, McGraw Hill Co., New York 1993.

**REFERENCES:**

1. Harris, C. M. Handbook of Acoustical Measurements and Noise Control, Acoustical Society of America, 1998.
2. Beranek L.L. & Ver I.L., Noise and Vibration Control Engineering: Principles and Applications, 2<sup>nd</sup> edition, Wiley 2006
3. Leonard Meirovitch, Fundamentals of Vibrations, Mc Graw Hill New York
4. J.S. Rao and K. Gupta, Advanced theory of Vibration.Willey Eastern.1992.
5. Ganesan.V., Internal Combustion Engines, 2<sup>nd</sup> edition, Tata McGraw Hill Co, 2003.
6. Obert.E.F., Internal Combustion Engines, Harper and Row, 1982.
7. Taylor.C.F., Internal Combustion Engines, MIT Press, 1972.
8. Heywood.J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1995

**OUTCOMES:**

- At the conclusion of the course you will be able to: Perform NVH analysis
- Evaluate and interpret NVH test results, identify vehicle noise and vibration root causes and recommend product development solutions integrate NVH control techniques at the design stage.
- Problem solving and decision making
- Advanced technical competence
- Professional legal and ethical standards

---

<b>AUBX11</b>	<b>COMPOSITES MATERIALS FOR AUTOMOBILES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **OBJECTIVES**

- To understand the composite materials and its applications in automotive Industry
- To have knowledge about composite structure.
- To understand the various types of composite materials.

### **MODULE I ITI INTRODUCTION 8**

Reinforcement – Fibres – Glass fibre, Aramid fibre, Carbon fibre, boron fibre – Fabrication – Properties – Applications – Comparison of fibres – Particulate and whisker reinforcements. Matrix materials – Properties-Wettability – Effect of surface roughness – Interfacial bonding – Methods for measuring bond strength.

### **MODULE II POLYMER MATRIX COMPOSITES 8**

Polymer Matrix Composites -Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrusion, resin transfer moulding, autoclave molding – Thermoplastic matrix composites – Injection molding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications.

### **MODULE III METAL MATRIX COMPOSITES 6**

Metal Matrix Composites Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, Mechanical properties. Applications.

### **MODULE IV CERAMIC MATRIX COMPOSITES 6**

Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – CVD, CVI, sol gel process. Interface in CMCs. Mechanical properties – Thermal shock resistance – Applications.

### **MODULE V COMPOSITE STRUCTURES 9**

Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue – Creep

Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted – laminate optimization.

**MODULE VI AUTOMOTIVE APPLICATIONS**

**8**

Drive Shafts, Suspension Arms, Wheels, Valve Guides, Clutch Plates, use of MMC in disc brakes, Mufflers and other applications

**Total Hours: 45**

**REFERENCES:**

1. Mathews F L and Rawlings R D, "Composite Materials: Engineering and Science", CRC Press and Woodhead Publishing Limited, 2002.
2. Krishnan K Chawla, "Composite Materials Science and Engineering", Springer, 2001.
3. Handbook of Composites – American Society of Metals, 1990.
4. Derek Hull, "An introduction to Composite Materials", Cambridge University Press, 1988.

**OUTCOMES:**

By the end of the course, students should be able to:

- Understand the preparation, applications and type or reinforcement.
- Understand the composite manufacturing processes.
- Demonstrate understanding of different theories of adhesion
- Explain the effects of micro structural parameters on the properties of composite
- Able to calculate stress, strain and modulus for a given problem of unidirectional composite.
- Identify the steps involved in material selection process of composite.
- Identify some of the items needed for production fabrication.

---

<b>AUBX12</b>	<b>VEHICLE COMFORT SYSTEM &amp; ERGONOMICS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- Understand the engineering principles that underpin the design of an automotive vehicle for the comfort of the occupants and other road users.
- Recognize the future direction of the design of comfort systems within the automotive engineering sector.
- Appreciate the role and use of comfort systems in automobile engineering.

**MODULE I INTRODUCTION TO AUTOMOTIVE COMFORT SYSTEMS 9**

Introduction to automotive comfort systems for both the vehicle occupants and other road users.

**MODULE II DESIGN, CONSTRUCTION AND OPERATION OF COMFORT SYSTEMS 7**

Introduction to the design, construction and operation of comfort systems such as: NVH (noise, vibration and harshness) of chassis, engines and power train, ride quality and sound quality; heating, ventilation and air conditioning systems.

**MODULE III DRIVER COMFORT 7**

Driver comfort – seating, visibility, man-machine system, Psychological factors – stress, attention

**MODULE IV PASSENGER COMFORT 7**

Passenger comfort - Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration.

**MODULE V COMFORT AND CONVENIENCE SYSTEM 8**

Steering and mirror adjustment – Central locking system – Garage door opening system – Tyre pressure control system – Rain sensor system – Environment information system.

**MODULE VI VEHICLE ERGNOMICS 7**

Introduction to human body, Anthropometrics and its application to vehicle

ergonomics and cockpit design. Ergonomic research methods / ergonomic audit, Practical work aimed at integrating design and ergonomics

**Total Hours: 45**

**REFERENCES:**

1. B.Peacock, Waldemar Karwowski; Automobile ergonomics. Publisher: CRC; 1<sup>st</sup> edition, 1993
2. Bosch, "Automotive Handbook", 5<sup>th</sup> Edition, SAE publication, 2000.
3. Ronald.K.Jurgen, "Automotive Electronics Handbook", 2<sup>nd</sup> Edition, McGraw-Hill Inc.,1999.

**OUTCOMES:**

- Describe the characteristics and importance of ergonomics in automotive design technology.
- Identify relevant automotive design standards with regard to ergonomics.
- Design a vehicle system based on automotive design standards with regard to ergonomics.
- Analyze vehicle design performance related to ergonomic aspect.



---

<b>AUBX13</b>	<b>TRAFFIC ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

### **OBJECTIVES**

- To introduce the students about various traffic engineering and management problems and their solutions.

### **MODULE I INTRODUCTION AND TRAFFIC CHARACTERISTICS 7**

Objectives and scope of traffic engg. Organizational set up of traffic engg department in India; Importance of traffic characteristics; Road user characteristics; Vehicular characteristics; Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

### **MODULE II TRAFFIC SURVEYS 7**

Methods of conducting the study and presentation of the data for traffic volume study; speed study and origin and destination study. Speed and delay study. Parking surveys; On street parking; off street parking. Accident surveys. Causes of road accidents and preventive measures; Use of photographic techniques in traffic surveys.

### **MODULE III HIGHWAY CAPACITY 7**

Importance. Space and time headway. Fundamental diagram of traffic flow. Relationship between speed; volume and density. Level of service. PCU. Design service volume. Capacity of non-urban roads. IRC recommendations. Brief review of capacity of urban roads.

### **MODULE IV TRAFFIC CONTROL 8**

Types of traffic control devices. Traffic signs; general principles of traffic signing; types of traffic signs. Road markings; types; general principles of pavement markings. Design of rotary. Grade separated intersections. Miscellaneous traffic control aids and street furniture.

### **MODULE V SIGNAL DESIGN 8**

Types of signals. Linked or coordinated signal systems. Design of signal timings by trial cycle method; approximate method; Webster's method and IRC method

Need and scope of traffic regulations. Regulation of speed; vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements; one way streets; tidal flow operations; exclusive bus lanes; traffic restraint; road pricing.

**Total Hours: 45**

**TEXT BOOK:**

1. Khanna S. K. and Justo C. E. G., "Highway Engineering", Nem Chand Bros., Roorkee.

**REFERENCES:**

1. Kadiyali L. R., "Traffic Engg. and Transport Planning", Khanna Publishers
2. Matson T. M., Smith W. S. and Hurd F. W., "Traffic Engineering", McGraw Hill, New York.
3. Drew D. R., "Traffic Flow Theory", McGraw Hill, New York.

**OUTCOMES:**

- Knowledge means the body of facts, principles, theories and practices that is related to a field of work or study. It is described as theoretical and/or factual knowledge; Skills means the ability to apply knowledge
- How to complete tasks and solve problems. They are described as cognitive (logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);
- Competence means the proven ability to use knowledge, skills and personal, social and methodological abilities in work or study situations and in professional and personal development. It is described in terms of responsibility and autonomy.

---

<b>AUBX14</b>	<b>FUEL CELL TECHNOLOGY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To introduce the concept of fuel cells for use in automobile
- To analyse the performance characteristics of the various components
- To compare them with the other powering devices.

**MODULE I INTRODUCTION TO FUEL CELLS 8**

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.

**MODULE II FUEL CELLS FOR AUTOMOTIVE APPLICATIONS 8**

Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.

**MODULE III COMPONENTS OF FUEL CELL 6**

Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects

**MODULE IV FUEL CELL PERFORMANCE 7**

Membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.

**MODULE V FUELING 8**

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.

**MODULE VI FUEL CYCLE ANALYSIS 8**

Introduction to fuel cycle analysis – application to fuel cell and other competing

technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

**Total Hours: 45**

**REFERENCES:**

1. Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1-86058 4233, 2004.
2. Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.

**OUTCOMES:**

By the conclusion of this course, each student should

- Have thorough understanding of performance behavior, operational issues and challenges for all major types of fuel cells.
- Use the techniques, skills, and modern engineering tools necessary for design and analysis of innovative fuel cell systems.
- Understand the impact of this technology in a global and societal context.
- Develop enough skills to design systems or components of fuel cells.
- Be ready to begin a career as an engineer in companies developing fuel cell components and systems.

---

<b>AUBX15</b>	<b>SIMULATION OF IC ENGINES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- To learn the simulation techniques to estimate the performance and emission characteristics of IC engines.
- At the end of this course, the student will be able to understand the various simulation techniques for SI and CI Engines.

**MODULE I INTRODUCTION 8**

Introduction-Heat of reaction-Measurement of URP-Measurement of HRP-Adiabatic flame temperature, complete combustion in C/H/O/N Systems,

**MODULE II ADIABATIC PROCESS 8**

Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature-Isentropic changes of state.

**MODULE III SI ENGINE SIMULATION WITH AIR AS WORKING MEDIUM 7**

Deviation between actual and ideal cycle-Problems, IC engine simulation with adiabatic combustion, temperature drop due to fuel vaporization, full throttle operation-efficiency calculation, part-throttle operation, super charged operation

**MODULE IV PROGRESSIVE COMBUSTION 8**

SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.

**MODULE V SIMULATION OF CI ENGINE 7**

Diesel Engine Simulation: Multi Zone model for combustion, different heat transfer models, equilibrium calculations, simulation of engine performance, and simulation for pollution estimation.

**MODULE VI SIMULATION OF NEW ENGINE CONCEPTS**

**7**

Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.

**Total Hours: 45**

**REFERENCES:**

1. Ganesan. V. Computer Simulation of spark ignition engine process, Universities Press (I) Ltd. Hyderabad, 1996.
2. Ramoss. A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.
3. Ashley Campbel, Thermodynamic analysis of combustion engines, John Wiley & Sons, New York, 1986
4. Benson. R.S., Whitehouse. N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.

**OUTCOMES:**

After completing the course students must be able to describe:

- The combustion and emission formation in the spark ignited engine
- A turbo-supercharging systems from a performance perspective
- The combustion and emission formation in the diesel engine
- Different methods to reduce exhaust emissions from diesel engines, both in combustion and after treatment
- Mass forces and vibration of a single cylinder engine
- How the two-stroke engine works
- How pulses in inlet and exhaust systems affect cylinder filling
- Thoughts and reasoning in current engine development

---

<b>AUBX16</b>	<b>OFF ROAD VEHICLES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To understand the basic working principle of off road vehicle.
- To know the transmission and power train arrangements of dozers.
- To understand the working process of agricultural tractors.
- To have knowledge about trucks and graders.

**MODULE I CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES 8**

Power plants, chassis and transmission, Multi-axle vehicles. Auxiliary transmission, compound transmission, twin & triple countershaft transmissions and planetary transmission, Final drives.

**MODULE II LAND CLEARING MACHINES AND BULLDOZER 6**

Bush cutter, stampers, Tree dozer, Rippers. Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self powered types.

**MODULE III TRACTORS AND AGRICULTURAL MACHINERY 7**

Classification of tractors, main tractor assemblies, functions of farm tractors, types of engine & transmissions used, braking system, Specifications of wheels and tyres, dual versus tandem tyres, applications of tractors, forces acting on a tractor on move, parallel pull and rolling resistance, tractor stability and weight distribution, maintenance and operation of tractors, differential lock.

**MODULE IV MINING TRUCKS 7**

Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.

**MODULE V SCRAPERS AND GRADERS 9**

Construction and working principles of Scrapers, elevating graders, self powered scrapers and graders.

**MODULE VI SHOVELS AND DITCHERS**

**8**

Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.

**Total Hours: 45**

**REFERENCES:**

1. Abrosimov. K. Bran berg.A. and Katayer.K., "Road making Machinery", MIR Publishers, Moscow, 1971.
2. C.P. Nakra, "Farm Machines and Equipment", Dhanpat Rai Publications, New Delhi
3. Wang.J.T., "Theory of Grand vehicles", John Wiley & Sons, New York, 1987.
4. Off the road wheeled and combined traction devices - Ashgate Publishing Co.Ltd. 1998.
5. J. Konard, "Manual of Tractors", Asia Publishing House.
6. Jain and Roy , Tractors and Agriculture Equipment.

**OUTCOME:**

- Be able to understand the various power train arrangements of off road vehicles.
- Know about functions of tractors and agricultural machineries.
- Will have knowledge on the working and design issues of off road vehicle.



---

<b>AUBX17</b>	<b>SURFACE ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To provide knowledge of principle and practice of surface engineering and coating techniques
- To provide knowledge about hardfacing and plating processes.
- To familiarise about thin film coating techniques.
- To provide knowledge about high energy modification processes

**MODULE I TRIBOLOGY PROCESSES 7**

Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication and wear testing.

**MODULE II PLATING PROCESSES 7**

Plating Processes: Fundamentals of electrodeposition, plating of nickel, chromium, tin and copper, pulsed plating, hydrogen embrittlement, plating adhesion, electroless plating, electrochemical conversion coating, selective plating for repair, plating properties, hard anodizing.

**MODULE III HARDFACING PROCESSES 8**

SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes - HVOF, Detonation gun and jet kote processes, hard facing consumables.

**MODULE IV SPECIAL DIFFUSION PROCESSES 7**

Principle of diffusion processes – Boriding, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion processes – Characteristics of diffused layer – micro structure and micro hardness evaluation – properties and applications.

**MODULE V THIN FILM COATINGS 8**

Physical vapour deposition processes – Thermal evaporation - sputter coating - Ion plating – Chemical vapour deposition – reactive sputtering - TiC, TiN,

Alumina, CBN, Diamond and DLC coatings. Structure, properties and applications.

**MODULE VI HIGH ENERGY MODIFICATION AND SPECIAL PROCESSES 8**

Electron beam hardening/ glazing, Laser beam hardening / glazing ion implantation, Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide cloth, thermal / chemical, Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates.

**Total Hours: 45**

**REFERENCES:**

1. William D. Callister, Materials Science and Engineering: An Introduction, 7<sup>th</sup> Edition, John Wiley & Sons, New York, 2007.
2. Yip-Wah Chung, Practical Guide to Surface Science and Spectroscopy, Academic Press, San Diego, CA, 2001.
3. Donald L. Smith, Thin-Film Deposition: Principles and Practice, McGraw-Hill, Boston, 1995.
4. Hornyak G. Louis, Tibbals, H.F., Dutta Joydeep, Fundamentals of Nanotechnology, CRC Press, Boca Raton, 2009.
5. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001, TK7870.15. F86 2001.
6. William M. Steen, Laser Material Processing, Springer, New York, 2003, TS183.S73.

**OUTCOMES:**

The students will be able to

- Evaluate various CAD models for rapid prototyping and related operations for STL model manipulation.
- Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
- Explain and summarize the principles and key characteristics of technologies and commonly used RP systems.

---

<b>AUBX18</b>	<b>ADVANCED MATERIAL TESTING &amp; FAILURE ANALYSIS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

### **OBJECTIVES**

- To have knowledge about importance and significances of material quality in service.
- To understand the impact on component life, customers satisfaction in performance.
- To know the procedure of Material Testing characterization and failure analysis.

### **MODULE I MATERIAL PROPERTIES 7**

Mechanical Characterization: Mechanical Property characterization- Principles & characterization techniques related to tensile, compressive, hardness, fatigue, and fracture toughness properties. Deformation, Super plasticity Stress-strain diagram, Determination of YS, UTS, MoE, %E, %RA, Hardness testing, true stress-strain diagram, stretcher strain characteristics, effects of cold working, & n values, poissons ratio

### **MODULE II MECHANICAL TESTS 7**

Deep drawn quality of sheets, Impact test, bend test, shear test, Significances of property evaluation, SN curves and fatigue life, non-destructive testing, residual stress measurements, microscopy and scanning electron microscopy, EDAX / WDS analysis, corrosion testing, wear & tear characteristics, slow strain rate characteristics, thermal behaviors. Thermal Analysis: Principles and applications of thermal analysis.

### **MODULE III PROPERTIES OF PLASTICS, ELASTOMERS AND COMPOSITES 8**

Molecular weight distribution, MFI, HDT & VICAT softening point, cold temperature behaviors, Rheological behaviors, hardness and impact properties, identification of polymers, weathering characteristics, cyclic temperature test, flammability, VOC and odor test, scratch resistance test, metal composition analysis, RoHS analysis.

### **MODULE IV MATERIAL BEHAVIOURS – ELECTRICAL EFFECTS 7**

Electrical properties of Materials – Dielectric constant, electrical resistivity,

wire harness test Mechanical behaviors, Electrical-Magnetic-Optical properties of polymer nano-composites.

**MODULE V MATERIAL BEHAVIOURS – EFFECTS 8**

Thermal properties of Materials – coefficient of thermal expansion & contraction, Thermal response, Fire retardancy, Chemical resistance.

**MODULE VI INSTRUMENTAL TECHNIQUES 8**

FTIR spectrometer, Thermal analyzer, X-ray analyzer, Optical emission spectroscopy, Ion Chromatography, Gas and Liquid Chromatography, High strain rate tester, Non-destructive instruments, etc. New innovations in testing and characterization, X-ray Diffraction, Electron microscope (SEM, TEM), Scanning probe microscopy (SPM, AFM), Spectroscopic methods (EDS, FTIR); Mechanical behaviors, Thermal response, Fire retardancy, Chemical resistance and Electrical-Magnetic-Optical properties of polymer nano-composites.

**Total Hours: 45**

**TEXT BOOK:**

1. Dictionary of Materials and Testing, Second Edition by Joan Tomsic
2. “Metallurgy of Failure Analysis” by A K. Das; by McGraw- Hill Professional Publication.

**REFERENCES:**

1. Material Characterization: Introduction to Microscopic & Spectroscopic Methods by Yang Leng John Wiley & Sons (Asia) Pte Ltd.
2. ASM Handbook on Metals Handbook: Vol. 8 Mechanical Testing – 1978.
3. ASM Handbook Vol.11 - Failure Analysis and Prevention, ASM International Publication, 1995.
4. Automotive Component Failures by A. M. Heyes .
5. Handbook of Case Histories of Failure Analysis, Vol 1 by C.Uhietal Robert

**OUTCOMES:**

- Select suitable material testing processes for failure analyze.
- Identify the relation between the mechanical properties and their role in performance.
- Will have knowledge about evaluating various mechanical and chemical properties.

---

<b>AUBX19</b>	<b>ALTERNATE PROPULSION</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To develop an understanding of how air-breathing engines and chemical rockets produce thrust;
- an ability to do overall engine performance analysis calculations;
- an ability to carry out performance calculations for individual engine components;
- an ability to carry out performance analysis for chemical rockets; an understanding of elementary overall engine design considerations.

**MODULE I PROPELLERS 8**

Ideal Momentum Theory and Blade Element Theory and their relative Merits, Numerical Problems on the Performance of Propellers using Propeller Charts, Selection of Propellers, Fixed, Variable and Constant Speed Propellers, Prop-Fan, Material for Propellers, Shrouded Propellers Helicopter rotor in Hovering Performance.

**MODULE II AIRCRAFT PISTON ENGINES 7**

The Internal Combustion Engine Process, Brief Historical Sketch S.I and C.I. Engines, 4-Stroke and 2-Stroke Engines, Thermodynamics of Engine Analysis, Combustion Process, Air Standard Cycles, Various, Type of Arrangements or Multi-Cylinder Aircraft Engines, their Merits and Operational Efficiencies,

Intake and Exhaust Manifolds, Cooling and Lubrication Systems, Valve Timing and Arrangements, I.H.P., B.H.P and F.H.P, Engine Performance, Effect of Altitude, Power required and Power available, Supercharging, Preliminary Design of Aircraft Piston Engine.

**MODULE III FUELS, COMBUSTION AND FLAME STABILITY 8**

Liquid Fuels, Hydrocarbons, Gasoline, Starting Mixtures and Temperatures, Vapor Lock, other Liquid Fuels and Blends, Combustion Knock and Knock Rating, Carburetion and Fuel Injection, Ignition of the Charge, Ignition System, Gas Turbine Fuels, Solid and Liquid Propellants.

**MODULE IV AIRCRAFT GAS TURBINE ENGINES 7**

Air-Standard Brayton Cycle, Actual Gas Turbine Engine Cycle, Compressor and Turbine Efficiencies, Compressor Work and Turbine Work, Centrifugal and Axial type of Compressor, their Comparative Action, Relative Merits in Operations, Combustion Chambers: Various Arrangements, Simplex and Duplex Burners.

**MODULE V STEADY 1D GAS DYNAMICS 8**

Basics, Simple Flows: Nozzle Flow, Nozzle Design, Nozzle Operating characteristics for Isentropic Flow, Nozzle Flow and Shock Waves. Nozzle characteristics for some Operational Engines. Rayleigh Flow and Fanno Flow. Effect of Frictional Duct Length in Subsonic Flow and Supersonic Flow, Numerical Problems in 1D Flow.

**MODULE VI INFLETS, NOZZLES AND COMBUSTION CHAMBERS 7**

Subsonic Inlets: Pressure Recovery, Inlet Sizing Drag Flow Distortion. Supersonic Inlets: Total and Sonic State Points,  $A/A^*$  Normal Shock based Internal Compression Inlets, Design Sizing and Performance.

**Total Hours: 45**

**REFERENCES:**

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5<sup>th</sup> Edition, 1993.
2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.
3. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory", Longman Co., ELBS Edition, 1989.
4. Gorden, C.V., "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA.

**OUTCOMES:**

Students who successfully complete the course will demonstrate the following outcomes through examinations:

- An understanding of quasi-one-dimensional flow;
- An understanding of the generation of thrust in air-breathing engines and rockets;
- An ability to carry out simple performance analysis of subsonic and supersonic inlets;
- An ability to carry out overall performance calculations of turbojets, turbofans and turboprops;
- An elementary understanding of combustors, afterburners, and exhaust nozzles;
- An understanding of axial flow compressors and turbines, and an ability to carry out flow and performance calculations for these;
- An ability to carry out simple flight performance calculations for rockets;
- An understanding of the fundamentals of chemical rocket performance;
- An understanding of how liquid and solid propellant rockets work.

---

<b>AUBX20</b>	<b>TRACTOR AND AGRICULTURAL MACHINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- The student will have good exposure to Tractors and farm equipments

**MODULE I GENERAL DESIGN OF TRACTORS 8**

Classification of tractors – Main components of tractor – Safety rules.

**MODULE II CONTROL OF THE TRACTOR AND FUNDAMENTALS OF ENGINE OPERATION 8**

Tractor controls and the starting of the tractor engines – Basic notions and definition – Engine cycles – Operation of multicylinder engines – General engine design – Basic engine performance characteristics.

**MODULE III ENGINE FRAME WORK AND VALVE MECHANISM OF TRACTOR 8**

Cylinder and pistons – Connecting rods and crankshafts – Engine balancing – Construction and operation of the valve mechanism – Valve mechanism troubles.

**MODULE IV COOLING SYSTEM OF A TRACTOR 7**

Cooling system – Classification – Liquid cooling system – Components,

**MODULE V LUBRICATION SYSTEM AND FUEL SYSTEM OF A TRACTOR 7**

Lubricating system servicing and troubles – Air cleaner and turbo charger – Fuel tanks and filters – Fuel pumps.

**MODULE VI FARM EQUIPMENTS 7**

Working attachment of tractors – Farm equipment – Classification – Auxiliary equipment – Trailers and body tipping mechanism.

**Total Hours:45**

**TEXT BOOK:**

1. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.



**REFERENCES:**

1. Kolchin,A., and V.Demidov, Design of Automotive Engines for Tractor
2. MIR Publishers, 1972.

**OUTCOMES:**

- Able to prepare a tractor for operation (including routine checks)
- Able to operate a tractor safely
- Able Complete and check tractor operations (including shutdown procedure design)

---

<b>AUBX21</b>	<b>FLEET MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

The student will have good exposure to Fleet management

- To understand the operation and management of transport organizations and fare structure
- To have a fair knowledge about various maintenance procedures
- To know about spare parts and supply chain management

**MODULE I MANAGEMENT TRAINING AND OPERATIONS 9**

Basic principles of supervising. Organising time and people. Job instruction training – Training devices and techniques – Drive and mechanic hiring – Driver checklist – Lists for driver and mechanic – Trip leasing – Vehicle operation and types of operation.

**MODULE II VEHICLE MAINTENANCE 8**

Scheduled and unscheduled maintenance – Planning and scope – Evaluation of PMI programme – Work scheduling – Overtime – Breakdown analysis – Control of repair backlogs – Cost of options.

**MODULE III VEHICLE PARTS, SUPPLY MANAGEMENT AND BUDGET 6**

Cost of inventory – Balancing inventory cost against downtime – Parts control – Bin tag systems – Time management – Time record keeping – Budget activity – Capital expenditures – Classification of vehicle expenses

**MODULE IV FLEET MANAGEMENT WITH COMPUTER CONTROLLING ACTIVITY 6**

Fleet management and data processing – Data processing systems – Software. Models – Computer controlling of fleet activity – Energy management.

**MODULE V SCHEDULING AND FARE STRUCTURE 9**

Route planning – Scheduling of transport vehicles – Preparation of timetable, Costs, fare structure – Methods of fare collection – Preparation of fare table.

---

**MODULE VI SCHEDULING AND FARE STRUCTURE**

**7**

Schedules and sections – Registration of motor vehicles – Licensing of drivers  
– Control of permits – Limits of speed – traffic signs – Constructional regulations  
– Description of goods carrier, delivery man, tanker, tipper, Municipal, fire  
fighting and break down service vehicle.

**Total Hours:45**

**TEXT BOOK:**

1. John Dolu, Fleet management, McGraw Hill Co., 1984.

**REFERENCES:**

1. Government Publication, The Motor vehicle Act, 1989.
2. Kitchin, L.D., Bus operation, Illiffe and Sons Ltd., London, III Edition, 1992.
3. Kadiyali, L.R., Traffic engineering and Transport Planning.

**OUTCOMES:**

After successful completion of this course, the participants should be able to:

- Demonstrate an understanding of the requirement for fleet and transport management to be part of , logistics management.
- Define the relevant fleet and transport management concepts.
- Apply the principles of asset management in transport and fleet management.
- Demonstrate an understanding of the roles and responsibilities of the various officials. .

**OBJECTIVE:**

- The student will have good exposure to applied hydraulics and pneumatics.
- The students can impart knowledge basic in fundamentals of fluids, hydraulics system and components.
- The students can impart knowledge basic in design of circuits and in accumulators.
- The students can impart knowledge in properties of air, compressors and regulators.
- The students can impart knowledge in pneumatic systems and components.

**MODULE I FLUID POWER SYSTEMS AND FUNDAMENTALS 8**

Introduction to fluid power, Advant ages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids - Fluid power symbols.

Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow - Reynold's number - Darcy's equation - Losses in pipe, valves and fittings.

**MODULE II HYDRAULIC SYSTEM & COMPONENTS 8**

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance - Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators - Fluid motors, Gear, Vane and Piston motors. Construction of Control Components : Direction control valve - 3/2 way valve - 4/2 way valve - Shuttle valve - check valve - pressure control valve – pressure reducing valve, sequence valve, Flow control valve - Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.

**MODULE III DESIGN OF HYDRAULIC CIRCUITS 8**

Reciprocation, quick return, sequencing, synchronizing circuits, simple

industrial circuits- press circuits, earth movers, grinding machines. safety and emergency modules. Accumulators and Intensifiers : Types of accumulators - Accumulators circuits, sizing of accumulators, intensifier - Applications of Intensifier - Intensifier circuit.

**MODULE IV PNEUMATIC SYSTEMS AND COMPONENTS 7**

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, Lubricator Unit - Air control valves, Quick exhaust valves, pneumatic actuators

**MODULE V PNEUMATIC SYSTEMS AND CIRCUIT DESIGN 7**

Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple industrial applications using cascade method.

**MODULE VI DESIGN OF PNEUMATIC CIRCUITS 7**

Servo systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics - Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

**Total Hours: 45**

**TEXT BOOKS :**

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.
2. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.

**REFERENCES :**

1. Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 1995
2. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
3. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976.
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Dudely A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

**OUTCOMES:**

- To know the fluid power ,advantages of fluid power ,application of fluid power system
- To know types of fluid power system, properties of hydraulic fluids ,general types of fluids
- The students can able to understand basic in design of circuits and in accumulators.
- The students can able to deliberate in pneumatic systems and component
- To know the fluid power ,advantages of fluid power ,application of fluid power system
- To know types of fluid power system, properties of hydraulic fluids ,general types of fluids

---

<b>AUBX23</b>	<b>COMPUTER AIDED DESIGN AND MANUFACTURING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- The student will have good exposure to computer aided design and manufacturing

**MODULE I INTRODUCTION 7**

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices. Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

**MODULE II GEOMETRIC MODELING 8**

Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired. Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

**MODULE III COMPUTER AIDED MANUFACTURING 8**

Numerical control, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

**MODULE IV COMPUTER AIDED PRODUCTION PLANNING 7**

Computer Aided Processes Planning, Material requirement planning, manufacturing resources planning,

**MODULE V COMPUTER AIDED PRODUCTION GROUP TECHNOLOGY 8**

Part family, coding and classification, production flow analysis, advantages and limitations, Retrieval type and Generative type.

**MODULE VI FLEXIBLE MANUFACTURING SYSTEMS**

**7**

DNC, AGV, ASRS, Flexible manufacturing systems - FMS equipment, system layouts, FMS control. CIM: Integration, CIM implementation, major functions in CIM, Benefits of CIM, Lean manufacturing, Just-in-time.

**Total Hours : 45**

**TEXT BOOK:**

1. CAD / CAM Principles and Applications - 2<sup>nd</sup> edition, P.N. Rao, Tata Mc. Graw Hill.

**REFERENCES:**

1. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH
2. CAD / CAM / CIM / Radhakrishnan and Subramanian / New Age
3. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
4. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.

**OUTCOMES:**

Upon successful completion of all Computer-Aided Design certificate program requirements, graduates will

- Interpret complex engineering drawings including geometric dimensioning and tolerancing.
- Perform competently in solving technical manufacturing and engineering mathematics problems.
- Exhibit competency in two-dimensional, three-dimensional and solid-modeling skills as applied to complex computer-aided design technology.
- Demonstrate an understanding of the role and function of computers and effectively use the computer to solve complex technical problems.



---

<b>AUBX24</b>	<b>STATISTICS AND QUALITY MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

### **OBJECTIVES**

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

### **MODULE I STATISTICAL PROCESS CONTROL 8**

Statistical tools used in quality in SQC, Variation in processes, Control charts, Variables, Attributes, Establishing and interpreting control charts, X , R chart, p chart, c chart, u chart. Process capability, Analysis of process capability

### **MODULE II INTRODUCTION OF TQM 7**

Introduction - Need for quality - Evolution of quality - Definition of quality – Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

### **MODULE III TQM PRINCIPLES 8**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

### **MODULE IV TQM TOOLS & TECHNIQUES I 8**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

**MODULE V TQM TOOLS & TECHNIQUES II**

**7**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

**MODULE VI QUALITY SYSTEMS**

**7**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

**Total Hours: 45**

**TEXT BOOK:**

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

**REFERENCES:**

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6<sup>th</sup> Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2003.
3. Suganthi, L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman, B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

**OUTCOMES:**

On completion of this module the student will:

- Be able to explore the history and basic ideas underlying quality management and have a detailed knowledge of the role of Total Quality Management (TQM) in modern management.
- Demonstrate knowledge of quality management systems, their implementation and the practical steps needed for implementation.

**B.Tech. Automobile Engineering**

---

- Be able to select and apply appropriate Specific Process Control (SPC) techniques and evaluate data generated.
- Demonstrate the ability to produce a quality manual.
- Have detailed knowledge of certification and accreditation.
- Have knowledge and insight of different quality management systems i.e. product quality management, safety and environmental management.
- Have knowledge of auditing and auditing systems.
- Be able to critique the current state of the art in Total Quality Management.

---

<b>AUBX25</b>	<b>VEHICLE BODY ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The students can impart knowledge in construction of car body, design criteria, types of car and safety aspects of car.
- The students able to know the construction of bus body and dimensions of bus body and safety aspects.
- The students can impart knowledge in types of commercial vehicles; design of cab and in aerodynamic testing, forces and moments.
- The student will be well versed in the design and construction of external body of the vehicles and materials used in vehicles.

**MODULE I CAR BODY DETAILS 8**

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver’s visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Variou panels in car bodies. Car body construction; design criteria. Crash tests on full scale model, Dummies and Instrumentation. Safety aspect of car body.

**MODULE II BUS BODY DETAILS 8**

Types of bus body: based on capacity, distance traveled and based on construction. Bus body lay out for various types, floor height, engine location, entrance and exit location, seating dimensions. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

**MODULE III COMMERCIAL VEHICLE DETAILS 7**

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body, Drivers cab design - Regulations.

**MODULE IV VEHICLE AERODYNAMICS 7**

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization

techniques, Airflow management test – measurement of various forces and moments by using wind tunnel.

**MODULE V BODY MATERIALS 8**

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service-corrosion and Anticorrosion methods,

**MODULE VI TRIM MECHANISMS AND BODY REPAIR 7**

Modern painting process procedure-paint problems and Body trim items-body mechanisms.

**Total Hours: 45**

**TEXT BOOKS:**

1. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.
2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.

**REFERENCES:**

1. Giles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 1991.
2. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.
3. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 1997.
4. Dieler Anselm., The passenger car body, SAE International, 2000

**OUTCOMES:**

Upon completion of the course:

- The students will understand the Role of various aerodynamic forces and moments, measuring instruments.
- The students will understand about different aspects of car body and bus body, types, commercial vehicle.
- The students will understand about the material used in body building, tools used, body repairs.

---

<b>AUBX26</b>	<b>PROFESSIONAL ETHICS IN ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- To Identify the core values that shape the ethical behavior of an engineer.
- To Utilize opportunities to explore one's own values in ethical issues.
- To Become aware of ethical concerns and conflicts.
- To Enhance familiarity with codes of conduct.
- To Increase the ability to recognize and resolve ethical dilemmas.

**MODULE I ENGINEERING ETHICS 8**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

**MODULE II ENGINEERING AS SOCIAL EXPERIMENTATION 8**

Engineering as Experimentation – Engineers as Responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

**MODULE III ENGINEER'S RESPONSIBILITY FOR SAFETY 7**

Safety and Risk – Assessment of Safety and Risk – Risk Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl and Bhopal  
UNIT IV

**MODULE IV RESPONSIBILITIES AND RIGHTS 8**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

**MODULE V GLOBAL ISSUES 7**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development.

**MODULE VI ROLE OF ENGINEERS**

**7**

Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

**Total Hours : 45**

**TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2000).

**REFERENCES:**

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

**OUTCOMES:**

- Able to locate, describe, and apply the content of at least one example of a law (state, national, or international) dealing with engineering ethics.
- Able to locate, describe, and apply the content of the code of ethics/conduct of at least one professional society.
- Able to prepare, describe, and defend their own personal definition of what makes for an ethical engineer.

**OBJECTIVE:**

- To acquire knowledge about the principle of chassis management system
- To learn about different sensors and actuator used in the vehicle.
- To gather knowledge about the modern techniques in the vehicle
- To learn control systems like steering, suspension, and braking system.
- To gain knowledge of the different controls system in vehicle navigation systems.

**MODULE I CHASSIS MANAGEMENT SYSTEM 8**

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level sensors.

**MODULE II DRIVELINE CONTROL SYSTEM 7**

Speed control – cylinder cut-off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - Power steering, collapsible and tilttable steering column – steer by wire.

**MODULE III SAFETY AND SECURITY SYSTEM 7**

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

**MODULE IV BODY CONTROL SYSTEM 7**

Requirement and characteristics suspension, different types suspension, Vehicle pitch, roll, bounce control, Semi active suspension, Active suspension systems, fully active suspension, power windows, thermal management system, adaptive noise control



**MODULE V INTELLIGENT TRANSPORTATION SYSTEM**

**9**

Traffic routing system - Automated highway systems - Lane warning system – Driver Information system, side blind zone warning system, automatic parking system, driver assistance systems - Radar guide brakes, radar guided lane assist, Global positioning system. Data communication within the car, Driver conditioning warning -Route Guidance and Navigation Systems – vision enhancement system.

**MODULE VI MODERN VEHICLE SYSTEMS**

**7**

Integrator starter, Alternator, Starts stop operation, Un man vehicle technology, Regenerative energy recovery, advanced lead acid batteries, alkaline batteries, Lithium batteries, Development of new energy storage systems, Deep discharge and rapid charging, ultra-capacitors. - In-Vehicle Computing – Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

**Total Hours: 45**

**TEXT BOOKS:**

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. LjuboVlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies” ButterworthHeinemann publications, Oxford, 2001.

**REFERENCES:**

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, New Delhi, 2002.
2. William B. Ribbens -Understanding Automotive Electronics, 5<sup>th</sup> edition, Butterworth Heinemann Woburn, 1998.
3. Bosch, “Automotive HandBook”, 6<sup>th</sup> edition, SAE, 2004.

**TERM WORK**

- Modern storage devices
- Future Cars in Hybrid and Electric
- Intelligent transportation systems

- Safety and security systems
- Energy control and regenerative technologies

**OUTCOME:**

- Apply the fundamentals of chassis management system and its control
- Analysis of different sensors and actuators for automotive applications.
- Discuss case studies on Research focused areas
- Learner can able to apply the knowledge to develop future technology cars

---

<b>AUB X28</b>	<b>MOTORSPORT ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- Understand and identify problem areas in the preparation of a Motorsport vehicle is essential for a Motorsport technician, as is the ability to configure and set up a vehicle in order to achieve its maximum performance with reliability and overall system efficiency.

**MODULE I OVER VIEW OF MOTOR SPORT ENGINEERING 8**

Introduction about motor sport vehicles, various types of motor sport vehicles and their requirements, competitions and requirements, Preparing for the competitions, Case studies of completed events., bench marking, project planning, PERT, CPM, FMEA, business plans

**MODULE II POWER TRAIN 8**

Engine management systems, sensors, alternative fuels, oxidizing agents, chemical composition of fuels, ignition systems and components.Engine and transmission configurations – front/ rear/mid engine and associated driveline Transmission systems – clutches, torque converters, manual gearbox types, automatic gearbox types, electronic and hydraulic transmission control, traction control, launch control, KERS systems. Final drive systems – differentials, Tor-sen, torque biasing, LSD, Salisbury, air-locking, fluid coupling Hybrid Drive systems.

**MODULE III MATERIALS AND PROCESSES 8**

Selection criteria: material properties, including cost drivers, mechanical, physical, chemical and process characteristics. basic properties of materials such as ceramics, metals, composites and polymers. Testing of materials, ISI standards, standard published data sources, engineering drawings Joining techniques including, brazing and welding, effect on structure and properties, use of adhesives.Processing limitations: effects of properties such as structure preventing or facilitating processing techniques. heat treatments of metals and alloys, coatings and other surface treatments, polymer processing.

**MODULE IV FAILURE MECHANISMS 7**

Causes of failure: appreciation of failure mechanisms in materials such as

metals, ceramics, polymers and composites; such as creep, fatigue, impact, overstressing, corrosion, temperature, thermal cycling, residual stresses, stress relaxation, degradation (composition change), radiation, electrical breakdown.

**MODULE V VEHICLE ELECTRONICS**

**7**

Electronics – semiconductors, electronic circuitry, integrated circuits. ignition systems, Engine management systems, sensors transistorized and capacitor discharge types, fuel injection systems and sensors, ECU programming and mapping., ABS, TRS, active suspension system, Tuned manifolding

**MODULE VI MOTOR VEHICLE CHASSIS**

**7**

Frame design for different vehicles, layout of components, weight distribution, weight transfer and braking requirements, suspension system, steering system, body design and fabrication, driver seat and safety requirements, Electrical systems and wiring, wheels and tires. Testing and validation.

**Total Hours: 45**

**REFERENCES**

- Hillier, VAW (2006) Fundamentals of Motor Vehicle Technology StanleyThornes
- Davis & Davis (2001) Supercharging, Turbocharging and Nitrous Oxide performance. Motorbooks.
- Marek, J. (2003) Sensors applications: sensors for automotive technology. Wiley
- Walker, D. (2001) Engine management. Haynes
- Staniforth, A (2002)Race and rally car sourcebook Haynes
- Staniforth, A (2006)Competition car suspension Haynes
- van Valkenburg, P (2001)Race car engineering and mechanicsMotorbooks International
- Milliken & Milliken (1997) Vehicle dynamics. SAE .

## **OUTCOMES**

The students should be able to:

- Carry out analysis concerning the preparation and refurbishment, or an in-depth analysis, practical application of a Motorsport vehicle system or assembly which involves project management and can be completed within constraints of time, budget and available resources.
- Do practical tasks and complete them to a standard acceptable within the Motorsport industry in terms of safe working practices, use of equipment and application of techniques.
- Critically analyze and solve open-ended problems of a complex nature and perform peer group evaluation.

---

<b>MEBX03 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS</b>	<b>L T P C</b>
<b>(Use of approved design data book is permitted)</b>	<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the design of jigs and fixtures
- To study about the press working tools
- To know about the dies and their elements

**MODULE I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES**  
**8**

Tool design objectives - Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

**MODULE II JIGS** **9**

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

**MODULE III FIXTURES** **9**

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures-Modular fixtures. Design and development of fixtures for given component.

**MODULE IV PRESS WORKING TERMINOLOGIES** **4**

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements.

**MODULE V PRESS WORKING ELEMENTS OF DIES AND STRIP LAYOUT** **6**

Elements of progressive combination and compound dies:Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip lay out-strip lay out calculations.

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

**Total Hours : 45**

**TEXT BOOKS:**

1. Edward G Hoffman, "Jigs & Fixture Design", Thomson – Delmar Learning, Singapore 2004
2. Donaldson. C, "Tool Design", Tata McGraw-Hill, 1986

**REFERENCES:**

1. Kempster, "Jigs & Fixtures Design", The English Language Book Society", 1978.
2. Joshi, P.H., "Jigs & Fixtures", Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004 Hiram E Grant, "Jigs and Fixture" Tata McGraw-Hill, New Delhi, 2003.
3. "Fundamentals of Tool Design", CEEE Edition, ASTME, 1983.
4. Design Data Handbook PSG College of Technology, Coimbatore.

**OUTCOMES:**

Upon completion of the subject, students will be able to

- Able to apply the basic principles in designing general jigs and fixtures, as well as molds and dies;
- Assess the performance of a given tool design for meeting the specific design criteria;
- Evaluate the effects of a given tool design on work quality.

---

<b>MEBX07</b>	<b>NANO MATERIALS &amp; FABRICATIONS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the principles of nano materials
- To study about the nano machining technique
- To understand about the inspection methods

**MODULE I INTRODUCTION TO NANOMATERIALS 7**

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical Development of nano materials-problems in fabrication and characterization of nano materials.

**MODULE II PRODUCTION OF NANOMATERIALS 10**

Methods of production of nanomaterials, Sol-gel synthesis, Inert gas condensation, Mechanical alloying or high-energy ball milling, Plasma synthesis, and Electrodeposition.

**MODULE III APPLICATION OF NANO MATERIALS 10**

Applications in Electronics, Chemical, Mechanical engineering industries-Use of nanomaterials in automobiles, aerospace, defence and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.

**MODULE IV NANO FABRICATION TECHNIQUE 4**

LIGA, Ion Beam Etching, - Nano fabrication Techniques, Quantum Materials.

**MODULE V NANO MACHINING TECHNIQUE 4**

Molecular Manufacturing Techniques, Nano Machining Techniques, Top down and Bottom up

**MODULE VI INSPECTION OF NANOMATERIALS 10**

Scanning Probe Microscopy (SPM)- Contact Mode, Tapping Mode, Scanning Tunnelling Mode (STM). Advanced Scanning Probe Microscopy – Electrostatic force Mode (EFM)- Magnetic Force Mode (MFM)- Scanning Thermal Mode (SthM), Piezo Force Mode (PFM). Scanning Capacitance Mode (SCM), Nanoidentation.

**Total Hours : 45**



**REFERENCE:**

1. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.

**OUTCOMES:**

Upon successful students will

- have a sound grounding and expert knowledge in multidisciplinary areas of nanoscience.
- have a sound grounding in and expert knowledge of the basic sciences relevant to employment or further study in the traditional sciences.
- have a grounding in economics and commerce relevant to the needs of high-technology companies.
- be prepared to work in a high tech work force or pursue a research higher degree in nanotechnology.
- analyse and critically evaluate ideas/information/data and apply relevant scientific principles to solve problems by, for example, creating hypotheses, testing theories and predictions, designing and carrying out experiments and analysing reported data.
- design and carry out experiments using both classical and novel science techniques and protocols.
- communicate their findings to a variety of audiences in written and spoken form through debates, posters, reports and oral presentations.
- appreciate that there are the relationships and connections across the sciences and non-science disciplines are core to nanotechnology and understand such relationships and connections.
- work and learn independently and appreciate the need for life-long learning.
- interact effectively as part of a team in order to achieve common goals.

---

<b>MEBX09</b>	<b>MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the concepts of MEMS design
- To know about the design of Optical MEMS

**MODULE I INTRODUCTION TO MEMS 8**

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelerometers and Micro fluidics, MEMS materials, Micro fabrication

**MODULE II MECHANICS FOR MEMS DESIGN 8**

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

**MODULE III ELECTRO STATIC DESIGN 8**

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inchworms, Electromagnetic actuators, Bistable actuators

**MODULE IV CIRCUIT AND SYSTEM ISSUES 7**

Electronic Interfaces, Feed back systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Piezo electric pressure sensor, Modeling of MEMS systems, CAD for MEMS.

**MODULE V INTRODUCTION TO OPTICAL MEMS 7**

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices.

**MODULE VI INTRODUCTION TO RF MEMS 7**

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital

Micro mirror devices. RF MEMS – design basics, case study – Capacitive RF MEMS switch, performance issues.

**Total Hours : 45**

**TEXTBOOK:**

1. Stephen Santerea, " Microsystems Design", Kluwer publishers, 2000.

**REFERENCES :**

1. Nadim Maluf, " An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Boca Raton, 2000.
3. Tai Ran Hsu, " MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

**OUTCOMES:**

- Describe new applications and directions of modern engineering
- Describe the techniques for building microdevices in silicon, polymer, metal and other materials.

---

<b>MEBX12</b>	<b>PROCESS PLANNING AND COST ESTIMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the various principles, practices of Process planning and cost estimation.
- To learn the various statistical approaches for Cost estimation.
- To understand the Process planning tool for continuous process improvement.

**MODULE I PROCESS PLANNING 10**

Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes – CAPP – Retrieval and generative type.

**MODULE II COMPUTER AIDED PROCESS PLANNING 10**

Computer Aided Process Planning - Variant process planning - Generative process planning - Forward and backward planning, Logical Design of Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

**MODULE III INTRODUCTION TO COST ESTIMATION 7**

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost- Material cost-Determination of material cost-Labour cost-Determination of labour cost - Expenses-Ladder of cost - Analysis of overhead expenses-Factory expenses – Depreciation - causes of deprecation – Methods of depreciation – Administrative Expenses – Selling Price Calculation.

**MODULE III PRODUCTION COST ESTIMATION 8**

Estimation in Forging shop – Losses in Forging – Forging cost – Estimation in welding shop – Gas cutting – Electric arc welding – Estimation in Foundry shop – Estimation of pattern cost and casting cost.

**MODULE IV ESTIMATION OF MACHINE TIME AND COST 5**

Estimation of machining time for lathe operation – estimation machining time for drilling, boring, shaping, planning milling and grinding operations.

**MODULE V ESTIMATION OF MACHINE COST 5**

Estimation of machining cost for lathe operation – estimation machining cost for drilling, boring, shaping, planning milling and grinding operations.

**Total Hours: 45**

**TEXT BOOK:**

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.

**REFERENCES:**

1. Phillip.F Ostwalal and Jairo Munez, "Manufacturing Processes and systems", John Wiley, 9<sup>th</sup> Edition, 1998
2. Russell. R.S and Tailor, B.W, "Operations Management", PHI, 4<sup>th</sup> Edition, 2003.
3. Chitale. A.V. and Gupta.R.C., "Product Design and Manufacturing", PHI, 2<sup>nd</sup> Edition, 2002.

**OUTCOMES:**

- Write, debug, and document well-structured Java applications of up to 500 lines
- Implement Java classes from specifications
- Effectively create and use objects
- from predefined class libraries
- Understand the behavior of primitive data types, object references, and arrays
- Use decision and iteration control structures to implement algorithms
- Write simple recursive algorithms
- Use interfaces, inheritance, and polymorphism as programming techniques

---

<b>MEBX19</b>	<b>ADVANCED OPTIMIZATION TECHNIQUES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To learn the various optimization techniques and its applications.
- At the end of this course, the student will have good exposure to optimization techniques and its applications

**MODULE I INTRODUCTION 8**

Statement of optimization problems – classification of optimization problem – classical optimization techniques; Single variable optimizations, Multi variable optimization, equality constraints, Inequality constraints, No constraints.

**MODULE II LINEAR PROGRAMMING 8**

Graphical method for two dimensional problems – central problems of Linear Programming – Definitions – Simplex – Algorithm – Phase I and Phase II of Simplex Method – Revised Simplex Method.

Simplex Multipliers – Dual and Primal – Dual Simplex Method – Sensitivity Analysis – Transportation problem and its solution – Assignment problem and its solution by Hungarian method – Karmakar’s method – statement, Conversion of the Linear Programming problem into the required form, Algorithm.

**MODULE III NON LINEAR PROGRAMMING (Unrestricted search and Unconstrained Optimization) 7**

Introduction – Unrestricted search – Exhaustive search – Interval halving method – Fibonacci method.

Unconstrained Optimization – Introduction – Random search method – Uni variate method – Pattern search methods – Hooke and Jeeves method, Simplex method– Gradient of a function – steepest descent method – Conjugate gradient method.

**MODULE IV NON LINEAR PROGRAMMING (Constrained Optimization) 7**

Constrained Optimization: Introduction – Characteristics of the problem – Random search methods – Complex method.

**MODULE V DYNAMIC PROGRAMMING 8**

Introduction – multistage decision processes – Principles of optimality – Computation procedures.

**MODULE VI DECISION MAKING 7**

Decisions under uncertainty, under certainty and under risk – Decision trees – Expected value of perfect information and imperfect information.

**Total Hours: 45**

**REFERENCES:**

1. Kalyanmoy Deb, “Optimization for Engineering Design, Algorithms and Examples”, Prentice Hall, 2004.
2. Hamdy A Taha , “Operations Research – An introduction”, Pearson Education, 2002.
3. Hillier / Lieberman, “Introduction to Operations Research”, Tata McGraw Hill Publishing Company Ltd, 2002.
4. Singiresu S Rao, “Engineering Optimization Theory and Practice”, New Age International, 1996.
5. Mik Misniewski, “Quantitative Methods for Decision makers”, MacMillian Press Ltd., 1994.
6. Kambo N S, “Mathematical Programming Techniques”, Affiliated East – West Press, 1991.

**OUTCOMES:**

Upon successful completion of this course, the student will be able to understand:

- basic theoretical principles in optimization;
- formulation of optimization models;
- solution methods in optimization;
- methods of sensitivity analysis and post processing of results
- applications to a wide range of engineering problems

---

<b>MEBX20</b>	<b>ADVANCED PRODUCTION PROCESSES FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>AUTOMOTIVE COMPONENTS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study about the powder metallurgy
- To understand the concepts of hydroforming process

**MODULE I POWDER METALLURGY 8**

Process flow chart – Production of metal powders and their raw materials  
– Manufacture of friction lining materials for clutches and brakes – Testing and inspection of PM parts.

**MODULE II FORMING PROCESS 8**

Forging – process flow chart, forging of valves – connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles. Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets.

**MODULE III HYDROFORMING PROCESS 7**

Hydroforming: Process, hydroforming of manifold and comparison with conventional methods – Hydro forming of tail lamp housing. Stretchforming – Process, stretch forming of auto body panels – Super plastic alloys for auto body panels.

**MODULE IV GEAR MANUFACTURING 8**

Different methods of Gear manufacture – Gear hobbing and gear shaping machines specifications – gear generation – different methods – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

**MODULE V CONCEPT & PROGRAMMING OF CNC MACHINES 8**

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feed back devices – manual part programming – steps involved – sample program in Lathe & milling.



**MODULE VI RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS**

**6**

Powder injection moulding – Shotpeen hardening of gears – Production of aluminium MMC liners for engine blocks – Plasma spray coated engine blocks and valves – Recent developments in auto body panel forming – Squeeze casting of pistons – aluminium composite brake rotors.

**Total Hours:45**

**TEXT BOOK:**

1. Heldt,P.M., High Speed Combustion Engines, Oxford Publishing Co., New York, 1990.

**REFERENCES:**

1. Haslehurst,S.E., Manufacturing Technology, ELBS, London, 1990.
2. Rusinoff, Forging and Forming of metals, D.B. Taraporevala Son & Co. Pvt.Ltd., Mumbai, 1995.
3. Subroff, A.M. & Others, Forging Materials & Processes, Reinhold Book Corporation, New York, 1988.
4. High Velocity Forming of Metals, ASTM, Prentice Hall of India (P) Ltd., New Delhi, 1990.
5. Groover. M.P., Automatic production systems and computer integrated manufacturing, Prentice-Hall, 1990.
6. GE Thyer, Computer Numerical Control of Machine Tools, BH.Newners, 1991.

**OUTCOMES:**

- Able to analyze and solve complex technical problems related to mechanical environments through the application of engineering principles
- Able to design and analyze mechanical components, processes, and systems through the application of engineering principles and practices
- Able to analyze and prepare graphics and other technical documents to appropriate engineering standards.
- Able to use computer hardware and software to support the engineering environment

**B.Tech. Automobile Engineering**

---

- Able to apply knowledge of manufacturing processes to the design of components
- Able to apply knowledge of materials and engineering principles to manufacturing operations and processes
- Able to apply knowledge of machinery, tools, and other equipment used in manufacturing processes
- Able to specify, coordinate, and conduct quality control and quality assurance procedures
- Able to recognize the environmental, economic, legal, safety, and ethical implications of mechanical engineering projects
- Able to use and maintain documentation, inventory, and records systems
- Able to participate in the management of an engineering project
- Able to develop strategies and plans to improve job performance and work relationships.

---

<b>MEBX25</b>	<b>ADVANCED I.C. ENGINES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- At the end of the course, the students will be able to understand the significance of various processes in I.C Engines.

**MODULE I INTRODUCTION 7**

Fuel air cycle and Actual cycle analysis, Properties of IC engine fuels, Refining process, chemical composition and molecular structure of fuels, octane number, cetane number. Knock rating of SI engine fuels.

**MODULE II COMBUSTION OF FUELS 6**

Combustion Stoichiometry of petrol, diesel, alcohol and hydrogen fuels – Chemical energy and heating values – Chemical equilibrium and maximum temperature

**MODULE III SI and CI ENGINE COMBUSTION 6**

SI engine combustion – Flame velocity and area of flame front –performance number – CI engine combustion. Fuel spray characteristics – droplet size, penetration and atomization.

**MODULE IV COMBUSTION MODELLING 10**

Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI engines. Adiabatic flame temperature, Heat release calculations. Thermodynamic and Fluid mechanic based models.

**MODULE V NON-CONVENTIONAL IC ENGINES 8**

Adiabatic and L.H.R. engines – Variable compression ratio engine – Wankel rotary combustion engine – Free piston engine - MAN combustion chamber and multi fuel engines – Stratified charge and lean burn engines – Locomotive and marine engines.

**MODULE VI COMBUSTION ANALYSIS IN IC ENGINES 8**

Photographic studies of combustion processes – P-? diagrams in SI and CI

engines, Rate of heat release – hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines

**Total Hours: 45**

**TEXT BOOKS:**

1. Ganesan .V - “IC Engines” - Tata McGraw-Hill, 2003.
2. John B. Haywodd, “Internal Combustion Engine Fundamentals”, McGraw-Hill Automotive Technology Series ISBN 0-07-1000499-8, 1988.

**REFERENCES:**

1. Ganesan .V – ‘Computer Simulation of Spark Ignition Processes’ - Universities Process Ltd, Hyderabad - 1993.
2. Ganesan.V. – Computer Simulation of compression ignition engines – Orcent Longman – 2000.
3. Richard Stone – “Introduction to IC Engines” – 2<sup>nd</sup> edition – Macmilan – 1992.

**OUTCOME:**

- The students will be able to safely and efficiently disassemble, inspect and re-assemble the engine, up to and including camshaft and crankshaft replacement.

---

<b>MEBX28</b>	<b>COMPUTATIONAL FLOW AND HEAT TRANSFER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the Boundary conditions of various FEA problems
- To study about the heat conduction of fluids
- To know about the convection and their significances

**MODULE I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8**

Basics of computational fluid dynamics – Governing equations of fluid dynamics– Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent flow – Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

**MODULE II DISCRETIZATION AND SOLUTION METHODOLOGIES 7**

Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

**MODULE III HEAT CONDUCTION 7**

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

**MODULE IV CONVECTION 8**

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

**MODULE V CALCULATION OF FLOW FIELD 7**

Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections -

Pressure - Correction equation, SIMPLE algorithm and its variants. Turbulence models: mixing length model, Two equation (k- $\epsilon$ ) models.

**MODULE VI DIFFUSION**

**8**

Finite volume formulation of steady one-dimensional Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional diffusion.

**Total Hours : 45**

**TEXT BOOKS:**

1. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd., 1998.

**REFERENCES :**

1. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", McGraw-Hill, 1980. Ane- Books 2004 Indian Edition.
2. Muralidhar, K and Sundarajan .T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
3. Bose, T.K., "Numerical Fluid Dynamics", Narosa publishing House, 1997.
4. Muralidhar, K and Biswas "Advanced Engineering Fluid Mechanics", Narosa Publishing House, New Delhi, 1996.
5. Anderson, J.D., "Computational fluid dynamics – the basics with applications", 1995.

**OUTCOMES:**

After successfully completing this course you will be able to:

- To develop an understanding for the major theories, approaches and methodologies used in CFD;
- To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modeling etc.) in using commercial CFD codes;
- To gain experience in the application of CFD analysis to real engineering designs.

**GENERAL ELECTIVES**

<b>GEBX01</b>	<b>DISASTER MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management.

**MODULE I ENVIRONMENTAL HAZARDS 7**

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

**MODULE II NATURAL DISASTERS 7**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

**MODULE III MAN-MADE DISASTERS 7**

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion.

**MODULE IV DISASTER MANAGEMENT 8**

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

**MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT 8**

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards.

**MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8**

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

**Total Hours: 45**

**REFERENCES:**

1. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), "Environmental Geography", Heritage Publishers, New Delhi, 1990.
3. Savinder Singh, "Environmental Geography", Prayag Pustak Bhawan, 1997.
4. Kates, B.I. and White, G.F., "The Environment as Hazards", Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), "Disaster Management", University Press, India, 2003.
6. Singh, R.B., "Space Technology for Disaster Mitigation in India (INCED)", University of Tokyo, 1994.
7. Bhandani, R.K., "An overview on Natural & Manmade Disaster & their Reduction", IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

**OUTCOMES:**

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with the National Policy on Disaster Management.



---

<b>GEBX02</b>	<b>NANO TECHNOLOGY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

**MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9**

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic, transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

**MODULE II TYPES OF NANOMATERIALS 9**

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

**MODULE III PRODUCTION OF NANOPARTICLES 7**

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

**MODULE IV CARBON BASED NANOMATERIALS 6**

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

**MODULE V NANOPHOTONICS 7**

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

**MODULE VI CHARACTERISATION TECHNIQUES 7**

Basic principles of scanning Electron Microscopy (SEM), Atomic force

## **B.Tech. Automobile Engineering**

---

microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

**Total Hours: 45**

### **TEXTBOOKS:**

1. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, 2000.
2. Guozhong Cao, "Nanostructures and Nano materials-Synthesis, Properties and Applications", Imperial College Press (2011).
3. Zhong Lin Wang, "Handbook of Nanophase and Nanomaterials (Vol 1 and II)", Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

### **REFERENCES:**

1. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley, 2013.

### **OUTCOMES:**

At the end of this course, the students will be able to:

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

---

<b>GEBX03</b>	<b>CONTROL SYSTEMS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of Control systems.

**MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8**

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

**MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8**

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

**MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7**

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

**MODULE IV STABILITY 8**

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

**MODULE V COMPENSATOR DESIGN 8**

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

**MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6**

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

**Total Hours : 45**

**REFERENCES:**

1. K. Ogata, "Modern Control Engineering", 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

**OUTCOMES:**

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

---

<b>GEBX04</b>	<b>GREEN DESIGN AND SUSTAINABILITY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

**MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7**

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

**MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 8**

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth- Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

**MODULE III FRAME WORK FOR ACHIEVING SUSTAINABILITY 7**

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

**MODULE IV GREEN BUILDINGS 8**

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

**MODULE V ENERGY CONSERVATION AND EFFICIENCY 7**

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

**MODULE VI GREEN BUILDINGS DESIGN**

**8**

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

**Total Hours: 45**

**TEXT BOOK:**

1. Kirby, J., Okeefe, P., and Timber lake, "Sustainable Development", Earthscan Publication, London, 1995.

**REFERENCE:**

1. Charles Kibert, J., "Sustainable Construction: Green Building Design and Delivery", 2<sup>nd</sup> Edition, John Wiley and sons, 2007.

**OUTCOMES:**

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

- explain the relationship between sustainability and emergence of green building practices.
- address the economic, environmental, and social concerns.

---

<b>GEBX05</b>	<b>KNOWLEDGE MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

**MODULE I KNOWLEDGE MANAGEMENT 6**

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

**MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9**

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

**MODULE III CAPTURING KNOWLEDGE AND SHARING 9**

Tacit knowledge capture - Explicit knowledge codification - Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

**MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9**

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery - Content management tools - Knowledge sharing and dissemination tools - Group ware and Collaboration tools - Intelligent filtering tools.

**MODULE V KNOWLEDGE APPLICATION**

**6**

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels - Knowledge repositories - Knowledge reuse -Case study: e-learning.

**MODULE VI VALUE OF KNOWLEDGE MANAGEMENT**

**6**

KM return on investment and metrics - Benchmarking method - Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

**Total Hours:45**

**TEXT BOOKS:**

1. Elias M. Awad, Hassan M. Ghaziri, "Knowledge Management", Prentice Hall, 2<sup>nd</sup> Edition, 2010.
2. Jay Liebowitz, "Handbooks on Knowledge Management", 2<sup>nd</sup> Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, "Knowledge Management: Systems and Processes", 2010.

**OUTCOMES:**

Students who complete this course will be able to

- describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- critically evaluate current trends in knowledge management and apply it for e-learning



---

<b>GEBX06</b>	<b>APPROPRIATE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

**MODULE I BASICS CONCEPTS 9**

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis- discounted cash flow, and energy fundamentals.

**MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 9**

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

**MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 9**

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

**MODULE IV WASTE MANAGEMENT 9**

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

**MODULE V ENERGY EFFICIENT TECHNIQUES 9**

Green building concepts-renewable energy sources- Solar – Steam and wind- Biofuels - Biogas – Electricity.

**MODULE VI TECHNOLOGY POLICY 9**

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

**Total Hours: 45**

**TEXT BOOKS:**

1. Barrett Hazeltine and Christopher Bull, "Appropriate Technology: Tools Choices and Implications", Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, "Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology", Stanford, 1986.

**REFERENCES:**

1. Richard Heeks, "Technology and Developing Countries: Practical Applications Theoretical Issues", 1995.
2. John Pickford, "The Worth of Water : Technical Briefs on Health, Water and Sanitation", Intermediate Technology Publications, 1998.

**OUTCOME:**

- At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

---

<b>GEBX07</b>	<b>SYSTEM ANALYSIS AND DESIGN</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the basic principles of systems engineering
- To understand the systems engineering methodology
- To provide a systems viewpoint

**MODULE I INTERDICTION TO SYSTEMS ENGINEERING 8**

Concept of Systems Engineering – Origin – Systems Approach – Advantages of systems approach – Examples.

The building blocks of modern systems – Systems and environment – Interfaces – Complexity of Modern Systems.

**MODULE II SYSTEM DEVELOPMENT PROCESS AND MANAGEMENT 8**

System life cycle – the systems engineering method – Role of Testing – Management of system development – Risk Management – Organisation.

**MODULE III CONCEPT DEVELOPMENT 8**

Need Analysis – Concept Exploration – Performance requirement and validation - Concept selection and validation – systems architecture – Decision making.

**MODULE IV ESTABLISHING ENGINEERING SYSTEMS 8**

Risk Analysis – Risk Mitigation –System performance Analysis – Simulation Techniques in System Analysis – Validation Methods..

**MODULE V DECISION SUPPORT TOOLS IN SYSTEMS ENGINEERING 7**

Analytical decision support – Statistical influences on system design – System performance analysis – System Reliability, Availability and Maintainability (RAM) – Analysis of Alternatives.

**MODULE VI CASE STUDIES**

**6**

Case studies in Software Systems Engineering – Systems for Product Design  
- Manufacturing Systems.

**Total Hours: 45**

**REFERENCES:**

1. Charles S. Wasson, "System Analysis, Design, and Development: Concepts, Principles, and Practices", Wiley Series in Systems Engineering and Management, 2006.
2. Kossiakoff Alexander and William N. Sweet A, "Systems Engineering: Principles And Practice", Wiley Student Edition, 2009.

**OUTCOMES:**

At the end of the course the student will have the

- ability to have systems of view of problems and issues at hand.
- ability to comprehend systems in their totality and specific.
- ability to design, build and evaluate simple systems for industrial requirement.
- ability to analyze systems and strengthen them for performance enhancement.

---

<b>GEBX08</b>	<b>VALUE ANALYSIS AND ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

**MODULE I VALUE ENGINEERING BASICS 8**

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

**MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6**

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

**MODULE III ORIENTATION AND INFORMATION PHASES 8**

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

**MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9**

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

**MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6**

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

**MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8**

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

**Total Hours: 45**

**TEXTBOOKS:**

1. Mudge, Arthur E. "Value Engineering- A systematic approach", McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), "Value Engineering", Narosa Publishing House, 2005.

**REFERENCES:**

1. Park RJ, "Value Engineering: A Plan for Invention", St.Lucie Press, New York, 1999.
2. Lawrence, D.M., "Techniques of Value Analysis and Engineering", McGraw Hill 1988.
3. George, E.D., "Engineering Design: a Material and Processing Approach", McGraw Hill, 1991.
4. Heller, D.E., "Value Management, Value Engineering and Cost Reduction", Addison Wesley, 1988.

**OUTCOME:**

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

---

<b>GEBX09</b>	<b>OPTIMIZATION TECHNIQUES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods.
- The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization techniques, and applications to engineering systems.

**MODULE I INTRODUCTION 7**

Overview of Optimization techniques for Civil Engineering Problems - Introduction to methods of optimization - Classification of Optimization problems - optimality and convexity - General optimization algorithm - necessary and sufficient conditions for optimality.

**MODULE II LINEAR PROGRAMMING 8**

Introduction to linear programming - a geometric perspective - Standard form in linear programming; basic solutions; fundamental theorem of linear programming - Simplex Algorithm for Solving Linear Programs - Duality; complementary slackness; economic interpretation of the dual;

**MODULE III DYNAMIC PROGRAMMING 8**

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP); Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

**MODULE IV APPLICATIONS 8**

Regression modeling in engineering; industrial blending problems; dynamic optimal control of engineering systems; optimal estimation in environmental engineering - Water resources; production planning in industrial engineering;

transportation problem - Heuristic optimization methods: genetic algorithms; ecological engineering application; Minimum cost network flow algorithms; out-of-kilter method; primal-dual methods; Dynamic Programming Applications - Water allocation as a sequential process - Capacity expansion and Reservoir operation.

**MODULE V INTEGER PROGRAMMING 8**

Integer programming - applications in optimal irrigation scheduling in agricultural engineering - Interior point optimization methods - affine scaling method.

**MODULE VI NON-LINEAR PROGRAMMING 6**

Non-linear programming - Kuhn-Tucker conditions for constrained nonlinear programming problems; necessary and sufficient conditions; quadratic programming; applications.

**Total Hours: 45**

**REFERENCES:**

1. Taha, H.A., "Operations Research - An Introduction", 9<sup>th</sup> Edition, Pearson Prentice Hall, 2011.
2. Winston.W.L. "Operations Research", 4<sup>th</sup> Edition, Thomson – Brooks/Cole, 2003.
3. Kreyszig .E., "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.

**OUTCOMES:**

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

- basic theoretical principles in optimization.
- formulation of optimization models.
- solution methods in optimization.
- methods of sensitivity analysis and post processing of results.
- applications to a wide range of engineering problems.



---

<b>GEBX10</b>	<b>ENGINEERING SYSTEM MODELLING AND SIMULATION</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

**MODULE I INTRODUCTION 6**

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

**MODULE II RANDOM NUMBERS / VARIATES 7**

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

**MODULE III MODELLING PROCESS 7**

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

**MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9**

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

**MODULE V SIMULATION LANGUAGES 10**

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

**MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6**

**Total Hours: 45**

**REFERENCES:**

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., "System Improvement Using Simulation", 3<sup>rd</sup> Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.
4. Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

**OUTCOMES:**

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

---

<b>GEBX11</b>	<b>SUPPLY CHAIN MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

**MODULE I INTRODUCTION TO SUPPLY CHAIN 9**

Understanding Supply Chain - Decision phases - Supply chain performance  
- Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

**MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 9**

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

**MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 9**

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

**MODULE IV SOURCING AND TRANSPORTATION 9**

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers  
- Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

**MODULE V INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 9**

Information technology in a supply chain – CRM, ISCM, SRM in supply chain  
- Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

**Total Hours: 45**

**REFERENCES:**

1. Sunil Chopra and Peter Meindl, "Supply Chain Management-Strategy Planning and Operation", Pearson Education, 4<sup>th</sup> Indian Reprint, 2010.
2. Jananth Shah "Supply Chain Management – Text and Cases" Pearson Education, 2008.
3. Altekar Rahul V, "Supply Chain Management-Concept and Cases", Prentice Hall India, 2005.
4. Monczka et al., "Purchasing and Supply Chain Management", Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

**OUTCOMES:**

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

---

<b>GEBX12</b>	<b>TOTAL QUALITY MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

**MODULE I INTRODUCTION 8**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**MODULE II TQM PRINCIPLES 7**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

**MODULE III TQM IMPROVEMENT PROCESS 8**

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**MODULE V TQM TOOLS 7**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality

Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**MODULE VI QUALITY SYSTEMS**

**7**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

**Total Hours: 45**

**TEXT BOOK:**

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education, Inc. 2003.

**REFERENCES:**

1. James R.Evans & William M.Lindsay, “The Management and Control of Quality”, 5<sup>th</sup> Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S., “Total Quality Management”, Butterworth Heinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., “Quality Management – Concepts and Tasks”, New Age International, 1996.
5. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

**OUTCOMES:**

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

---

<b>GEBX13</b>	<b>ENERGY STUDIES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

**MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7**

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

**MODULE II SOLAR ENERGY 8**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

**MODULE III OTHER RENEWABLE ENERGY SOURCES 8**

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

**MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8**

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

**MODULE V ENERGY CONSERVATION AND MANAGEMENT 7**

Need for energy conservation – use of energy efficient equipments. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

**MODULE VI GLOBAL ENRGY ISSUES AND CARBON CREDITS 7**

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

**Total Hours: 45**

**TEXT BOOKS:**

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

**REFERENCES:**

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

**OUTCOMES:**

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.



---

<b>GEBX14</b>	<b>ROBOTICS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To learn about the robots, various components, of Robots, programming and their applications.

**MODULE I INTRODUCTION 8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

**MODULE II ROBOT DRIVES AND CONTROL 8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

**MODULE III ROBOT SENSORS 8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

**MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES 7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

**MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS 7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots –Application of robots in surgery, Manufacturing industries, space and underwater.

**MODULE VI ROBOT KINEMATICS AND DYNAMICS 7**

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity

of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

**Total Hours: 45**

**REFERENCES:**

1. Yoram Koren, "Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al, "Expert Systems and Robotics", Springer –Verlag, New York, May 1991.

**OUTCOMES:**

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

---

<b>GEBX15</b>	<b>CYBER SECURITY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the basics of Cyber Security Standards and Laws.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

**MODULE I FUNDAMENTALS OF CYBER SECURITY 8**

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

**MODULE II TYPES OF THREATS AND SECURITY MEASURES 8**

Security Programs – Non-malicious program Errors – Virus and other Malicious Code – Targeted Malicious Code – Control against program threats – Web Attacks – DOS – Online Security Resources.

**MODULE III APPLICATION SECURITY 8**

Introduction to Databases - Database Security Requirements – Reliability & Integrity – Multilevel Databases - E-Mail and Internet Security – SQL Injection – Cross Site Scripting – Local File Inclusion – Intrusion Detection Software”s.

**MODULE IV PHYSICAL SECURITY AND FORENSICS 7**

Firewalls – Benefits and Limitations – Firewall Types - Components – Server Room Design and Temperature Maintenance – Cyber Terrorism and Military Operation Attacks- Introduction to Forensics – Finding evidence on PC and Evidence on System Logs – Windows and Linux logs.

**MODULE V CYBER STALKING & FRAUD 7**

Introduction – Internet Frauds – Auction Frauds – Identity theft – Phishing – Pharming- Cyber Stalking – Laws about Internet Fraud – Protecting against Cyber Crime – Secure Browser settings – Industry Espionage.

**MODULE VI CYBER SECURITY STANDARDS AND POLICIES**

**7**

Introduction– ISO 27001– ISO 27002 - PCI DSS – Compliance - IT ACT – Copyright ACT, Patents. Definition of Policy – Types- User Policies- Administrative Policies – Access control – Developmental Policies.

**Total Hours: 45**

**TEXT BOOK:**

1. Chuck Easttom, “Computer Security Fundamentals”, 2<sup>nd</sup> Edition, Pearson Education, 2012.

**REFERENCES:**

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3<sup>rd</sup> Edition, Pearson Education, 2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3<sup>rd</sup> Edition, Pearson Education, 2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2000.

**OUTCOMES:**

Upon completion of this course, attendees should be able to satisfy the critical need for ensuring Cyber Security in Organizations.

- The students attending this course will be able to analyse the attacks and threats.
- They can also provide solutions with Intrusion Detection systems and Softwares.
- They will have knowledge about Cyber Frauds and Cyber Laws.

---

<b>GEBX16</b>	<b>USABILITY ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

**MODULE I INTRODUCTION 6**

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

**MODULE II USER INTERFACES 8**

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

**MODULE III INTERACTION DESIGN 8**

Process of Interaction Design - Establishing Requirements – Design, Prototyping and Construction - Evaluation and Framework.

**MODULE IV USABILITY TESTING 8**

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

**MODULE V USABILITY ASSESSMENT METHODS 8**

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual

Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards

**MODULE VI USER INTERFACES**

**7**

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

**Total Hours : 45**

**TEXT BOOKS:**

1. Yvonne Rogers, Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human - Computer Interaction”, John Wiley & Sons, 3<sup>rd</sup> Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, “Usability Engineering”, Morgan Kaufmann Academic Press, 1994. (Module I – VI).

**REFERENCES:**

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Interaction”, Pearson Education, 5<sup>th</sup> Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, “Usability Engineering: Process, Products, and Examples”, Pearson/Prentice Hall, 2008

**OUTCOMES:**

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

---

<b>GEBX17</b>	<b>INDUSTRIAL SAFETY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To understand the various safety measures to be taken in different industrial environments.

**MODULE I SAFETY MANAGEMENT 7**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

**MODULE II SAFETY IN MANUFACTURING 7**

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

**MODULE III SAFETY IN CONSTRUCTION 8**

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

**MODULE IV ELECTRICAL SAFETY 8**

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

**MODULE V SAFETY IN MATERIAL HANDLING 8**

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

**MODULE VI SAFETY EDUCATION AND TRAINING**

**7**

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

**Total Hours: 45**

**REFERENCES:**

1. Krishnan N.V, "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Blake R.B., "Industrial Safety", Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., "Construction Safety, Security, and Loss Prevention", John Wiley and Sons, 1979.
4. Fordham Cooper W., "Electrical Safety Engineering", Butterworths, London, 1986.
5. Alexandrov M.P., "Material Handling Equipment", Mir Publishers, Moscow, 1981.

**OUTCOMES:**

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.



---

<b>GEB X18</b>	<b>TRANSPORT MANAGEMENT</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

**MODULE I INTRODUCTION 7**

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

**MODULE II ORGANISATION AND MANAGEMENT 7**

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

**MODULE III TRANSPORT SYSTEMS 9**

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

**MODULE IV SCHEDULING AND FARE STRUCTURE 8**

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

**MODULE V MOTOR VEHICLE ACT**

**7**

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

**MODULE VI MAINTENANCE**

**7**

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

**TOTAL HOURS: 45**

**TEXT BOOKS:**

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffie and Sons Co., London, 1992

**REFERENCES:**

1. Government Motor Vehicle Act, Publication on latest act to be used as on date

**OUTCOMES:**

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

---

<b>GEBX19</b>	<b>ADVANCED OPTIMIZATION TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

**MODULE I INTRODUCTION 7**

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

**MODULE II HEURISTICS METHODS 8**

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing

**MODULE III GENETIC ALGORITHM 7**

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning- practical genetic algorithms

**MODULE IV ANT COLONY OPTIMIZATION 8**

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

**MODULE V FUZZY LOGIC AND ANN 8**

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

**MODULE VI IMPLEMENTATIONS & APPLICATIONS**

**7**

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

**Total Hours: 45**

**REFERENCES:**

1. Singiresu S. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice", John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
4. Kalymanoy Deb, "Optimization for Engineering Design", PHI, 2003.
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006.

**OUTCOMES:**

At the end of the course student will be able to

1. Formulate a real life situation as an optimization the problem.
2. Identify the appropriate solution methodology and provide a solution

---

<b>GEB X20</b>	<b>PLANT ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

**MODULE I INTRODUCTION OF PLANTS 7**

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

**MODULE II ELEMENTS OF PLANT 8**

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

**MODULE III DETAIL ENGINEERING 10**

P & ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List, I/O Count, Specification Sheets, Instrument Installation (Hook ups), Control Philosophy – Detail Engineering.

**MODULE IV SUPPORT FROM OTHER DISCIPLINE 8**

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture

**MODULE V INSTALLATION AND COMMISSIONING 7**

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

**MODULE VI CASE STUDIES 5**

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc.

**Total Hours: 45**

**REFERENCES :**

1. Duncan C. Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering - Technology and operations management, John Wiley & Sons, 2001
3. Robert C Rosaler, Standard Handbook of Plant Engineering, McGraw-Hill third edition, 2004.
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

**OUTCOMES:**

At the end of the course, the student will be able to

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

---

<b>GEBX21</b>	<b>PROJECT MANAGEMENT SYSTEM</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

**MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9**

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

**MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8**

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

**MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10**

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

**MODULE IV PROJECT HR & COMMUNICATION MANAGEMENT 10**

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies- Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management- Formal vs. Informal Communications- Written, Verbal and Non-Verbal Communications.

**MODULE V PROJECT PROCUREMENT & RISK MANAGEMENT 8**

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases.

**Total Hours: 45**

**REFERENCES:**

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel "Software Project Management", Tata McGraw-Hill, 2009.

**OUTCOMES:**

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in the project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.



**GEBX22 NATIONAL SERVICE SCHEME L T P C**  
**(Paper: 01 - As per Ministry of Youth Affairs and Sports) 0 0 3 1**

**OBJECTIVES:**

- understand the community in which they work
- understand themselves in relation to their community
- identify the needs and problems of the community and involve them in problem-solving
- develop among themselves a sense of social and civic responsibility
- utilise their knowledge in finding practical solutions to individual and community problems
- develop competence required for group-living and sharing of responsibilities
- gain skills in mobilising community participation
- acquire leadership qualities and democratic attitudes
- develop capacity to meet emergencies and natural disasters and
- practise national integration and social harmony

**MODULE I INTRODUCTION AND BASIC CONCEPTS OF NSS 4**

History, philosophy, aims & objectives of NSS – Emblem, flag, motto, song, badge, etc. – Organizational structure, roles and responsibilities of various NSS functionaries.

**MODULE II NSS PROGRAMMES AND ACTIVITIES 10**

Concept of regular activities, special camping, Day Camps – Basis of adoption of village/slums, Methodology of conducting Survey – Financial pattern of the scheme – Other youth programme/schemes of GOI – Coordination with different agencies – Maintenance of the Diary.

**MODULE III UNDERSTANDING YOUTH 5**

Definition, profile of youth, categories of youth – Issues, challenges and opportunities for youth – Youth as an agent of social change.

**MODULE IV COMMUNITY MOBILISATION**

**9**

Mapping of community stakeholders – Designing the message in the context of the problem and the culture of the community – Identifying methods of mobilisation – Youth-adult partnership.

**MODULE V VOLUNTEERISM AND SHRAMDAN**

**7**

Indian Tradition of volunteerism – Needs and importance of volunteerism – Motivation and Constraints of Volunteerism – Shramdan as a part of volunteerism.

**Total Hours: 35**

**PH.D. LEVEL COURSES**

<b>AUBZ01</b>	<b>AUTOMOTIVE ENGINE MANAGEMENT AND EMISSION CONTROLS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The main objective is to impart knowledge about pollution and control techniques.
- The concept of formation and control techniques of pollutants for both spark ignition and compression ignition engine.
- The testing procedures, emission standards and measurements instruments for analysis of various pollutants.

**MODULE I ENGINE EMISSION AND STANDARDS 8**

Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings, Air pollution due to IC Engines,. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Euro and Bharat Norms, – Crevice Volumes and Flow in crevice, leakage past to exhaust valves, valve over lap, deposit on valves, oil on comparison chamber valves, carbon mono oxide emission, oxide of nitrogen, other emission aldehydes, sulfur, lead, phosphorus.

**MODULE II AUTOMOTIVE ELECTRONICS 10**

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control, micro processor 8085.. Inductive, Hall Effect, hot wire, thermistor, piezo electric and resistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, Engine & vehicle design data crash, exhaust oxygen level, knock, engine temperature, manifold temperature and pressure sensors.

**MODULE III CONTROL OF EMISSIONS FROM SI AND CI ENGINES 9**

Parameters to be controlled in SI and CI engines. Design of engine, optimum selection of operating variables for control of emissions, EGR, Air injector PCV system, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, two stroke engine pollution control.

NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, driving cycles.

**MODULE IV SI AND CI ENGINE MANAGEMENT**

**9**

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch Monojetronic, L-jetronics and LH-Jetronic. Group and sequential injection techniques. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control. Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronically controlled Unit Injection system, common rail fuel injection system. fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

**MODULE V TEST PROCEDURES AND EMISSION MEASUREMENTS**

**9**

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures -Chassis dynamo-seven mode and thirteen mode cycles for Emission Sampling - Sampling problems - Emission analyzers -NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

**Total Hours: 45**

**TEXTBOOKS:**

1. G.P.Springer and D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.

**REFERENCES:**

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company. Newyork 1993.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatement', Butterworths ltd., London1990.

5. A.Alexander, J.P.Barde, C.Iomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987.

**OUTCOME :**

- Analyze about different type of pollutants and control techniques for both spark ignition and compression ignition engine.
- Equip with the practical knowledge about testing procedures, emission standards and measurements instruments for analysis of various pollutants.
- Discuss case studies on Research focused areas.

**OBJECTIVES:**

- To study the sources of vibrations and methods to reduce these vibrations
- To study the numerical methods of vehicle dynamics
- To study the vehicle handling and stability of vehicles

**MODULE I BASIS OF VIBRATION 7**

Fundamentals of vibration, single degree of freedom, two degree of Freedom Multi degree freedom, free, forced and damped vibrations, modeling and simulation studies, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed. Modal analysis

**MODULE II VERTICAL DYNAMICS 9**

Sources of Vibration, Human response to vibration. Design, analysis and simulation of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties. Approximate methods for determining fundamental frequency, Dunkerleys lower bound, Rayleighs upper bound.

**MODULE III LONGITUDINAL DYNAMICS AND CONTROL 7**

Aerodynamic forces and moments. Equation of motion. Tyre forces, rolling resistance, Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control. Case Studies.

**MODULE IV LATERAL DYNAMICS 7**

Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Stability of vehicle on banked road and during turn. Effect of suspension on cornering.

Oversteer, under steer, steady state cornering, effect of braking, driving torques on steering, effect of camber, transient effects in cornering. Tyre forces and moments, Tyre structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tyre. Performance of tyre on wet surface. Ride property of tyres. Magic formulae tyre model, Estimation of tyre road friction. Test on Various road surfaces. Tyre vibration. Introduction to human body, Anthropometrics and its application to vehicle ergonomics and cockpit design. Ergonomic research methods / ergonomic audit, Practical work aimed at integrating design and ergonomics

**Total Hours: 45**

**TEXT BOOKS:**

1. J. Y. Wong, Theory of Ground Vehicles, 3<sup>rd</sup> Edition, Wiley-Interscience, 2001.
2. Singiresu S. Rao, Mechanical Vibrations (5<sup>th</sup> Edition), Prentice Hall, 2010.
3. Rajesh Rajamani, Vehicle Dynamics and Control, 1<sup>st</sup> edition, Springer, 2005.
4. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers Inc, 1992.

**REFERENCES:**

1. G. Nakhaie Jazar, Vehicle Dynamics: Theory and Application, 1<sup>st</sup> edition, Springer, 2008.
2. Michael Blundell & Damian Harty, The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004.
3. Hans B Pacejka, Tyre and Vehicle Dynamics, 2<sup>nd</sup> edition, SAE International, 2005.
4. John C. Dixon, Tyres, Suspension, and Handling, 2<sup>nd</sup> Edition, Society of Automotive Engineers Inc, 1996.

**OUTCOME:**

- Analyze the causes and vibration reduction methods in the vehicle
- Enhance the numerical ability to solve vehicle dynamics problems
- Analyze the vehicle handling and stability of vehicles.
- Discuss case studies on Research focused areas.

**OBJECTIVES:**

- Basic principles of aerodynamics for the design of vehicle body.
- To Study the Automotive Aerodynamics
- At the end of this course, the student will have good exposure to Automotive Aerodynamics

**MODULE I INTRODUCTION** **9**

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

**MODULE II AERODYNAMIC DRAG AND RESISTANCE OF VEHICLE** **10**

Flow pattern around the vehicle – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles. Resistance to vehicle motion – Air, Rolling and Grad resistance – Performance – Fuel consumption and performance

**MODULE III MODIFICATION AND OPTIMIZATION OF VEHICLE SHAPE** **8**

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

**MODULE IV EFFECT AND CHARACTERISTICS OF FORCES AND MOMENTS** **9**

The origin of forces and moments on vehicle - side wind problems – methods to calculate forces and moments - vehicle dynamics Under side winds – the effects of forces and moments - Characteristics of forces and moments – Dirt accumulation on the vehicle - wind noise - drag reduction in vehicles

**MODULE V AUTOMOTIVE AERO DYNAMICS WIND TUNNEL TESTING** **9**

Principles of wind tunnel technology – Types, Stress with scale models – full scale wind tunnels – measurement techniques – flow visualization



techniques, component balance to measure forces and moments. –  
Equipment and transducers – road testing methods. Introduction to CFD.

**Total Hours: 45**

**TEXTBOOK:**

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 4<sup>th</sup> Edition, SAE 1998.

**REFERENCES:**

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2<sup>nd</sup> Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Vehicle Aerodynamics, SP-1145, SAE, 1996.

**OUTCOMES:**

- Exhibit understanding of how aerodynamics affects the motorsport vehicle design and operation
- Apply knowledge for critical awareness of the wind tunnel techniques used to analyse motorsport aerodynamic problems and apply these techniques and concepts to develop solution strategies for relevant wind tunnel simulations.
- Discuss case studies on Research focused areas

---

<b>AUBZ04</b>	<b>AUTOMOTIVE SAFETY SYSTEM</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To Study the Automotive Safety system.
- At the end of this course, the student will have good exposure to Automotive Safety system.

**MODULE I INTRODUCTION 9**

Automotive safety – Introduction, Types. Active safety: driving safety, conditional safety, perceptibility safety, operating safety- Passive safety: exterior safety, interior safety- deceleration curve with respect to Engine location, deceleration of vehicle , passenger compartment, deceleration on impact with stationary and movable obstacle, sandwich construction

**MODULE II PASSIVE SAFETY CONCEPTS AND EQUIPMENTS 9**

Design of body for safety, engine location, deceleration of vehicle, passenger compartment, deceleration on impact with stationary and movable obstacles. Deformation behavior of vehicle body. Concept of crumble zone, Safety Cage. Regulations, Seat belt, automatic seatbelt pretensioner system and importance , Force limiter/Load Limiter, automatic seat belt tightener system and importance , collapsible steering column, tiltable steering column with advantages , air bags, Designing aspcts of automotive bumpers and materials for bumpers.

**MODULE III ACTIVE SAFETY AND CONVENIENCE SYSTEM 9**

Antiskid braking system, Secondary braking system. Stability Control. Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system, manual and automated wiper system, Driver alertness detection system, Adaptive lighting.

**MODULE IV COLLISION WARNING AND AVOIDANCE 9**

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

Steering and mirror adjustment, information system. Adaptive cruise control, Warning systems, Collision Avoidance systems

**MODULE V VEHICLE INTEGRATION AND NAVIGATION SYSTEM 9**

Intelligent vision system, Vehicle Network system. Global Positioning System-Stay connect, remote link, auto emergency call, phone to vehicle control. Road Network, Navigation System. Telematics-Vehicle Diagnostics, Environment information system.

**Total Hours: 45**

**TEXT BOOK:**

1. Bosch, "Automotive HandBook", 6<sup>th</sup> edition, SAE, 2004.
2. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.

**REFERENCES:**

1. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition-McGraw-Hill Inc., - 1999.
2. ARAI Safety standards

**OUTCOMES:**

- Analysis the active safety and passive safety systems.
- Apply knowledge to analyze antilock brakes, crash performance, occupant safety and traction control contribute to automotive safety.
- Discuss case studies on Research focused areas

---

<b>AUBZ05</b>	<b>COMBUSTION THERMODYNAMICS AND HEAT TRANSFER</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The objective of this course is to impart the knowledge about the principle of engine combustion process
- To introduce the various heat transfer models and its measuring methods.

**MODULE I THERMODYNAMICS OF COMBUSTION 8**

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

**MODULE II COMBUSTION IN SI ENGINES 9**

Stages of combustion - Flame propagation - Rate of pressure rise - Cycle to cycle variation Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion.

**MODULE III COMBUSTION AND KNOCK IN CI ENGINE 8**

Droplet and spray combustion theory - stages of combustion - delay period - peak pressure - Heat release – Gas temperature - Diesel knock.

**MODULE IV CHEMICAL KINETICS OF COMBUSTION AND FLAMES 10**

Combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion. Laminar - premixed and diffusion flames – flame speed correlations- quenching, flammability, and ignition, flame stabilization, turbulent premixed, diffusion flames-Damkohler number.

**MODULE V HEAT TRANSFER IN IC ENGINES AND INSTRUMENTATION 10**

Engine Heat transfer and heat Balance. Measurement of Instantaneous heat transfer rate. Heat transfer modeling. Heat transfer coefficients, radiative heat transfer. Temperature measurement in Piston, Cylinder, Cylinder Head, Liner and valves. Pressure sensors, crank angle encoder. Hot wire and laser Doppler anemometry and velocimetry for flow and

combustion analysis in IC engines. In-cylinder pressure measurement and Rate of heat release calculation.

**Total Hours: 45**

**REFERENCES:**

1. J.I.Ramos, "Modeling of Internal Combustion Engine", McGraw hill book company New york 1990.
2. John. B. Heywood,' "Internal Combustion Engines", Tata McGraw Hill Co., Newyork, 1988.
3. Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Wiley eastern India ltd,1996.
4. Spalding.D.B., "Some fundamentals of Combustion", Butterworth Science Publications, Londpon, 1985.
5. Irvin Glasman, "Combustion" Academic Press, London, 1987, ISBN 0-12-285851-4.
6. Ashley Campbel, "Thermodynamic analysis of combustion engine", John book company, Newyork, 1979.

**OUTCOMES:**

- A complete knowledge about combustion and heat radiation processes in practical application such as furnace, boilers, and other combustion chambers.
- Understand the fundamentals of the combustion and heat radiation
- Knowledge of the physical processes (fluid dynamics, heat and mass transfer) and chemical processes (thermodynamics and chemical kinetics) involved in combustion.
- Perform mathematical modeling and numerical simulation.
- Discuss case studies on Research focused areas

---

<b>AUBZ06</b>	<b>INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- Study of the theory, construction and operation of different measurement technology.
- Instruments transducers and their application in automotive industry.

**MODULE I MEASUREMENT SYSTEMS 9**

Static and Dynamic Measurement systems-importance and methods of measurement -systems - characteristics of measuring system-static and dynamic characteristics- Analysis of experimental , Error analysis-types of errors-limiting errors.

**MODULE II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 9**

Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile –filters -types – Data Acquisition system - analog and digital type DAS- Indicators, Printers and display device – Signal Analyzing with example of automobile applications.

**MODULE III MECHANICAL MEASUREMENT 9**

Instrumentation for Measuring Weight, Force, torque , pressure, power, temperature, fluid flow and special methods , vibration piezo electric effect, rotational speed .Measuring Velocity, acceleration and angular motion with respect to automobile applications

**MODULE IV ENGINE EXPERIMENTAL TECHNIQUES 9**

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements.

**MODULE V VEHICLE EXPERIMENTAL TECHNIQUES 9**

Laboratory tests- test tracks - Endurance Tests- crash tests- wind tunnel tests- Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard

**B.Tech. Automobile Engineering**

---

impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

**Total Hours: 45**

**TEXTBOOK:**

1. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London, 1968.
2. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, New Delhi, 1995.

**REFERENCES:**

1. A.W. Judge, 'Engineering Precision Measurement', Chapman and Hall Ltd, Essex Street W.C., 1951.
2. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi, 1990.
3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990.

**OUTCOME**

- Apply knowledge about instrumentation and experimental techniques.
- Encompass information of Instruments transducers and their application in automotive industry.
- Discuss case studies on Research focused areas

---

<b>AUBZ07</b>	<b>VEHICLE CONTROL SYSTEMS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To explain the principle of chassis management system
- To study about different sensors and actuator used in the vehicle.

**MODULE I INTRODUCTION 9**

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level, Engine and vehicle design data.

**MODULE II DRIVELINE CONTROL SYSTEM 9**

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - power steering, collapsible and tiltable steering column – steer by wire.

**MODULE III SAFETY AND SECURITY SYSTEM 9**

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

**MODULE IV COMFORT SYSTEM 9**

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

**MODULE V INTELLIGENT TRANSPORTATION SYSTEM 9**

Traffic routing system - Automated highway systems - Lane warning system – Driver Information system, side blind zone warning system, automatic parking system, driver assistance systems - Data communication within the car, Driver conditioning warning -Route Guidance and Navigation



**B.Tech. Automobile Engineering**

---

Systems – vision enhancement system - In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

**Total Hours: 45**

**TEXT BOOKS:**

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, ButterworthHeinemann publications, Oxford, 2001.

**REFERENCES:**

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, New Delhi, 2002.
2. William B. Ribbens -Understanding Automotive Electronics, 5<sup>th</sup> edition, Butterworth Heinemann Woburn, 1998.
3. Bosch, “Automotive HandBook”, 6<sup>th</sup> edition, SAE, 2004.

**OUTCOME**

- Apply the fundamentals of chassis management system and its control
- Analysis of different sensors and actuators for automotive applications.
- Discuss case studies on Research focused areas

**OBJECTIVES:**

- To familiarize the various steps involved in the vehicle design process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To acquire knowledge about standard practices and standard data in vehicle design
- To learn to use catalogues and standard machine components

**MODULE I INTRODUCTION**

**9**

Classification of design – Engineering materials and their physical properties as applied to design – Selection of materials – Factors of safety in design – Endurance limit of materials –Determination of endurance limit for ductile materials — Principle of design optimization – Future trends – CAD Euler’s formula – Rankine’s formula – Tetmajer’s formula –Johnson formula.

**MODULE II SUSPENSION DESIGN AND SHAFT**

**9**

Design of close coiled helical spring subjected to axial loading and Torsion springs. Design of Leaf spring and Damper for various loading conditions. Design of axles – Design of shafts on the basis of strength – Design of shaft on the basis of rigidity – Design of hollow shafts propeller shaft, universal coupling design.

**MODULE III DESIGN OF TRANSMISSION SYSTEM**

**9**

Design considerations and Design of clutch – strength of gear teeth – Lewis equation – Terminology of gears –Dynamic tooth load – Design of spur gears – helical gears – herringbone gears – bevel gears and worm gears. Design of Final drive. Design journal bearings - Ball and Roller bearings – Types of Roller bearings – Bearing life –Static and Dynamic load capacity – Bearing material – Boundary lubrication – Oil flow and temperature rise.Design of Final drive.

**MODULE IV DESIGN OF CHASSIS SYSTEM**

**8**

Design of Chassis frame, Brake design for various speed and load conditions, steering system, Design eccentricity loaded columns – Reduction of stress concentration.

**MODULE V ENGINE COMPONENTS DESIGN**

**10**

Design of piston, piston ring, piston pin, connecting rod, crank shaft, cam shaft, Determination of the mass of a flywheel for a given coefficient of speed fluctuation. Engine flywheels stresses of rim of flywheels. Design of hubs and arms of flywheel – Turning moment diagram. Design of valve, Design of push rods

**Total Hours: 45**

**TEXT BOOKS**

1. Jain, R.K., Machine Design, Khanna Publishers, 1992.
2. Sundararaja Murthy, T.V., Machine Design, Khanna Publishers, New Delhi, 1991.
3. Bhandari, V.B., Design of Machine elements, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.

**REFERENCES**

1. Hall Allen, S. & Others, Machine Design, Schaum Publisher Co., 1982.
2. Sigley, Machine Design, McGraw Hill, 1981.
3. Design Data Book, PSG College of Technology, Coimbatore, 1992.

**COURSE OUTCOMES:**

- The student will be capable of designing Automobile Components like Shafts, Gears, Bearings and Flywheel
- Apply the knowledge of the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength in vehicle design.

**OBJECTIVES:**

- To impart knowledge in computer simulation of IC engine process.
- To know the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation.
- To get introduced to two stroke engine simulations.
- To know about CI engine simulations.

**MODULE I INTRODUCTION 9**

Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models – Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylinder models. Step by step approach in SI engine simulation.

**MODULE II COMBUSTION AND STOICHIOMETRY 9**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. Conversion of volumetric analysis to mass analysis. Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.

**MODULE III COMPUTER SIMULATION OF SI ENGINE WITH FUEL AIR CYCLE 9**

SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Wiebe's law combustion analysis.

**MODULE IV COMPUTER SIMULATION OF SI ENGINE WITH GAS EXCHANGE PROCES 9**

Introduction, gas exchange process, Heat transfer process, friction calculations, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance.

**MODULE V COMPUTER SIMULATION OF CI ENGINE 9**

Zero, one and multizone models for diesel engine combustion. Double Wiebe's Law

Analysis for diesel combustion. Heat release model and different heat transfer models.

Equilibrium calculations. Parametric studies on simulated engine performance.

**Total Hours: 45**

**TEXTBOOK:**

1. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderabad, 1996.

**REFERENCES:**

1. John. B. Heywood, 'Internal Combustion Engines"', Tata McGraw Hill Co., Newyork,1988.
2. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979.
3. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992. P.
4. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.

**OUTCOMES:**

The student should be able to

- Analyze the combustion processes and assume suitable parameters.
- Create models for SI engine processes.

- Create models for two stroke engine processes.
- Create models for CI engine processes.
- Test the models in computers and validate with actual testing results

---

<b>AUBZ10</b>	<b>AUTOMOTIVE MATERIAL CHARACTERISATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the various materials in the automotive components.
- To familiarize the different material selection processes.
- To learn the different failure analysis of automotive materials.

**MODULE I MATERIAL SELECTION 8**

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 II COMPOSITES 7**

Metal matrix composites, polymer matrix composites, ceramic matrix composites, Fiber Reinforced Plastics (FRP). Role of nano composites in automotive systems.

**MODULE III NON-METALLIC MATERIALS 8**

Polymers – types of polymer, commodity and engineering polymers – Properties and auto Applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Urea and Phenol formaldehydes. Elastomers – natural and synthetic rubbers, tires, properties of rubbers and auto applications.

**MODULE IV PLASTIC AND COMPOSITE MATERIALS MANUFACTURING PROCESSES 7**

Hand moulding, compression moulding, Reaction Injection moulding (RIM), blow moulding, filament winding, pultrusion, pulforming, SMC & DMC.

**MODULE V SMART MATERIALS 7**

Functional properties that lead to their consideration, piezoelectric materials, Electroactive materials, Shape Memory Alloys(SMA),Optical fibers– definition, types.

**MODULE VI MATERIAL CHARACTERIZATION**

**8**

Types of failures, fracture mechanisms, types of defects in metals & cracks, types of fatigue, importance of endurance life, corrosion – causes, effects and preventions, wear & tear, X-ray Diffraction, Transmission Electron Microscope, Scanning Electron Microscope, Hardness testing, Impact test.

**Total Hours: 45**

**REFERENCES:**

1. Kenneth G. Budinski and Michael K. Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4<sup>th</sup> 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.

**OUTCOMES:**

- The students will be capable of selecting the appropriate materials for the automotive component manufacturing.
- The students can select the materials according to their strengths.
- The students can evaluate the material by the failure analysis.





**MODULE IV SUSPENSION FRONT AXLE**

**9**

Suspension computer models using Bond graphs technology CAMPG, Suspension computer models & simulations using MATLAB/Simulink, Fundamental concepts of vehicle vibrations principle. Bumper design computer model - moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings.

**MODULE V CRUSH AND DRIVE LINE**

**10**

Torque capacity of clutch. Computer aided design of clutch components. Computer aided design of three speed and four speed gear boxes. Drive train model, computer models using MATLAB/Simulink-Analysis of loads. Vehicle Collision analysis, Fundamental law of motion, energy and momentum forces and moments 2D and 3D computer models for calculation of impact forces. Computer aided design of propeller shaft. Modelling of final drive. The dynamics of roll overs analysis. Modelling and analysis of axles. Introduction to the ADAMS vehicle design software groups. Finite Element modelling (FEA) and failure analysis stress. Deformation calculation.

**Total Hours: 45**

**TERM WORK**

- Two and three dimensional tyre model
- 3D vehicle design mechanisms, various Auto body panels
- Suspension model and simulations using MATLAB/Simulink
- Computer aided design of propeller shaft and final drive gearing.
- Finite Element modelling (FEA) and failure analysis
- Individual vehicle design project.

**CASE STUDIES**

- Vehicle tyre performances on various surfaces, Cornering characteristics and Mechanics of vehicle terrain interaction of vehicle.
- Study of loads - moments and stresses on various types of frame members
- Suspension modelling and simulation using Bond graphs technology CAMPG, MATLAB

**TEXT BOOKS:**

1. DeanAverns, " Automobile Chassis Design ", Illiffe Books Ltd, 1992.
2. Radhakrishnan.P. and Kothandaraman.C.P., "Computer Graphics and Design", Dhanpal Rai & Sons, Delhi 1990.

**REFERENCES:**

1. Heldt.P.M., " Automotive Chassis", Chilton Co., New York, 1992.
2. Steeds.W., "Mechanics of Road vehicles", Illiffe Books Ltd., London, 1990.
3. Giles.J.G., Steering, "Suspension and tyres", Illiffe Books Ltd., London, 1988.
4. Newton, Steeds & Garret, "Motor vehicle", Illiffe Books Ltd., London, 1982.
5. Heldt.P.M., "Torque converter", Chilton Book Co., New York, 1982.
6. Ramamurthi.V., "Computer Aided Design in Mechanical Engg"., Tata McGraw Hill, New Delhi, 1987.
7. Naim A Kheir system modeling and computer simulation Marcel Dekker Inc 1996
8. Hatmut Bossel Modeling and simulation Volume
9. Michael Blundell, DamianHarty –The multibody systems approach to vehicle dynamics Elsevier 2004
10. GuiRong Liu S SQuek The finite element method: A Practical course Butterworth Heinemann 2003

**OUTCOMES:**

At the completion of this course the students will be able to

- apply the concepts of analysis the various vehicle system performances.
- to mathematical model the different vehicle systems.
- to solve different types of simulation problems for automotive application and application of FEA techniques related to automobile
- able to discuss the approach for predicting vehicle performance
- to simulate and analyze vehicle performance