HINDUSTAN UNIVERSITY
HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

B.Tech.

(Mechatronics Engineering)

CURRICULUM & SYLLABI

For the Academic year

2015 – 2016

DEPT. OF MECHANICAL ENGINEERING
HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE
HINDUSTAN UNIVERSITY

ACADEMIC REGULATIONS FOR B. TECH.

(Effective from 2015)

1.0 Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

The Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the Institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfil their obligations to the nation and the society.
- To promote research in the field of Science, Humanities, Engineering, Technology and allied branches.

1.3 Aims and Objectives of the Institute are focused on

- Providing world class education in engineering, technology, applied sciences and management.
- Keeping pace with the ever changing technological scenario to help the students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2.0 Admission

2.1. The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the B.Tech programme will be decided by BOM as per the directives from MHRD, Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2. (i) Full-Time:

At the time of applying for admission, the candidates should have passed / appeared and be awaiting results of the final examination of the 10+2 system or its equivalent with Mathematics, Physics and Chemistry as subjects of study.

(ii) Lateral Entry:

At the time of applying for admission, the candidates should have a Diploma in Engineering/Technology in the relevant branch of specialization awarded by the State Board of Technical Education, Tamil Nadu or any other authority accepted by the Board of Management of the University as equivalent thereto.

2.3. The selected candidates will be admitted third semester to the B.Tech programme after he/she fulfils all the admission requirements set by the Institute and after the payment of the prescribed fees.

2.4. In all matters relating to admission to the B.Tech programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5. If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3.0 Structure of the B.Tech Programme

3.1 The programme of instruction will consist of:

i) a general Core foundation (**CF**) programme comprising
- English;
- Basic Sciences (BS) including Physics, Chemistry, Mathematics;
- Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;

ii) Compulsory Core courses (**CC**) consisting of

a. Professional Core (**PC**), an engineering core programme introducing the students to the foundations of engineering in his/her branch (Department) comprising theory and Practical/ field work/ Mini project/ Project ;

b. Professional Electives (**PE**)- an elective programme enabling the students to take up a group of courses for specialisation/ interest to him/her in his/her branch (Department);

iii) Engineering Electives(**EE**) - Engineering electives offered by other engineering departments;
iv) Open Electives(**OE**)- Courses offered by non-Engineering departments (Humanities and Management Schools) other than communication skills and personality development credit courses;
v) Non-CGPA courses shall be offered in any semester which are compulsory, but not calculated for GPA. The credits will be mentioned in the grade card.

In addition, a student should satisfactorily complete NSS/NCC/NSO and Professional practice like Seminar and/or Internship in Industry or elsewhere, Soft skill development.

3.2 The complete programme will consist of 4 categories: **Core Foundation (CF)** consists of English, Basic Sciences, Engineering Sciences; **Core Courses (CC)** consists of Professional Core (PC), Professional Elective (PE), and Practical/field work/projects; **Engineering Elective (EE)** and **Open Electives (OE)** distributed over seven semesters with two semesters per year. The eighth semester may be left for the project work so that the student can take up industrial project.

3.3 All the Professional Electives shall be from V semester onwards and VIII semester may be left for the project work.

3.4 The Engineering Elective and Open Elective shall start from III and IV semester respectively**.**

3.5 Every B. Tech. Programme will have a curriculum and syllabi (course contents) approved by Academic Council.

3.6 Credits are assigned to the courses based on the following general pattern:

- One credit for one hour/week/Semester for *Theory/Lecture (L)* or *Tutorials (T) Courses;* and,
- One credit for three hours/week/Semester for *Laboratory/Practical(P) Courses;*
- *One credit for 4 weeks of Industrial Training and*
- *One credit for 4 hours of project per week per semester.*

NOTE: Other student activities not demanding intellectual work or enabling properassessments like, practical training, study tour and guest lecture not to carry *Credits;*

As per guidelines, *Credit* values for different academic activities to be represented by following the well accepted practice

Lectures (hrs/wk/Sem.)	Tutorials (hrs/wk/Sem.)	Practical Work (hrs/wk/Sem.)	*Credits* (L: T: P)	Total *Credits*
3	*0*	*0*	*3:0:0*	*3*
3	*1*	*0*	*3:0:0*	*4*
2	*1*	*0*	*2:1:0*	*3*
2	*0*	*2*	*2:0:1*	*3*
2	*1*	*2*	*2:1:1*	*4*
0	*0*	*3*	*0:0:1*	*1*
0	*0*	*6*	*0:0:2*	*2*

3.7 The curriculum of any branch of the B. Tech. programme is designed to have a minimum total of **180 credits** for the award of B. Tech. degree.

3.8 No semester shall have more than six lecture based courses and four laboratory courses as prescribed in the curriculum carrying a maximum of 30 credits, subject to the following:

Students are permitted to register for an additional course for earning additional credits from the Vth semester onwards provided the student have at least 7.5 CGPA in earlier semester without any arrears .

However, in special cases, students of VII semester will be permitted to take two additional subjects to the following conditions:

a) The maximum number of credits registered in any semester shall not exceed 30.
b) No withdrawal from any of the courses for which a student has registered will be allowed, except as per regulation **8.0**.
c) The student's Faculty Adviser and Head of the Dept. recommends the same.

3.9 Every course of B. Tech. programme shall be placed in one of the four broad categories listed in Table 1.

Table 1: Typical Curriculum Structure for B. Tech. Degree Programmes

Sl. No.	Course Classification	Range of Total Credit (%)	Suggested (out of 180)	
1	**Core Foundation (CF)**	**20-30**	**26**	**47**
2	**Core Courses (CC)**	**55-65**	**59**	**106**
3	i) Professional Core (PC)#, Theory Lab/project	40-60 (*30-40)* (10-20)	51 (37) (14)	91 (66) (25)
4	ii) Professional Electives (PE)	8-12	8	15
5	**Engineering Electives (EE)**	**5-10**	**8**	**15**
6	**Open Electives (OE)**	**5-10**	**7**	**12**
	Total	100	**180**	

Departments in consultation with their respective BOS are free to judiciously mix the theory and lab contents so as to meet the total credit criteria for PC.

A student must earn a minimum number of credits under each category as shown in Table-1 and also a minimum total of **180 credits** for the award of B. Tech degree. For Lateral entry students, minimum requirement is **136 credits** for the award of B. Tech degree.

3.10 The suggested course distribution per semester is shown below. However, the departments are free to distribute the credit distributions for CC as per their requirement

Comp/ Semester	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
CC		8	19	16	20	18	19	12	112
CF	20	13	4	4		0			41
EE			3	3	3	3	3		15
OE				3	3	3	3		12
Total	20	21	26	26	26	24	25	12	180

3.11 The medium of instruction, examination and project reports will be English.

4.0 Faculty Adviser

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5.0 Class Committee

5.1 Every class of the B. Tech. programme will have a Class Committee consisting of Faculty and students.

5.2 The constitution of the Class Committee will be as follows:

a) One professor not associated with teaching the particular class to be nominated by the Dean (Academic) to act as Chairman of the Class Committee.
b) Course coordinator of each of the lecture based subjects
c) Workshop Superintendent (for first two semesters)
d) Four students from the respective class; and
e) Faculty Advisers of the respective class.

All teachers offering the common courses shall be invited to attend the class committee meetings.

5.3 The basic responsibilities of the Class Committees are

a) to review periodically the progress of the classes,
b) to discuss issues concerning curriculum and syllabi and the conduct of the classes.
c) The method of assessment in the course will be decided by the teacher, in consultation with the class committee, and will be announced to the students at the beginning of the semester. Each class committee will communicate its recommendations to the Head of the Department and the Dean (Academic).
d) The Class Committees without student members is responsible for the finalisation of the semester results.
e) The Class Committees shall meet at least thrice in a semester, once at the beginning of the semester, once after first unit test, once before end semester examination.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade Points	Remarks
90 – 100	S	10	
80 - 89	A	09	
70 - 79	B	08	
60 - 69	C	07	
55 - 59	D	06	
45 - 54	E	05	
<45	U	00	To Reappear for end-semester examination
	RA	*00*	*Failure due to insufficient attendance/ sessional marks less than minimum required in course. Subsequently to be changed into pass (E to S) or U grade in the same semester.*

6.2 GPA and CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of C_i for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from the first semester onwards.

6.3 For the students with letter grade **RA** and **U** in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

7.0 Enrolment and Registration

7.1 ***Enrolment:***

A student will be eligible for enrolment only if he/she satisfies regulation**11** (maximum duration of the programme) and will be permitted to enrol only if he/she has cleared all dues to the Institute, Hostel, Library up to the end of the previous semester provided he/she is not debarred from enrolment on disciplinary grounds.

7.2 ***Registration:***

Except for the first year, registration of a semester will be done in the parent department during a specified week before the start of current semester.

Late registration/enrolment will be permitted with a fine as decided from time to time up to two weeks from the last date specified for registration.

7.3 The registration sheet contains the course number, course name, number of credits, category for each course to be taken in that semester and signature of the course instructor. The student makes the choice of course in consultation with his/her Faculty Advisor.

8.0 Registration Requirement

8.1 The curriculum for any semester, except for the first and final semester will normally carry credits between 21 and 30.

8.2 The student should make sure that the registration for CC/EE/OE courses for a particular semester is as per the student handbook. In case of non-conformity, the Faculty Advisor has the liberty to modify the registration as per the regulation that are in force, in consultation with the student.

8.3 If a student finds his/her academic/course load heavy in any semester, or for any other valid reason, he/she may drop EE/OE courses within **fifteen days** of the commencement of the semester but before the commencement of first unit test with the written approval of his/her Faculty Advisor and Head of the Department.

However, the student should ensure that the total number of credits registered in any semester should enable him/her to earn the minimum of **16**credits and registered all CC courses for that semester.

8.4 The number of EE/OE credits that a student can register during the semester should not exceed by more or less 6 credits of the total stipulated credits mentioned by the Department for the particular semester. However, this restriction is not applicable for final (8^{th}) semester.

8.5 In case of an academic backlog carried forward in a semester, registration for additional subjects for extra credits will be restricted to maintain the minimum requirements as prescribed in regulations.

8.6 The students failing in EEs and OEs can opt for equivalent EEs and OEs and make up for required credits in the subsequent semesters

9.0 Contact Courses

9.1 A contact course may be offered during the regular semester by a Department, to a student who has obtained **"RA" grade** due to lack of attendance or due to lack of sessional marks in a course work.

9.2 No student should register for more than two contact courses during the semester.

9.3 The assessment procedure for the contact course will be similar to the regular semester course.

9.4 The students who has obtained **U** grade can apply for improvement of sessional marks in case their score is above 20. The maximum marks awarded shall be 30.

10.0 Continuation of the Programme

10.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his/her parents regarding the shortage of his/her credit will be sent by the HOD after the announcement of the results of the university examinations. A student may dropout to complete the backlog requirements.

11.0 Maximum Duration of the Programme

(i) Full-Time:

A student is expected to complete the B.Tech programme in **eight semesters**.
However, a student may complete the programme at a slower pace, but in any case **not more than 14 semesters**, excluding semesters withdrawn on medical grounds, etc. as per **12.0**.

(ii) **Lateral Entry:**

A student is expected to complete the B.Tech programme in **six semesters**.
However, a student may complete the programme at a slower pace, but in any case **not more than 12 semesters**, excluding semesters withdrawn on medical grounds, etc. as per **12.0**.

12.0 Temporary Withdrawal from the Programme

A student may be permitted by the Dean (Academic) to withdraw from the programme for a semester or longer for reasons of ill health or other valid reasons. Normally a student will be

permitted to withdraw from the programme only for a maximum continuous period of two semesters.

13.0 Discipline

13.1 Every student is required to observe discipline and decorous behaviour both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

13.2 Any act of indiscipline of a student reported to the Dean (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on a suitable punishment if the charges are substantiated. The committee will also authorize the Dean (Academic) to recommend to the Vice Chancellor the implementation of the decision. The student concerned may appeal to the Vice Chancellor whose decision will be final. The Dean (Academic) will report the action taken at the next meeting of the Council.

13.3 Ragging of any form is a criminal and non-bailable offence in our country. The current State and Central legislations provide for stringent punishment including imprisonment. Once the involvement of student(s) is established in ragging, the offending student(s) will be dismissed from the institution. Every senior student of the institute, along with the parent, shall give an undertaking every year in this regard and this should be submitted at the time of enrolment.

14.0 Attendance

14.1 A student whose attendance is less than 75% in any course, whatever may be the reason for the shortfall of the attendance, will not be permitted to appear in the end-semester examination of the course in which shortfall exists.

His/her registration for that course will be treated as cancelled, and he/she shall be awarded **'RA' grade** (RA stands for registration cancelled for want of minimum attendance) in that subject. This grade shall appear in the grade card till the course is successfully completed.

In the case of a core course, the student should register for and repeat the course as per **9.0**.

14.2 The teacher handling a course must finalise the attendance 3 calendar days before the last instructional day of the course in the semester.

The particulars of all students who have attendance less than 75% in that course must be announced in the class by the teacher himself/herself.

Copies of the same should be sent to the Dean (Academic) and Heads of Departments concerned. Students who get less than 75% should not be permitted to sit for the end-semester examination for that course without the permission of Dean, Academic.

14.3 Condonation of Attendance: Every student is expected to put in 100% attendance. The minimum attendance requirement is 75%. For cases of casual absenteeism, no condonation of attendance is permissible. If a student has less than 75%, he/she should be assigned **'RA' grade** in that subject. The percentage of attendance in a subject shall be computed as:

(a) For calculation of attendance in normal cases:

For cases of casual absenteeism, actual % of attendance is computed as:

$$\frac{\text{Actual no. of classes attended x 100}}{\text{Total no. of classes held till date of compilation of attendance}}$$

which should be ≥ 75%. Otherwise RA grade shall be awarded. Such cases will not come under the purview of Condonation of attendance.

(b) For the case of minor illness:

A student should have at least 65% attendance with medical certificate as calculated as per (a) above. For condonation the attendance is computed as:

Notional % of attendance =

$$\frac{\text{Actual no. of classes attended x 100}}{\text{(Total no. of classes held in the semester) - (No. of classes held during the days of illness)}}$$

which should be ≥ 75% for condonation.

(c) For calculation of attendance in case of prolonged illness and/or hospitalisation with medical certificate:

A student should have more than 50% attendance calculated as per (a) aboveto be eligible fo r condonation.

Notional % of attendance =

$$\frac{\text{Actual no. of classes attended x 100}}{\text{(Total no. of classes held in the semester) - (No. of classes held during the days of prolonged illness and/or hospitalization)}}$$

which should be ≥ 75% for condonation.

(d) Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Dean (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

(e) University is providing an incentive to those students who are involved in extracurricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events. For calculation of attendance for these cases:

A student should have at least 65% attendance with relevant certificate as calculated as per (a) above. For Condonation the attendance is computed as:

Notional % of attendance =

$$\frac{\text{Actual no. of classes attended x 100}}{\text{(Total no. of classes held in the semester) - (No. of classes held during the days of on duty)}}$$

which should be ≥ 75% for condonation.

All such applications should be recommended by the concerned HOD and forwarded to Dean (Academic) within seven instructional days after the programme / activity.

15.0 Assessment Procedure – Tests and Examinations

15.1 The Academic Council will decide from time to time on the system of tests and examinations in each subject in each semester.

15.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test / Exam
First Periodical Test	10%	2 Periods
Second Periodical Test	10%	2 Periods
Model Test	20%	3 hours
Seminar/ Assignments/Quiz	10%	-
End – semester examination	50%	3 Hours

No retest will be conducted for sessional examinations.

15.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records and viva – weightage 60%.
(ii) End semester examination of 3 hours duration including viva– weightage 40%.

15.4 For courses on Physical Education, NSS, etc. the assessment will be as satisfactory/not satisfactory only.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End-semester Examination	50%

For end – semester examination, the student will submit a Project Report in a format specified by the Dean (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end – semester examination will be based on the report and a viva-voce examination on the project conducted by a Committee constituted by the Registrar / Controller of examination. This will include an external expert.

16.2 The project reports of B.Tech students who have not completed their course work will be evaluated in that semester itself and the result sent, in confidential, to the Controller of examination. The result of the project work evaluation will be declared by Controller of examination only after the successful completion of the course requirements.

17. Declaration of results

17.1 (i) A candidate who secures not less than 45% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

(ii) To be Eligible to appear for the end semester examinations for a particular course, a candidate will have to secure a minimum of 40% marks in the sessional for that course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of UG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes

of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, and wishes to improve on his/her sessional marks, he/she will have to register for the particular course and attend the course as per **9.0**with permission of the HOD concerned and Dean (Academic) with a copy marked to the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 After ten semesters, the sessional marks of the candidate will not be considered for a pass in a course. A candidate who secures minimum required marks for passing will be given only up to C grade irrespective of marks obtained and declared pass in the course.

18.0 Course Repetition

18.1 A student who earns U or RA grade in a core course has to repeat it compulsorily when the course is offered next as specified in **9.0**.

A student securing a U or RA grade in an elective course may repeat it if he/she so desires to get a successful grade.

A course successfully completed cannot be repeated.

19.0 Grade Card

19.1 Letter grade

Based on the performance, each student is awarded a final letter grade at the end of the semester, in each subject. The letter grades and the corresponding grade points are as **6.1**.

19.2 A student is considered to have completed a subject successfully and earned credits if he/she secures a letter grade other than U or RA in that subject. A letter grade **U or RA** in any subject implies a failure in that subject.

19.3 After results are declared, grade sheet will be issued to each student which will contain the following details:

(i) Program and branch for which the student has enrolled.
(ii) Semester of registration.
(iii) The course number, name of the course, category of course and the credits for each course registered in that semester
(iv) The letter grade obtained in each course

(v) Semester Grade Point Average (GPA)
(vi) The total number of credits earned by the student up to the end of that semester in each of the course categories.
(vii) The Cumulative Grade Point Average (CGPA) of all the courses taken from the first semester.

20. Class/Division

20.1 Classification is based on CGPA and is as follows:

CGPA ≥ 8.0 : **First Class with distinction**

6.5 ≤ CGPA < 8.0: **First Class**

5.0 ≤ CGPA < 6.5: **Second Class.**

20.2(i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses **within 10 semesters.**

(iii) The period of authorized discontinuation of the programme (vide clause 12.0) will not be counted for the purpose of the above classification.

Transfer of credits

21.1. Within the broad framework of these regulations, the Academic Council, basedon the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21.2 The Academic Council may also approve admission of lateral entry (who hold a diploma in Engineering/ technology) candidates with advance credit based on the recommendation of the transfer of credits committee on a case to case basis.

22.0 Eligibility for Award of the B.Tech Degree

22.1 A student shall be declared to be eligible for award of the B.Tech degree if he/she has

(i) registered and successfully completed all the core courses and projects;
(ii) successfully acquired the minimum 180 credits within the stipulated time;
(iii) earned the specified credits in all the categories of subjectsas specified in the curriculum corresponding to the branch of his/ her study ;
(iv) no dues to the Institute, Hostels, Libraries etc.; and
(v) no disciplinary action is pending against him / her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

23.0 Change of Branch

23.1 If the number of students in any branch of B.Tech. class as on the last instructional day of the First Semester is less than the sanctioned strength, then the vacancies in the said branches can be filled by transferring students from other branches. All such transfers will be allowed on the basis of merit of the students. The decision of the Chancellor shall be final while considering such requests.

23.2 All students who have successfully completed the first semester of the course will be eligible for consideration for change of branch subject to the availability of vacancies.

24.0 Power to modify

Notwithstanding all that has been stated above, the Academic Council shall modify any of the above regulations from time to time subject to approval by the Board of Management.

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SEMESTER I

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	ELA101	CF	Technical English	3	0	0	3	3
2	MAA101	CF(BS)	Engineering Mathematics– I	3	1	0	4	4
3	PHA101/ CYA101	CF(BS)	Engineering Physics / Engineering Chemistry	3	0	0	3	3
4	MEA101	CF(ES)	Computer Aided Engineering Drawing	1	1	3	3	5
5	CSA101	CF(ES)	Computer Programming	3	0	0	3	3
Practical								
6	PHA131/ CYA131	CF(BS)	Physics lab/Chemistry Lab*	0	0	3	1	3
7	CSA131	CF(ES)	Computer Programming Lab	0	0	3	1	3
8	ELA131	CF	Communication Skills Lab-I	0	0	2	1	2
9	GEA131	CF(ES)	Engineering Practices Lab-I	0	0	3	1	3
Total							**20**	**29**

SEMESTER II

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA102	CF (BS)	Engineering Mathematics – II	3	1	0	4	4
2	PHA101/ CYA101	CF(BS)	Engineering Chemistry / Engineering Physics*	3	0	0	3	3
3	MEA102	CF(ES)	Engineering Mechanics	3	1	0	4	4
4	EEB 122	CC (PC)	Basics of Electrical and Electronics Engineering	3	1	0	4	4
5	MEB101	CC(PC)	Manufacturing Technology- I	3	0	0	3	3
6	ELA102	CF(English)	Personality Development and Soft Skills	2	0	0	1	2
Practical								
7	PHA131/ CYA131	CF(BS)	Physics lab/Chemistry Lab*	0	0	3	1	3
8	GEA132	CF(ES)	Engineering Practices Lab-II	0	0	3	1	3
9	EEB145	CC (PC)	Basic Electrical and Electronics Lab	0	0	3	1	3
Total							**22**	**29**

SEMESTER III

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA201	CF (BS)	Engineering Mathematics – III	3	1	0	4	4
2	MHB201	CC (PC)	Digital and Power Electronics	3	1	0	4	4
3	MHB202	CC (PC)	Electrical Machines and Drives	3	1	0	4	4
4	MHB203	CC (PC)	Kinematics of Machinery	3	1	0	4	4
5	MEB206	CC (PC)	Strength of Materials	3	1	0	4	4
6		EE	Engineering Elective I	3	0	0	3	3
Practical								
6	MHB231	CC (PC)	Electrical Machines and Drives Lab	0	0	3	1	3
7	MHB232	CC (PC)	Digital and Power Electronics Lab	0	0	3	1	3
8	MHB233	CC (PC)	Computer Aided Design Lab	0	0	3	1	3
9	SSA231	CF(ES)	Aptitude I[$]	1	0	1	1	2
Total							**27**	**34**

SEMESTER IV

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA204	CF (BS)	Probability and Statistics	3	1	0	4	4
2	MEB203	CC (PC)	Manufacturing Technology-II	3	0	0	3	4
3	MHB204	CC (PC)	Microprocessor and Microcontroller	3	0	0	3	4
4	MHB205	CC (PC)	Fundamentals of Control Systems	3	0	0	3	4
5		EE	Engineering Elective-II	3	0	0	3	3
6		OE	Open Elective-I	3	0	0	3	3
Practical								
6	MHB234	CC (PC)	Manufacturing Process Lab	0	0	3	1	3
7	MHB235	CC (PC)	Microprocessor and Microcontroller Lab	0	0	3	1	3
8	MHB237	CC (PC)	Fluid Mechanics and Machinery Lab	2	0	2	3	4
9	MHB236	CC (PC)	Design Project-I*	0	0	0	2	-
10	SSA232	CF(ES)	Aptitude II[$]	1	0	1	1	2
Total							**27**	**34**

Note: * The Design Project by students which does not require contact hours.

SEMESTER V

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MHB301	CC (PC)	Machine Dynamics	3	1	0	4	4
2	MHB302	CC (PC)	Metrology and Measurements	3	0	0	3	3
3	MHB303	CC (PC)	Hydraulics and Pneumatics	3	1	0	4	4
4		CC (PE)	Professional Elective-I	3	0	0	3	3
5		EE	Engineering Elective-III	3	0	0	3	3
6		OE	Open Elective-II	3	0	0	3	3
Practical								
6	MHB331	CC (PC)	Kinematics and Dynamics Lab	0	0	3	1	3
7	MHB332	CC (PC)	Metrology and Measurements	0	0	3	1	3
8	MHB333	CC (PC)	Hydraulics and Pneumatics Lab	0	0	3	1	3
9	MHB334	CC	Condition Monitoring and Non Destructive Testing Lab	2	0	2	3	4
10	SSA331	CF(ES)	Pre-placement Program	1	0	1	1	2
Total							**27**	**35**

Note: * The Design Project by students which does not require contact hours.

SEMESTER VI

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MHB304	CC (PC)	Sensors and PLC	3	0	0	3	3
2	MHB305	CC (PC)	Virtual Instrumentation	3	1	0	4	4
3	MHB306	CC (PC)	CNC Technology	3	0	0	3	3
4		CC (PE)	Professional Elective-II	3	0	0	3	3
5		EE	Engineering Elective-IV	3	0	0	3	3
6		OE	Open Elective-III	3	0	0	3	3
Practical								
6	MHB335	CC (PC)	PLC and Motion Control Lab	0	0	3	1	3
7	MHB336	CC (PC)	Virtual Instrumentation Lab	0	0	3	1	3
8	MHB337	CC (PC)	CNC Lab	0	0	3	1	3
9	MHB338	CC	Design Project-II	0	0	6	2	6
Total							**24**	**32**

Note: * The Design Project by students which does not require contact hours.

SEMESTER VII

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	MHB401	CC (PC)	Design of Mechatronics System	3	0	0	3	3
2	MHB402	CC (PC)	Robotics and Machine Vision System	3	0	0	3	3
3	MHB403	CC (PC)	Artificial Intelligence for Mechatronics Systems	3	0	0	3	3
4		CC (PE)	Professional Elective-III	3	0	0	3	3
5		EE	Engineering Elective-V	3	0	0	3	3
6		OE	Open Elective-IV	3	0	0	3	3
Practical								
6	MHB431	CC (PC)	Robotics and Machine Vision System Lab	0	0	3	1	3
7	MHB432	CC (PC)	Building Automation System Lab	2	0	2	3	4
8	ATB435	CC (PC)	Autotronics Lab	2	0	2	3	4
9	MHB433	CC (PC)	Comprehension &Viva-voce II	0	0	0	2	0
Total							**27**	**29**

Note: * The Design Project by students which does not require contact hours.

SEMESTER VIII

S. No.	Course Code	Course Classification	Course Title	L	T	P	C	TCH
Theory								
1	CYA102	CC (PC)	Environmental Science And Engineering	3	0	0	3	3
2		CC (PE)	Professional Elective-V	3	0	0	3	3
Practical								
1	MHB441	CC (PC)	Project & Viva-voce	0	0	24	6	24
Total							**12**	**30**

Professional Elective Courses – PE

Sl. No	Course	Course Title	L	T	P	C	TCH
Semester V							
1.	MHC351	Process Automation	3	0	0	3	**3**
2.	MEC352	Non-destructive Testing Methods	3	0	0	3	**3**
3.	MHC352	Electronic Devices and Circuits	3	0	0	3	**3**
4.	MHC353	Applied Thermodynamics	3	0	0	3	**3**
Semester VI							
1.	MHC355	Material Science	3	0	0	3	**3**
2.	MHC356	Embedded System	3	0	0	3	**3**
3.	MHC357	Design of Mechanical Elements	3	0	0	3	**3**
4.	MHC358	Computer Integrated Manufacturing	3	0	0	3	**3**
5.	MHC359	Digital Image Processing	3	0	0	3	**3**
Semester VII							
1.	MHC451	Medical Mechatronics	3	0	0	3	**3**
2.	MEC456	Maintenance Engineering	3	0	0	3	3
3.	MEC351	Composite Materials and Structures	3	0	0	3	**3**
Semester VIII							
1.	MHC454	Rapid Prototyping	3	0	0	3	**3**
2.	MEC358	Un-conventional Machining Processes	3	0	0	3	**3**
3.	MHC453	Product Design and Costing	3	0	0	3	**3**
4.	MHC455	Finite Element Method	3	0	0	3	**3**

Engineering Elective Courses

Semester –III (Engineering Elective-I)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of Aeronautical Engineering							
1	AED251	Aircraft Design	3	0	0	3	**3**
2	AED252	Elements of Avionics	3	0	0	3	**3**
Department of Automobile Engineering							
3	ATD251	Renewable sources of Energy	3	0	0	3	**3**
4	ATD252	Concept of Engineering Design	3	0	0	3	**3**
Department of Chemical Engineering							
5	CHD251	Petrochemical Engineering	3	0	0	3	3
Department of Civil Engineering							
6	CED251	Green & Smart Buildings	3	0	0	3	**3**
Department of Computer Science & Engineering							
7	CSD251	Object Oriented Programming	3	0	0	3	**3**
8	CSD252	Java programming	3	0	0	3	**3**
9	CSD253	Web Development	3	0	0	3	**3**
Department of Electronics & Communication Engineering							
10	ECD251	Communication Engineering	3	0	0	3	**3**
11	ECD252	Linear Circuits	3	0	0	3	**3**
Department of Electrical & Electronics Engineering							
12	EED251	Electrical Drives And Control	3	0	0	3	**3**
Department of Electronics & Instrumentation Engineering							
13	EID251	Measurements and Instrumentation	3	0	0	3	3
14	EID252	Digital Principles and System Design	3	0	0	3	3
15	EID253	Instrumentation for Environmental Analysis	3	0	0	3	3

Semester –IV (Engineering Elective-II)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of Aeronautical Engineering							
16	AED253	Aero Engine Maintenance and Repair	3	0	0	3	**3**
17	AED254	Aircraft Maintenance Practices	3	0	0	3	**3**
18	AED255	Introduction to NDT	3	0	0	3	**3**
Department of Automobile Engineering							
19	ATD253	Special Type of Vehicles	3	0	0	3	**3**
20	ATD254	Automobile Air Conditioning	3	0	0	3	**3**
Department of Chemical Engineering							
21	CHD252	Genetic Engineering	3	0	0	3	**3**
Department of Civil Engineering							
22	CED252	Solid Waste Management	3	0	0	3	**3**
Department of Computer Science & Engineering							
23	CSD254	Python Programming	3	0	0	3	**3**
24	CSD255	C with Assembly language programming	3	0	0	3	**3**
25	CSD256	Mobile Application Development	3	0	0	3	**3**
Department of Electronics & Communication Engineering							
26	ECD253	Basics of Digital Signal Processing Techniques	3	0	0	3	**3**
27	ECD254	Data Communication and Network System	3	0	0	3	**3**
Department of Electrical & Electronics Engineering							
28	EED 252	Electronics And Microprocessors	3	0	0	3	**3**
Department of Electronics & Instrumentation Engineering							
29	EID254	Automotive Instrumentation and Embedded Systems	3	0	0	3	3
30	EID255	Aircraft Systems and Instrumentation	3	0	0	3	3
31	EID256	Microprocessor and Applications	3	0	0	3	3
Department of Mechanical Engineering – Mechatronics							
32	MHD25 1	Mobile Robots	3	0	0	3	3

Semester –V (Engineering Elective-III)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of Aeronautical Engineering							
32	AED351	Air Transportation & Aircraft Maintenance	3	0	0	3	**3**
33	AED352	Experimental Stress Analysis	3	0	0	3	**3**
34	AED353	Computer Integrated Manufacturing	3	0	0	3	**3**
Department of Automobile Engineering							
35	ATD351	Fuel Cells and Applications	3	0	0	3	**3**
36	ATD352	Automotive Safety	3	0	0	3	**3**
37	ATD353	ECU development in Automobile systems	3	0	0	3	**3**
Department of Chemical Engineering							
38	CHD351	Neural Networks and Artificial Intelligence	3	0	0	3	**3**
39	CHD352	Polymer and Elastomer Technology	3	0	0	3	**3**
Department of Civil Engineering							
40	CED351	Intelligent Transportation System	3	0	0	3	**3**
Department of Computer Science & Engineering							
41	CSD351	Software Project Management	3	0	0	3	**3**
42	CSD352	Digital Image Processing	3	0	0	3	**3**
43	CSD353	System Modelling and Simulation	3	0	0	3	**3**
Department of Electronics & Communication Engineering							
44	ECD351	Mobile Communication Engineering	3	0	0	3	**3**
45	ECD352	Radar and Optical Communication	3	0	0	3	**3**
Department of Electrical & Electronics Engineering							
46	EED351	Control Engineering	3	0	0	3	**3**
Department of Electronics & Instrumentation Engineering							
47	EID351	Instrumentation and Process Control	3	0	0	3	3
48	EID352	Bio-medical Instrumentation	3	0	0	3	3
49	EID353	Instrumentation in Automotive Industries	3	0	0	3	3
Department of Mechanical Engineering – Mechatronics							
50	MHD351	Industrial Robotics	3	0	0	3	3
51	MHD352	Machine Vision	3	0	0	3	3

Semester –VI (Engineering Elective-IV)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of Aeronautical Engineering							
50	AED354	Airframe Maintenance & Repair Practices	3	0	0	3	**3**
51	AED355	Fundamentals of space vehicle design	3	0	0	3	**3**
52	AED356	Aeroelasticity	3	0	0	3	**3**
Department of Automobile Engineering							
53	ATD354	Composite materials in Automotive Application	3	0	0	3	**3**
54	ATD355	Transport management	3	0	0	3	**3**
55	ATD356	Automobile Engineering	3	0	0	3	**3**
Department of Chemical Engineering							
56	CHD353	Transport Processes	3	0	0	3	**3**
Department of Civil Engineering							
57	CED352	Remote Sensing Techniques and GIS	3	0	0	3	**3**
Department of Computer Science & Engineering							
58	CSD354	Wireless Sensor Networks	3	0	0	3	**3**
59	CSD355	Cyber security & Cyber Laws	3	0	0	3	**3**
60	CSD356	Big Data Analytics	3	0	0	3	**3**
Department of Electronics & Communication Engineering							
61	ECD353	Image Processing and Pattern Recognition	3	0	0	3	**3**
62	ECD354	Digital Design and Implementation using HDL & VHDL	3	0	0	3	**3**
63	ECD355	Basics of Satellite Communication	3	0	0	3	**3**
Department of Electrical & Electronics Engineering							
64	EED352	Energy Audit And Energy Regulation	3	0	0	3	**3**
Department of Electronics & Instrumentation Engineering							
65	EID354	Fiber Optics and Laser Instrumentation	3	0	0	3	3
66	E D355	Power plant Instrumentation	3	0	0	3	3
67	EID356	Microcontrollers and PLC	3	0	0	3	3
Department of Mechanical Engineering – Mechatronics							
68	MHD353	Underwater Robotics	3	0	0	3	3
69	MHD354	Applied Pneumatics for Industrial Automation	3	0	0	3	3

Semester –VII (Engineering Elective-V)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of Aeronautical Engineering							
68	AED451	Wind Tunnel Techniques	3	0	0	3	**3**
69	AED452	Vibration and Aero Elasticity	3	0	0	3	**3**
70	AED453	Fatigue and Fracture Mechanics	3	0	0	3	**3**
Department of Automobile Engineering							
71	ATD451	Vibration and Noise control	3	0	0	3	**3**
72	ATD452	Automotive Aerodynamics	3	0	0	3	**3**
73	ATD453	Autotronics	3	0	0	3	**3**
Department of Chemical Engineering							
74	CHD451	Industrial Catalysis	3	0	0	3	**3**
Department of Computer Science & Engineering							
75	CSD451	Cyber Forensics	3	0	0	3	**3**
76	CSD452	Ethical Hacking	3	0	0	3	**3**
77	CSD453	IT infrastructure Management	3	0	0	3	**3**
Department of Electronics & Communication Engineering							
78	ECD451	Fundamentals of Wireless Sensor Networks	3	0	0	3	**3**
79	ECD452	Telecommunication Switching Techniques	3	0	0	3	**3**
80	ECD453	Fundamentals of SDR	3	0	0	3	**3**
Department of Electrical & Electronics Engineering							
81	EED451	Building Energy Management And Control Systems	3	0	0	3	**3**
Department of Electronics & Instrumentation Engineering							
82	EID451	Internet of Things-Embedded Control	3	0	0	3	3
83	EID452	Virtual Instrumentation	3	0	0	3	3
84	EID453	Automotive Sensors and Applications	3	0	0	3	3
Department of Mechanical Engineering – Mechatronics							
85	MHD451	Building Automation	3	0	0	3	3

Open Electives

a) Semester IV (Open Elective-I)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of English							
1	ELF251	Introduction to Media Studies	3	0	0	3	3
2	ELF252	Introduction to Film Studies	3	0	0	3	3
Department of Chemistry							
3	CYF251	Applied Chemistry I	3	0	0	3	3
4	CYF252	Environment Science & Engineering	3	0	0	3	3
Department of Foreign Language							
5	FLF251	French	3	0	0	3	3
6	FLF252	German	3	0	0	3	3
7	FLF253	Japanese	3	0	0	3	3
School of Management							
8	MGF251	Organizational Behaviour	3	0	0	3	3
9	MGF252	Business Communication	3	0	0	3	3

b) Semester – V(Open Elective-II)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of English							
1	ELF351	Writing for Media: Theory & Practice	3	0	0	3	3
2	EL F 352	Introduction to Linguistics	3	0	0	3	3
Department of Chemistry							
3	CYF351	Applied Chemistry II	3	0	0	3	3
4	CYF352	Analytical Chemistry I	3	0	0	3	3
School of Management							
5	MGF351	Research methods in Business	3	0	0	3	3
6	MGF352	Entrepreneurship Development	3	0	0	3	3
7	MGF353	Principles of Management	3	0	0	3	3

c) Semester VI (Open Elective-III)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of English							
1	ENF353	Introduction to Translation Studies	3	0	0	3	3
2	ENF354	Indian Literatures in Translation	3	0	0	3	3
Department of Chemistry							
3	CYF252	Environment Science & Engineering	3	0	0	3	3
Department of Foreign Language							
4	FLF251	French	3	0	0	3	3
5	FLF252	German	3	0	0	3	3
6	FLF253	Japanese	3	0	0	3	3
School of Management							
7	MGF354	Business Plan and Ethics	3	0	0	3	3
8	MGF355	Business Economics	3	0	0	3	3
9	MGF356	Professional Ethics	3	0	0	3	3

d) Semester VII (Open Elective-IV)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
Department of English							
1	ELF451	Advanced Academic Writing	3	0	0	3	3
School of Management							
2	MGF451	Total Quality Management	3	0	0	3	3
3	MGF452	Family Business Management	3	0	0	3	3
4	MGF453	Social Entrepreneurship	3	0	0	3	3

Semester wise Credit

Course Category		I	II	III	IV	V	VI	VII	VIII	Total	Grand Total
CF	English	4	3	-	-	-	-	-	-	**7**	**44**
	BS	8	8	4	4	-	-	-	-	**24**	
	ES	8	5	-	-	-	-	-	-	**13**	
CC	PC (Theory)	-	7	16	12	11	8	8	6	**68**	**109**
	PC (Practical)	-	1	3	6	4	6	6	-	**26**	
	PE	-	-	-	-	3	6	6	-	**15**	
EE		-	-	3	3	3	3	3	-	**15**	**15**
OE		-	-	-	3	3	3	3	-	**12**	**12**
Total		**20**	**24**	**26**	**24**	**24**	**26**	**26**	**6**	**180**	**180**

SYLLABUS

SEMESTER - I

ELA101 TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

GOAL

The goal of the programme is to provide a theoretical input towards nurturing accomplished learners who can function effectively in the English language skills; to cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning; to help them become responsible members or leaders of the society in and around their workplace or living space; to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.

OBJECTIVES

The course should enable the students to:

1. Widen the capacity of the learners to listen to English language at the basic level and understand its meaning.
2. Enable learners to communicate in an intelligible English accent and pronunciation.
3. Assist the learners in reading and grasping a passage in English.
4. Learn the art of writing simple English with correct spelling, grammar and punctuation.
5. Cultivate the ability of the learners to think and indulge in divergent and lateral thoughts.

OUTCOME

The students should be able to:

1. Have the self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language.
2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts.
4. Write instructions, recommendations, checklists, process-description, letter-writing and report writing.
5. Have the confidence to develop thinking skills and participate in brainstorming, mind-mapping, audiovisual activities, creative thinking and also answer tests in the job-selection processes.

UNIT I LISTENING SKILL **9**

Listening to the sounds, silent letters & stress in English words & sentences - Listening to conversation & telephonic conversation -- Listening for general meaning & specific information -- Listening for positive & negative comments - Listening to technical topics - Listening to prose & poetry reading - Listening exercises.

Embedded language learning: Sentence definition -- Spelling & punctuation -- Imperative form Sequencing of sentences -- Gerunds -- Infinitives -- 'Wh'-questions.

UNIT IISPEAKING SKILL **9**

Self-introduction - Expressing personal opinion - Dialogue - Conversation - Simple oral interaction - Speaking on a topic -- Expressing views for & against -- Speaking on personal topics like hobbies, topics of interest, present & past experiences, future plans - Participating in group discussions, role plays, debates, presentations, power-point presentations & job-interviews.

Embedded language learning: Adverbs -Adjectives - Comparative and Numerical adjectives -- Nouns & compound nouns -- Prefixes and suffixes.

UNIT III READING SKILL **9**

Reading anecdotes, short stories, poems, parts of a novel, notices, message, time tables, advertisements, leaflets, itinerary, content page - Reading pie chart & bar chart -- Skimming and scanning -- Reading for contextual meaning - Scanning for specific information -- Reading newspaper & magazine articles - Critical reading -- Reading-comprehension exercises.

Embedded language learning: Tenses - Active and passive voice -- Impersonal passive -- Words and their function -- Different grammatical forms of the same word.

UNIT IV WRITING SKILL **9**

Writing emails, notes, messages, memos, notices, agendas, advertisements, leaflets, brochures, instructions, recommendations & checklists -- Writing paragraphs -- Comparisons & contrasts Process description of Flow charts - Interpretation of Bar charts & Pie charts - Writing the minutes of a meeting -- Report writing -- Industrial accident reports -- Letter-writing -- Letter to the editors - Letter inviting & accepting or declining the invitation - Placing orders - Complaints -- Letter requesting permission for industrial visits or implant training, enclosing an introduction to the educational institution -- Letters of application for a job, enclosing a CV or Resume - Covering letter.

Embedded language learning: Correction of errors - Subject-verb Concord -- Articles - Prepositions - Direct and indirect speech.

UNIT V THINKING SKILL **9**

Eliciting & imparting the knowledge of English using thinking blocks - Developing thinking skills along with critical interpretation side by side with the acquisition of English -- Decoding diagrams & pictorial representations into English words, expressions, idioms and proverbs.

Embedded language learning: General vocabulary -- Using expressions of cause and effect - Comparison & contrast -- If-conditionals -- Expressions of purpose and means.

REFERENCES

1. Norman Whitby. Business Benchmark: Pre-Intermediate to Intermediate - BEC Preliminary. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).

2. Devaki Reddy &ShreeshChaudhary. Technical English. New Delhi: Macmillan, 2009.
3. Rutherford, Andrea J. Basic Communication Skills for Technology. 2nd edition. New Delhi: Pearson Education, 2006.

MAA101 ENGINEERING MATHEMATICS I

L	T	P	C
3	1	0	4

MAA 101	**ENGINEERING MATHEMATICS-I**	**4 CREDITS**
AIM	• The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subject and make use of MATLAB software to visualize the application of the concepts learnt.	
OBJECTIVES	**OUTCOME**	
• To find out algebraic Eigen value problems from practical areas and obtain the Eigen solutions in certain cases using MATLAB. • To diagonalize a matrix which would render the Eigen solution procedure very simple. • To understand effectively the basic concepts of differentiation and partial differentiation and their applications. • To understand effectively the methods of integration and their applications. • To solve differential equations of certain type, that they might encounter in the same or higher semesters. • To find the values and the expansions of trigonometric and hyperbolic functions using MATLAB	• Visualized the Cayley-Hamilton theorem, Diagonalization of Matrix, Taylor's series, Maxima and Minima of functions of two variables, integration- Area, volume, surface and Hyperbolic function using MATLAB. • Functions and their interesting properties in science and engineering using MATLAB is the outcome of this paper	

UNIT I MATRICES 12(8+4)

Characteristic equation – Eigen values and Eigen vectors – Properties - Cayley Hamilton theorem (Statement only) – Verification and inverse using Cayley Hamilton theorem- Diagonalization of matrices using similarity transformation.

Lab: Eigen values and Eigen vectors, Verification and inverse using Cayley Hamilton theorem- Diagonalisation

UNIT II DIFFERENTIAL CALCULUS 12(8+4)

Methods of differentiation of functions – Product and Quotient rules – Inverse trigonometric functions - Implicit function - parametric form. Partial differentiation – Total differentiation- Taylor's series – Maxima and minima of functions of two variables.

Lab: Taylor's series – Maxima and minima of functions of two variables

UNIT III INTEGRAL CALCULUS 12(8+4)

Integration – Methods of integration – Substitution method - Integration by parts – Integration using partial fraction - Bernoulli's formula. Applications of Integral Calculus: Area, Surface area and Volume.

Lab: Applications of Integral Calculus: Area, Surface area and Volume.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12(8+4)

Second order differential equations with constant coefficients – Particular integrals – e^{ax}, $Sinax, Cosax, x^m$, e ^{ax} Cos bx, e ^{ax} Sin bx. Solutions of homogeneous differential equations with variable coefficients - Variation of parameters.

Lab: Solution of Second order differential equations**.**

UNIT V TRIGONOMETRY 12(8+4)

Expansions of sin nθ, cos nθ, tan nθ where n is appositive integer. Expansions of $\sin^m\theta$, $\cos^n\theta$, $\sin^m\theta\cos^n\theta$ in terms of sines and cosines of multiples of θ where m and n are positive integers. Expansions of $\sin\theta$, $\cos\theta$, $\tan\theta$ .Hyperbolic functions - Relation between trigonometric and hyperbolic functions - Inverse hyperbolic function.

Lab: Expansions of sinθ, cosθ, tanθ and sin nθ, cos nθ, tan nθ and hyperbolic functions.

TOTAL: 60

TEXT BOOK:

1. Venkataraman M.K, Engineering Mathematics, Volume I & Volume II, The National Publishing Company, Chennai, 1985.
2. Dr.A. Singaravelu, Engineering Mathematics, Volume I, Meenakshi Agency, 2012

REFERENCES

1. Kandasamy P, Thilagavathy K and Gunavathy K, Engineering Mathematics, Volume I & II, S. Chand and Company, New Delhi, 2005.
2. Bali N.P, Narayana Iyengar. N.Ch., Engineering Mathematics,

Laxmi Publications Pvt. Ltd, New Delhi, 2003.
3. Veerarajan T, Engineering Mathematics (for first year), Fourth Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2005.
4. Erwin Kreyzig, A Text book of Engineering Mathematics, John Wiley, 1999.
5. Grewal B.S, Higher Engineering Mathematics, Thirty Eighth Editions, Khanna Publisher, Delhi, 2004.
6. Chandrasekaran A, A Text book of Engineering Mathematics I, Dhanam Publications, Chennai, 2010

PHA101 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

To impart fundamental knowledge in various fields of Physics and its applications.

OBJECTIVES

The course should enable the students to:

1. Develop strong fundamentals of properties and behaviour of the materials
2. Enhance theoretical and modern technological aspects in acoustics and ultrasonics.
3. Enable the students to correlate the theoretical principles with application oriented study of optics.
4. Provide a strong foundation in the understanding of solids and materials testing.
5. Enrich the knowledge of students in modern engineering materials.

OUTCOME

The students should be able to:

1. Understand the properties and behaviour of materials.
2. Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonics and be able to employ it as an engineering tool.
3. Understand the concept, working and application of lasers andfiber optics.
4. Know the fundamentals of crystal physics and non destructive testing methods.
5. Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.

UNIT I PROPERTIES OF MATTER 9

Elasticity - types of moduli of elasticity - Stress-Strain diagram - Young's modulus of elasticity Rigidity modulus - Bulk modulus - Factors affecting elasticity - twisting couple on a wire - Torsional pendulum - determination of rigidity modulus of a wire - depression of a cantilever - Young's modulus by cantilever - uniform and non-uniform bending - viscosity - Ostwald's viscometer - comparison of viscosities.

UNIT IIACOUSTICS AND ULTRASONICS 9

Classification of sound - characteristics of musical sound - intensity - loudness - Weber Fechner law - Decibel - Reverberation - Reverberation time, derivation of Sabine's formula for reverberation time(Jaeger's method) - absorption coefficient and its determination - factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies. Ultrasonics - production - Magnetostriction and Piezoelectric methods -

properties - applications of ultrasonics with particular reference to detection of flaws in metal (Non - Destructive testing NDT) - SONAR.

UNIT III LASER AND FIBRE OPTICS 9

Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics - Nd-Yag laser - CO2 laser Semiconductor laser - applications - optical fiber - principle and propagation of light in optical fibers Numerical aperture and acceptance angle - types of optical fibers - single and multimode, step index and graded index fibers - applications - fiber optic communication system.

UNIT IV CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING 9

Crystal Physics: Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - 'd' spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - coordination number Packing factor for SC, BCC, FCC and HCP structures.

Non Destructive Testing: Liquid penetrate method - Ultrasonic flaw detection - ultrasonic flaw detector (block diagram) - X-ray Radiography - Merits and Demerits of each method.

UNIT V MODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS 9

Modern Engineering Materials: Metallic glasses: Preparation properties and applications. Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis -Properties and applications.

Superconducting Materials: Superconducting phenomena - Properties of superconductors - Meissner effect - Type I and Type II superconductors - High Tc superconductors (qualitative) - uses of superconductors.

TOTAL : 45

TEXT BOOKS

1. Gaur R.K. and Gupta S.L., "Engineering Physics ", 8th edition, Dhanpatrai publications (P) Ltd., New Delhi 2010.
2. P.Mani, "Engineering Physics", Vol-I, Dhanam Publications, Chennai 2011.
3. Rajendran V. an Marikani A., "Applied Physics for engineers" , 3rd edition, Tata McGraw -Hill publishing company Ltd., New Delhi,2003.

REFERENCES

1. Uma Mukherji, Engineering Physics ,Narosa publishing house, New Delhi, 2003.
2. Arumugam M., Engineering Physics ,Anuradha agencies, 2007.
3. Palanisamy P.K., Engineering Physics, SciTech Publications, Chennai 2007.
4. Arthur Beiser, Concepts of Modern Physics, Tata McGraw -Hill Publications, 2007.
5. P.Charles, Poople and Frank J. Owens, Introduction to Nanotechnology, Wiley India,

CYA101 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

To impart basic principles of chemistry for engineers.

OBJECTIVES

The course should enable the students to

1. Make the students conversant with the basics of

   (a) Water technology And (b) Polymer science

2. Provide knowledge on the requirements and properties of a few important engineering materials.
3. Educate the students on the fundamentals of corrosion and its control.
4. Give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.
5. Create an awareness among the present generation about the various conventional energy sources.

OUTCOME

The students should be able to

1. Gain basic knowledge in water analysis and suitable water treatment method.
2. Get an idea on the type of polymers to be used in engineering applications.
3. Get awareness about new materials
4. Get knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.
5. Get exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.
6. Get a good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.

UNIT I WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

Hardness (Definition, Types, Units) - problems - Estimation of Hardness (EDTA Method) - Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment- Desalination - Reverse Osmosis.

Classification of Polymers - PVC, Bakelite - preparation, properties and applications - Effect of Polymer Structure on Properties - Compounding of Plastics- Polymer Blends and Polymer Alloys Definition, Examples

UNIT IIENGINEERING MATERIALS 9

Properties of Alloys - Heat Treatment of Steel - Polymer Composites - types and applications.Lubricants - Classification, properties and applications - Mechanism of Lubrication - MoS2 And Graphite - Adhesives - classification and properties - Epoxy resin (Preparation, properties and applications) - Refractories - Classification, Properties and General Manufacture - Abrasives Classification , Properties and Uses - Carbon nano tubes - preparation, properties and applications.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Conductometric Titration – HClvsNaOH and mixture of acids vsNaOH - Electrochemical Series and its applications - Nernst Equation - problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series - Corrosion (Definition, Examples, effects) - Mechanism of Dry Corrosion and Wet Corrosion - Differential aeration Corrosion , examples - Factors Influencing Corrosion - Metal and Environment - Corrosion Control - Design -Cathodic Protection methods - Protective Coatings - Galvanising - Anodising - Electroplating (Cu and Ni) and Electroless plating (Cu and Ni) Constituents of Paints and varnish.

UNIT IV CHEMICAL THERMODYNAMICS 9

Thermodynamic terminology- First Law of Thermodynamics-Internal energy- enthalpy - heat capacity work done in isothermal expansion of an ideal gas -problems - second law of thermodynamics entropy change - phase transformations and entropy change - problems - Work Function & Free Energy Function- Maxwell's Relations-Gibbs Helmholtz equation- van't Hoff Isotherm- van't Hoff Isochore - Problems.

UNIT V FUELS AND ENERGY SOURCES 9

Fuels - classification - Calorific Value - Dulong's Formula - Problems - Determination of Calorific Value by Bomb Calorimeter - Coal - Proximate Analysis - problems - Octane Number - Cetane Number - Diesel Index (Definitions only) - Bio Gas - Producer Gas -Water Gas - Preparation, Properties and Uses - Batteries - Primary Cells - Leclanche Cell -Secondary Cell - Nickel Cadmium Battery Fuel Cells - Hydrogen -Oxygen Fuel Cell - Solar Battery - Lead Acid Storage Cell - Nuclear Energy Light water nuclear power plant.

TOTAL : 45

TEXT BOOKS

1. S. S. Dara, Text Book of Engineering Chemistry, S. Chand & Company Ltd., New Delhi, 2003
2. Murthy, Agarwal& Naidu, Text Book of Engineering Chemistry, BSP, 2003.
3. S.Sumathi, Engineering Chemistry, Dhanam Publications, 2008.
4. S.Sumathi and P.S.Raghavan, Engineering Chemistry II, Dhanam Publications, 2008.

REFERENCES

1. B. K. Sharma, Engineering chemistry, Krishna Prakasam Media (P) Ltd., 2003
2. A 1. Vogel, A text book of Qualitative Inorganic Analysis, ELBS, London, 2004
3. A. Gowarikar, Text Book of Polymer Science, 2002
4. Kuriacose&Rajaram, Vols. 1 & 2, Chemistry in Engineering and Technology, 2004
5. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co. Jalandar, 2004.

MEA101 COMPUTER AIDED ENGINEERING DRAWING

L	T	P	C
1	1	3	3

GOAL

To develop graphical skills for communicating concepts, ideas and designs of engineering products and to give exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice.

OBJECTIVES

The course should enable the students to

1. Introduce drawing standards and use of drawing instruments.
2. Introduce first angle projection.
3. Practice of engineering hand sketching and introduce to computer aided drafting
4. Familiarize the students with different type of pictorial projections.
5. Introduction to Solid modeling
6. Introduce the process of design from sketching to parametric 3D CAD and 2D orthographic drawings to BIS

OUTCOME

The students should be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact

Note: Only first angle projection is to be followed

Unit I – BASICS OF ENGINEERING GRAPHICS AND PLANE CURVES 12

Importance of graphics Use of drawing instruments - BIS conventions and specifications - drawing sheet sizes, layout and folding - lettering - Dimensioning-Geometrical constructions - Scales. Introduction to plane curves like ellipse, parabola, cycloids and involutes

Drafting methods - introduction to Computer Aided Drafting – Computer Hardware – Workstation – Printer and Plotter – Introduction to software for Computer Aided Design and Drafting – Exposure to Solid Modeling software – Geometrical Construction-Coordinate Systems/Basic Entities

Unit II – VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING15

Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Pictorial Projection methods - Layout of views- Free hand sketching of multiple views from pictorial views of objects.Drafting of simple Geometric Objects/Editing

General principles of presentation of technical drawings as per BIS - Introduction to Orthographic projections - Naming views as per BIS - First angle projection method. Conversion to orthographic views from given pictorial views of objects, including dimensioning – Drafting of Orthographic views from Pictorial views.

Unit III – PROJECTIONS OF POINTS, LINES, SURFACES AND SOLIDS 18

Introduction to Projections of points – Projections of straight lines located in first quadrant using rotating line method only – Projections of plane surfaces when the surface of the lamina is inclined to one reference plane only – Projections of simple solids when the axis of the solid is inclined to one reference plane only – Sectioning of above solids in simple positions – Section Views. Practice includes drafting the projection of lines and solids using appropriate software. 2D drawing commands: Zoom, Picture editing commands, Dimensioning and 2D drafting.

Unit IV GEOMETRICAL MODELING AND ISOMETRIC VIEWS 15

Solid Modeling – Types of modeling - Wire frame model, Surface Model and Solid Model – Introduction to graphic software for solid modeling. Principles of isometric projection and solid modeling. Isometric drawing – IsoPlanes and 3D Modelingcommands.Projections of Principal Views from 3-D Models

Unit V COMPUTER AIDED DESIGN AND DRAFTING 15

Preparation of solids of machine components like slide block, solid bearing block, bushed bearing, gland, wall bracket, guide bracket, shaft bracket, jig plate, shaft support (open type), vertical shaft support etc using appropriate modeling software.

Introduction to computer aided drafting and dimensioning using appropriate software. Generate 2D drawing from the 3D models – generate and develop the lateral surfaces of the objects. Presentation Techniques of Engineering Drawings – Title Blocks – Printing/Plotting of drawing.

TOTAL PERIODS: 75

TEXT BOOKS

1. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd.,New Delhi, 2010.

2. Warren J. Luzadder and Jon.M.Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., Eleventh Edition, 2003.

REFERENCE BOOKS:

1. Introduction to AutoCAD – 2D and 3D Design, A.Yarmwood, Newnes Elsevier, 2011

2. Engineering Drawing and Graphic Technology-International Edition, Thomas E. French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, 1993

3. Engineering Drawing and Design-Sixth Edition, C. Jensen, J.D. Helsel, D.R. Short, McGraw-Hill, 2002

4. Technical Drawing-Fourteenth Edition, F. E. Giesecke, A. Mitchell, H. C. Spencer, I.L. Hill, J.T. Dygdon, J.E., Novak, Prentice-Hall, 2012,
5. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2007.
6. Mechanical Engineering Drawing-Self Taught, Jashua Rose, http://www.gutenberg.org/files/23319/23319-h/23319-h.htm

Bureau of Indian Standards (BIS) for Engineering Drawing:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

CSA101 COMPUTER PROGRAMMING

L	T	P	C
3	0	0	3

GOAL

To introduce computers and programming and to produce an awareness of the power of computational techniques that are currently used by engineers and scientists and to develop programming skills to a level such that problems of reasonable complexity can be tackled successfully.

OBJECTIVES

The course should enable the students to:

1. Learn the major components of a Computer system.
2. Learn the problem solving techniques.
3. Develop skills in programming using C language.

OUTCOMES

The student should be able to:

1. Understand the interaction between different components of Computer system and number system.
2. Devise computational strategies for developing applications.
3. Develop applications (Simple to Complex) using C programming language.

UNIT I COMPUTER FUNDAMENTALS 9

Introduction - Evolution of Computers - Generations of Computer - Classification of Computers Application of Computers - Components of a Computer System - Hardware - Software - Starting a Computer (Booting) - Number Systems.

UNIT II COMPUTER PROGRMMING AND LANGUAGES 9

Introduction - Problem-Solving Techniques: Algorithms, Flowchart, Pseudocode - Program Control Structures - Programming Paradigms - Programming languages - Generations of Programming Languages - Language Translators - Features of a Good ProgrammingLanguages.

UNIT III PROGRAMMING WITH C 9

Introduction to C - The C Declaration - Operators and Expressions - Input and Output in C - Decision Statements - Loop Control Statements.

UNIT IV FUNCTIONS, ARRAYS AND STRINGS 9

Functions - Storage Class - Arrays - Working with strings and standard functions.

UNIT V POINTERS, STRUCTURES AND UNION 9

Pointers - Dynamic Memory allocation - Structure and Union - Files.

TOTAL : 45

TEXT BOOK

1. ITL Education Solution Limited, Ashok Kamthane, "Computer Programming", Pearson Education Inc 2007 (Unit: I to V).

REFERNCES

1. Byron S. Gottfried, "Programming with C", Second Edition, Tata McGraw Hill 2006.
2. YashvantKanetkar, "Let us C", Eighth edition, BPP publication 2007.
3. Stephen G.Kochan, "Programming in C - A Complete introduction to the C programming language" , Pearson Education, 2008.
4. T.JeyaPoovan, "Computer Programming Theory and Practice", Vikas Pub, New Delhi

PHA131 PHYSICS LABORATORY
(COMMON TO ALL BRANCHES)

L	T	P	C
0	0	3	1

S.No.	List of Experiments
1	Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2	Non Uniform Bending - Determination of Young's Modulus.
3	Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4	Lee's Disc - Determination of thermal conductivity of a bad conductor.
5	Air Wedge - Determination of thickness of a thin wire.
6	Spectrometer - Refractive index of a prism.
7	Semiconductor laser - Determination of wavelength of Laser using Grating.

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 30 STUDENTS

1	Torsional Pendulum	(500 gm, wt, 60 cm wire Al-Ni Alloy)	5 nos.
2	Travelling Microscope	(X10)	15 nos.
3	Capillary tube	(length 10cm, dia 0.05mm)	5 nos.
4	Magnifying lens	(X 10)	15 nos.
5	Lee's disc apparatus	(std form)	5 nos.
6	Stop watch	(+/- 1 s)	5 nos.
7	Meter scale	1m length	5 nos.
8	Spectrometer	(main scale 360 deg, ver 30")	5 nos.
9	Grating	(2500 LPI)	5 nos.
10	Laser	(632.8 nm)	5 nos.
11	Semi-transparent glass plate	Al coating, 65 nm thickness, 50% visibility	5 nos.
12	Equilateral prism	(n = 1.54)	5 nos.
13	Thermometer	+/- 1 deg	8 nos.
14	Screw gauge	(+/- 0.001cm)	12 nos.
15	Vernier caliper	(+/- 0.01 cm)	8 nos.
16	Steam Boiler	1 L	5 nos.
17	Scale	50 cms	5 nos.
18	Cylindrical mass	100 gms	10 sets
19	Slotted wt	300 gms	5 sets
20	Heater	1.5 KW	5 nos.
21	Transformer sodium vapour lamp	1 KW	10 nos.

22	Sodium vapour lamp	700 W	5 nos
23	Burette	50 mL	5 nos
24	Beaker	250 mL	5 nos
25	Spirit level		10 nos

REFERENCE : P.Mani, Engineering Physics Practicals, Dhanam Publications, Chennai, 2005.

CYA131 CHEMISTRY LABORATORY

L	T	P	C
0	0	3	1

S.No.	List of Experiments (Any five)
1	Estimation of Commercial soda by acid-base titration
2	Determination of Percentage of nickel in an alloy
3	Determination of Temporary, permanent and total hardness of water by EDTA method
4	Determination of Chloride content in a water sample
5	Potentiometric Estimation of iron
6	Conductometric Titration of a strong acid with a strong base
7	Conductometric Titration of mixture of acids.
8	Determination of Degree of polymerization of a polymer by Viscometry

List of Glassware and Equipments required for a batch of 30 students

S.No.	Items	Quanty
1	Burett (50 mL)	30 Nos.
2	Pipette(20 mL)	30 Nos.
3	Conical Flask(250 mL)	30 Nos.
4	Distilled water bottle(1 L)	30 Nos
5	Standard flask (100 mL)	30 Nos
6	Funnel (small)	30 Nos
7	Glass rod20 cm length	30 Nos
8	Reagent Bottle (250 mL)	30 Nos
9	Reagent Bottle (60 mL)	30 Nos
10	Beaker (100 mL)	30 Nos
11	Oswald Viscometer (Glass)	30 Nos
12	Measuring Cylinder(25 mL)	30 Nos
13	Digital Conductivity MeterPICO make	8 Nos.
14	Conductivity cell(K=1)	12 Nos.
15	Digital PotentiometerPICO make	8 Nos.
16	Calomel ElectrodeGlass	12 Nos.
17	Platinum Electrode – Polypropylene	12 Nos.
18	Burette Stands – Wooden	30 Nos.
19	Pipette stands – Wooden	30 Nos.

20	Retard stands – Metal	30 Nos.
21	Porcelain Tiles – Metal	30 Nos.
22	Clamps with Boss heads – Metal	30 Nos.

REFERENCES

1. J.Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantative Chemical Analysis, 6th Edition, Pearson Education, 2004.
2. C. W. Garland, J. W. Nibler, D. P. Shoemaker, ;"Experiments in Physical Chemistry, 8th ed.," McGraw-Hill, New York, 2009.
3. S. Sumathi, Engineering Chemistry Practicals, Dhanam Publications, 2011.

CSA131 COMPUTER PROGRAMMING LABORATORY
(Common to all branches)

L	T	P	C
0	0	3	1

GOAL

To provide an awareness to develop the programming skills using computer languages.

OBJECTIVES

The course should enable the students to:

1. To gain knowledge about Microsoft office, Spread Sheet.
2. To learn a programming concept in C.

OUTCOME

The students should be able to

1. Use MS Word to create document, table, text formatting and Mail merge options.
2. Use Excel for small calculations using formula editor, creating different types of charts and including pictures etc,
3. Write and execute the C programs for small applications.

LIST OF EXPERIMENTS

a) Word Processing **12**

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing- flow Chart

b) Spread Sheet **9**

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document

8. **c) Programming in C** **24**

8. To write a C program to prepare the electricity bill.
9. **Functions**

   (a) Call by value (b) Call by reference.

10. To write a C program to print the Fibonacci series for the given number.
11. To write a C program to find the factorial of number using recursion.
12. To write a C program to implement the basic arithmetic operations using Switch Case statement.
13. To write a C program to check whether the given number is an Armstrong number.
14. To write a C program to check whether the given string is a Palindrome.

15. To write a C program to create students details using Structures.
16. To write a C program to demonstrate the Command Line Arguments.
17. To write a C program to implement the Random Access in Files.
18. To write C programs to solve some of the Engineering applications

TOTAL : 45

HARDWARE/SOFTWARE REQUIRED FOR BATCH OF 30 STUDENTS

HARDWARE

LAN system with 33 nodes (OR) Standalone PCs - 33 Nos

Printers - 3 Nos

SOFTWARE

OS - Windows / UNIX

Application package - MS office

Software - C language

ELA131 COMMUNICATION SKILLS LABORATORY 1

L	T	P	C
0	0	2	1

GOAL

The goal of the programme is to provide a practical input towards nurturing accomplished learners who can function effectively in the English language skills.

OBJECTIVES

The course should enable the students to

1. Extend the ability of the learners to be able to listen to English and comprehend its message.
2. Enable the learners to have a functional knowledge of spoken English.
3. Assist the learners to read and grasp the meaning of technical and non-technical passages in English.
4. Help the learners develop the art of writing without mistakes.
5. Expand the thinking capability of the learners so that they would learn how to view things from a different angle.

OUTCOME

The students should be able to

1. Listen to and evaluate English without difficulty and comprehend its message.
2. Develop a functional knowledge of spoken English so as to use it in the institution and at job interviews.
3. Read and comprehend the meaning of technical and non-technical passages in English.
4. Develop the art of writing so as to put down their thoughts and feelings in words.
5. Think independently and contribute creative ideas.

UNIT I LISTENING SKILL

Listening to conversations and interviews of famous personalities in various fields -- Listening practice related to the TV-- Talk shows - News - Educative programmes -- Watching films for critical comments - Listening for specific information - Listening for summarizing information - Listening to monologues for taking notes - Listening to answer multiple-choice questions.

UNIT IISPEAKING SKILL

Self-introduction -- Group discussion - Persuading and negotiating strategies - Practice in dialogues - Presentations based on short stories / poems -- Speaking on personal thoughts and feelings - academic topics - News reading - Acting as a compere -- Speaking about case studies on problems and solutions - Extempore speeches.

UNIT III READING SKILL

Reading anecdotes to predict the content - Reading for interpretation -- Suggested reading -- Short stories and poems -- Critical reading - Reading for information transfer - Reading newspaper and magazine articles for critical commentary - Reading brochures, advertisements, pamphlets for improved presentation.

UNIT IV WRITING SKILL

At the beginning of the semester, the students will be informed of a mini dissertation of 1000 words they need to submit individually on any non-technical topic of their choice. The parts of the dissertation will be the assignments carried out during the semester and submitted towards the end of the semester on a date specified by the department. This can be judged as part of the internal assessment.

UNIT V THINKING SKILL

Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms and proverbs - Inculcating interest in English using thinking blocks. Making pictures and improvising diagrams to form English words, phrases and proverbs -- Picture reading

REFERENCES

1. Raman, Meenakshi, and Sangeetha Sharma. Technical Communication: English Skills for Engineers. 2nd edition. New Delhi: Oxford University Press, 2010.
2. Riordian, Daniel. Technical Communication. New Delhi. Cengage Learning, 2009

Websites for learning English

1. British: Learn English - British Council (Listen & Watch) - <http://learnenglish. british council. org/>
2. American: Randall's ESL Cyber Listening Lab - <http://www.esl-lab.com/>
3. Intercultural: English Listening Lesson Library Online http://www.elllo.org/

Equipments required

1. Career Lab:1 room
2. 2 Computers as a Server for Labs (with High Configuration)
3. LCD Projectors - 4 Nos
4. Headphones with Mic (i-ball) - 100 Nos
5. Speakers with Amplifiers, Wireless Mic and Collar Mic - 2 Sets
6. Teacher table, Teacher Chair - 1 + 1
7. Plastic Chairs - 75 Nos

GEA131 ENGINEERING PRACTICE LABORATORY - I
(Common to all branches)

L	T	P	C
0	0	3	1

GOAL

To provide the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

OBJECTIVES

The course should enable the students to

1. Relate theory and practice of basic Civil and Mechanical Engineering
2. Learn concepts of welding and machining practice
3. Learn concepts of plumbing and carpentry practice

OUTCOMES

The students should be able to

1. Identify and use of tools, Types of joints used in welding, carpentry and plumbing operations.
2. Have hands on experience on basic fabrication techniques such as carpentry and plumbing practices.
3. Have hands on experience on basic fabrication techniques of different types of welding and basic machining practices.

LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING PRACTICE **15**

1. Welding

   Arc welding: Butt joints, Tee and lap joints.

2. Basic Machining

   Facing, turning, threading and drilling practices using lathe and drilling operation with vertical drilling machine.

3. Machine assembly practice

   Study of centrifugal pump

4. Study on

a. Smithy operations - Productions of hexagonal headed bolt.

b. Foundry operations - Mould preparation for gear and step cone pulley.

II. CIVIL ENGINEERING **12**

1. Basic pipe connection using valves, couplings, unions, reducers, elbows in household fitting.

2. Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

3. Wood work: Sawing, Planning and making common joints.

4. Study of joints in door panels, wooden furniture.

TOTAL : 45

Reference:

Jeyapoovan T and Saravanapandian M., Engineering practices lab manual, 4th Edition, Vikas publishing House, New Delhi, 2010.

List equipment and components

(For a Batch of 30 Students)

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools:
   (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer,wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and otherwelding outfit. 2 Nos.
5. Centre lathe 2 Nos.

6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

SEMESTER-II

MAA 102– ENGINEERING MATHEMATICS – II

(Common to All Branches)

L T P C

3 1 0 4

MAA 102	**ENGINEERING MATHEMATICS-II**	**4 CREDITS**
AIM	• The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subject using MATLAB.	
OBJECTIVES	**OUTCOME**	
• To understand effectively the evaluation of double and triple integrals and their applications • To know the basics of vector calculus comprising of gradient, divergence, curl, line surface and volume integrals along with the classical theorems involving them • To have a sound knowledge of Laplace transform and its properties. Solutions of Laplace transform using MATLAB. • To understand and expand periodic functions as Fourier series using MATLAB	• To understand effectively the evaluation of double and triple integrals and their applications • To know the basics of vector calculus comprising of gradient, divergence, curl, line surface and volume integrals along with the classical theorems involving them • To have a sound knowledge of Laplace transform and its properties. Solutions of Laplace transform using MATLAB. • To understand and expand periodic functions as Fourier series using MATLAB	

UNIT I MULTIPLE INTEGRALS 12(8+4)

Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian co ordinates – Volume as a triple integral - Change of variables between Cartesian and polar coordinates.

Lab: Area and Volume of double integration and triple integration.

UNIT II VECTOR CALCULUS 12(8+4)

Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle between surfaces- Irrotational and solenoidal vector fields.

Green's theorem - Gauss divergence theorem and Stoke's theorem (without proof) – Verification and evaluation of the above the theorems - Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelopipeds.

Lab: Green's theorem - Gauss divergence theorem and Stoke's theorem

UNIT III LAPLACE TRANSFORM 12(8+4)

Laplace transform – Conditions of existence – Transform of elementary functions – properties - Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of periodic functions. Inverse Laplace transforms using partial fraction and convolution theorem. Solution of linear ODE of second order with constant coefficients.

Lab: Solutions of differential equations using Laplace transform

UNIT IV FOURIER SERIES 12(8+4)

Dirichlet's Conditions – General Fourier Series – Odd and even functions – Half range sine and cosine series –Harmonic Analysis.

Lab: Solutions of Fourier series and Harmonic Analysis.

UNIT V COMPLEX VARIABLES 12(8+4)

Functions of a complex variable – Analytic function - Cauchy - Riemann equations (Statement only) – Properties of analytic function (Statement only) – Construction of Analytic functions by Milne – Thomson method.

Lab: Cauchy - Riemann equations, Milne – Thomson method

TOTAL: 60

TEXT BOOK:

1. Venkatraman M.K, Mathematics, Volume – II & Volume -III, National Publishing Company, Chennai, 1985.
2. A.P.Santhakumaran, P.Titus, Engineering Mathematics - II, NiMeric Publications, Nagercoil, 2012

REFERENCE:

1. Kandasamy P, Engineering Mathematics Volume II, S. Chand & Co., New Delhi, 1987.
2. Grewal B.S, "Engineering Maths – II", Sultan Chand, New Delhi, 1993.
3. Bali N.P, Manish Goyal, Text book of Engineering Mathematics, 3rd Edition, Lakshmi Publications, 2003.
4. Chandrasekaran A, Engineering Mathematics, Volume – II, Dhanam Publication, 2008.

PHA101 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

To impart fundamental knowledge in various fields of Physics and its applications.

OBJECTIVES

The course should enable the students to:

6. Develop strong fundamentals of properties and behaviour of the materials
7. Enhance theoretical and modern technological aspects in acoustics and ultrasonics.
8. Enable the students to correlate the theoretical principles with application oriented study of optics.
9. Provide a strong foundation in the understanding of solids and materials testing.
10. Enrich the knowledge of students in modern engineering materials.

OUTCOME

The students should be able to:

6. Understand the properties and behaviour of materials.
7. Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonics and be able to employ it as an engineering tool.
8. Understand the concept, working and application of lasers and fiber optics.
9. Know the fundamentals of crystal physics and non-destructive testing methods.
10. Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.

UNIT I PROPERTIES OF MATTER 9

Elasticity - types of moduli of elasticity - Stress-Strain diagram - Young's modulus of elasticity Rigidity modulus - Bulk modulus - Factors affecting elasticity - twisting couple on a wire - Torsional pendulum - determination of rigidity modulus of a wire - depression of a cantilever - Young's modulus by cantilever - uniform and non-uniform bending - viscosity - Ostwald's viscometer - comparison of viscosities.

UNIT IIACOUSTICS AND ULTRASONICS 9

Classification of sound - characteristics of musical sound - intensity - loudness - Weber Fechner law - Decibel - Reverberation - Reverberation time, derivation of Sabine's formula for reverberation time(Jaeger's method) - absorption coefficient and its determination - factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies. Ultrasonics - production - Magnetostriction and Piezoelectric methods - properties - applications of ultrasonics with particular reference to detection of flaws in metal (Non - Destructive testing NDT) - SONAR.

UNIT III LASER AND FIBRE OPTICS **9**

Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics - Nd-Yag laser - CO2 laser Semiconductor laser - applications - optical fiber - principle and propagation of light in optical fibers Numerical aperture and acceptance angle - types of optical fibers - single and multimode, step index and graded index fibers - applications - fiber optic communication system.

UNIT IV CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING **9**

Crystal Physics: Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - 'd' spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - coordination number Packing factor for SC, BCC, FCC and HCP structures.

Non Destructive Testing: Liquid penetrate method - Ultrasonic flaw detection - ultrasonic flaw detector (block diagram) - X-ray Radiography - Merits and Demerits of each method.

UNIT VMODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS **9**

Modern Engineering Materials: Metallic glasses: Preparation properties and applications. Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis -Properties and applications.

Superconducting Materials: Superconducting phenomena - Properties of superconductors - Meissner effect - Type I and Type II superconductors - High Tc superconductors (qualitative) - uses of superconductors.

TOTAL : 45

TEXT BOOKS

4. Gaur R.K. and Gupta S.L., "Engineering Physics ", 8th edition, Dhanpatrai publications (P) Ltd., New Delhi 2010.
5. P.Mani, "Engineering Physics", Vol-I, Dhanam Publications, Chennai 2011.
6. Rajendran V. an Marikani A., "Applied Physics for engineers" , 3rd edition, Tata McGraw -Hill publishing company Ltd., New Delhi,2003.

REFERENCES

6. Uma Mukherji, Engineering Physics ,Narosa publishing house, New Delhi, 2003.
7. Arumugam M., Engineering Physics ,Anuradha agencies, 2007.
8. Palanisamy P.K., Engineering Physics, SciTech Publications, Chennai 2007.
9. Arthur Beiser, Concepts of Modern Physics, Tata McGraw -Hill Publications, 2007.
10. P.Charles, Poople and Frank J. Owens, Introduction to Nanotechnology, Wiley India,

CYA101 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

To impart basic principles of chemistry for engineers.

OBJECTIVES

The course should enable the students to

1. Make the students conversant with the basics of
2. (a) Water technology And (b) Polymer science
3. Provide knowledge on the requirements and properties of a few important engineering materials.
4. Educate the students on the fundamentals of corrosion and its control.
5. Give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.
6. Create an awareness among the present generation about the various conventional energy sources.

OUTCOME

The students should be able to

1. Gain basic knowledge in water analysis and suitable water treatment method.
2. Get an idea on the type of polymers to be used in engineering applications.
3. Get awareness about new materials
4. Get knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.
5. Get exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.
6. Get a good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.

UNIT I WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

Hardness (Definition, Types, Units) - problems - Estimation of Hardness (EDTA Method) - Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment- Desalination - Reverse Osmosis.

Classification of Polymers - PVC, Bakelite - preparation, properties and applications - Effect of Polymer Structure on Properties - Compounding of Plastics- Polymer Blends and Polymer Alloys Definition, Examples

UNIT IIENGINEERING MATERIALS 9

Properties of Alloys - Heat Treatment of Steel - Polymer Composites - types and applications.Lubricants - Classification, properties and applications - Mechanism of Lubrication -

MoS2 And Graphite - Adhesives - classification and properties - Epoxy resin (Preparation, properties and applications) - Refractories - Classification, Properties and General Manufacture - Abrasives Classification , Properties and Uses - Carbon nano tubes - preparation, properties and applications.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Conductometric Titration – HClvsNaOH and mixture of acids vsNaOH - Electrochemical Series and its applications - Nernst Equation - problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series - Corrosion (Definition, Examples, effects) - Mechanism of Dry Corrosion and Wet Corrosion - Differential aeration Corrosion , examples - Factors Influencing Corrosion - Metal and Environment - Corrosion Control - Design -Cathodic Protection methods - Protective Coatings - Galvanising - Anodising - Electroplating (Cu and Ni) and Electroless plating (Cu and Ni) Constituents of Paints and varnish.

UNIT IV CHEMICAL THERMODYNAMICS 9

Thermodynamic terminology- First Law of Thermodynamics-Internal energy- enthalpy - heat capacity work done in isothermal expansion of an ideal gas -problems - second law of thermodynamics entropy change - phase transformations and entropy change - problems - Work Function & Free Energy Function- Maxwell's Relations-Gibbs Helmholtz equation- van't Hoff Isotherm- van't Hoff Isochore - Problems.

UNIT V FUELS AND ENERGY SOURCES 9

Fuels - classification - Calorific Value - Dulong's Formula - Problems - Determination of Calorific Value by Bomb Calorimeter - Coal - Proximate Analysis - problems - Octane Number - Cetane Number - Diesel Index (Definitions only) - Bio Gas - Producer Gas -Water Gas - Preparation, Properties and Uses - Batteries - Primary Cells - Leclanche Cell -Secondary Cell - Nickel Cadmium Battery Fuel Cells - Hydrogen -Oxygen Fuel Cell - Solar Battery - Lead Acid Storage Cell - Nuclear Energy Light water nuclear power plant.

TOTAL : 45

TEXT BOOKS

1. S. S. Dara, Text Book of Engineering Chemistry, S. Chand & Company Ltd., New Delhi, 2003
2. Murthy, Agarwal& Naidu, Text Book of Engineering Chemistry, BSP, 2003.
3. S.Sumathi, Engineering Chemistry, Dhanam Publications, 2008.
4. S.Sumathi and P.S.Raghavan, Engineering Chemistry II, Dhanam Publications, 2008.

REFERENCES

1. B. K. Sharma, Engineering chemistry, Krishna Prakasam Media (P) Ltd., 2003
2. A 1. Vogel, A text book of Qualitative Inorganic Analysis, ELBS, London, 2004
3. A. Gowarikar, Text Book of Polymer Science, 2002
4. Kuriacose&Rajaram, Vols. 1 & 2, Chemistry in Engineering and Technology, 2004
5. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co. Jalandar, 2004.

MEA102 ENGINEERING MECHANICS

L	T	P	C
3	1	0	4

GOAL

To provide an understanding of the effects of forces, torques and motion on a variety of structures and vehicles.

OBJECTIVES

The course should enable the students to

1. Impart knowledge on the vector and scalar representation of forces and moments
2. Impart knowledge on static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions.
3. Understand the principle of work and energy.
4. Comprehend on the effect of friction on equilibrium, the laws of motion, the kinematics of motion and the interrelationship.
5. Write the dynamic equilibrium equation.

All these should be achieved both conceptually and through solved examples.

OUTCOME

The students should be able to

1. Apply the law of forces and Newton's 2nd law in determining motion and

   The dynamics of particles and vehicles
2. Implement vectors in mechanics problems and Know about Energy and momentum conservation
3. Know the dynamics of a rigid body and its rotation and Do the calculation and motion of the centre of mass of a system of particles
4. Use vectors to solve mechanics problems and Develop particle and vehicle trajectory equations
5. Calculate the motion of rigid bodies and Solving problems on engineering mechanics that arise on other modules of the course.

UNIT I BASICS & STATICS OF PARTICLES **12**

Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Vectors - Vectorial representation of forces and moments - Vector operations : addition, subtraction, dot product, cross product - Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES **12**

Free body diagram - Types of supports and their reactions - Requirements of stable equilibrium Static determinacy - 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 - Equilibrium of Rigid bodies in three dimensions - Examples.

UNIT III FRICTION **12**

Frictional force - Laws of Coulomb friction - Simple contact friction - Belt friction - Transmission of power through belts - Wedge Friction - Screw Jack - Rolling resistance.

UNIT IV PROPERTIES OF SURFACES AND SOLIDS **12**

Determination of Areas and Volumes - Determination of first moment of area Centroid of sections, Second and product moments of plane area - Rectangle, circle, triangle, T section, I section, Angle section, Hollow section- Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia -Product moment of inertia.

UNIT V DYNAMICS OF PARTICLES **12**

Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion Newton's law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

TOTAL : 60

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and vol. 2 Dynamics, McGraw-Hill International Edition, 1997.
2. Rajasekaran, S, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2003.
3. Bedford and N. Fowler, Engineering Mechanics-Dynamics, Adison-Wesley

REFERENCES

1. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
2. Ashok Gupta, Interactive Engineering Mechanics - Statics - A Virtual Tutor (CDROM), Pearson Education Asia Pvt., Ltd., 2002.Hill, 2001.
3. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, IV Edition - Pearson Education Asia Pvt., Ltd., 2003.

EEB122 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	1	0	4

OBJECTIVES:

1. To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
2. To explain the fundamentals of semiconductor and applications.
3. To explain the principles of digital electronics
4. To impart knowledge of communication.

OUTCOMES:

1. ability to identify the electrical components explain the characteristics of
2. electrical machines.
3. ability to identify electronics components and use of them to design
4. circuits.

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 12

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits –Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.
Operating Principles of Moving Coil and Moving Iron Instruments (Ammetersand Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

Construction, Principle of Operation, Basic Equations and Applications of DCGenerators, DC Motors, Single Phase Transformer, single phase induction
Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and itsCharacteristics – Half wave and Full wave Rectifiers – Voltage Regulation.Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics –Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 12

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders– Flip-Flops – Registers and Counters – A/D and D/A Conversion (singleconcepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Mittle N., “Basic Electrical Engineering”, Tata McGraw Hill Edition, NewDelhi, 1990.
2. Sedha R.S., “Applied Electronics”, S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “BasicElectrical, Electronics and Computer Engineering”, Tata McGraw Hill,Second Edition, 2006.

2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”,Oxford press 2005.

3. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, 1994.

4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’Outline Series, McGraw Hill, 2002.

5. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers,2003

MEB101 MANUFACTURING TECHNOLOGY-I

L	T	P	C
3	0	0	3

GOAL

To introduce basic manufacturing processes and to develop theoretical skill of students.

OBJECTIVES

The course should enable the students to

1. Learn Metal joining processes
2. Learn Casting processes.
3. Learn Metal forming/high energy rate forming.
4. Learn the processing of plastics

OUTCOME

The students should be able to

1. Understand the various manufacturing methods employed in the Industry.
2. Get knowledge in Basic welding & finishing operations
3. Get knowledge in Hot & cold working of metals including High Energy Rate forming
4. Get knowledge in Plastic manufacturing.

UNIT I METAL CASTING PROCESSES **10**

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 - Ceramic mould - Lost Wax process - Pressure die casting - Centrifugal casting - CO2 process - Sand Casting defects - Inspection methods.

UNIT II FABRICATION PROCESS **10**

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 - Percusion 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 - Friction welding - Diffusion welding - Flame cutting - Weld defects - Brazing and soldering process - Methods and process capabilities - Filler materials and fluxes - Types of Adhesive bonding

UNIT III BULK DEFORMATION PROCESSES **10**

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 - Defects

in rolled parts - Principles of Extrusion - Types of Extrusion - Hot and Cold extrusion -Principle of rod and wire drawing - Equipments used.

UNIT IV SHEET METAL FORMING PROCESSES 8

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

UNIT V FORMING AND SHAPING OF PLASTICS 7

Types of plastics - Characteristics of 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 : 45

TEXT BOOKS

1. HajraChoudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt Ltd., Mumbai, 2007
2. Serope Kalpak Jain, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 4th Edition, 2009.

REFERENCES

1. Elements of Manufacturing Processes, B.S. MagendranParashar& R.K. Mittal, Prentice Hall of India, 2008.
2. Manufacturing Technology, P.N. Rao, Tata McGraw-Hill Publishing Limited, 2010.
3. A text book of production technology, P.C. Sharma, S. Chand and Company, 2010.
4. Manufacturing Process - Begman, John Wilely& Sons, VIII Edition, 1999.

ELA102 PERSONALITY DEVELOPMENT AND SOFT SKILLS

L	T	P	C
2	0	0	1

GOAL

- To enhance holistic development of students and improve their employability skills.
- To nurture the language skills and cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning
- To help them become responsible members or leaders of the society in and around their workplace or living space
- to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.

OBJECTIVES

The course should enable the students to

6. Develop inter personal skills and be an effective goal oriented team player.
7. Develop professionals with idealistic, practical and moral values.
8. Develop communication and problem solving skills.
9. To face the challenges in the world and enable the students excel in the world of work and life.

OUTCOME

The students should be able to:

1. Have the self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language.
2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts.
4. Have the confidence to develop thinking skills and participate in brainstorming, mind-mapping, audiovisual activities, creative thinking and also answer tests in the job-selection processes.
5. Make right decisions, communicate effectively, and develop self-management talents, to lead a healthy and productive life.
6. Imbibe the requisite employability skills , learned skills, intuitive skills and people skills

UNIT I:- SPEAKING SKILLS **9**

Art of Speaking- Body Language and speaking- Non Verbal communication- -Vocal Communication Techniques- Intercultural communication- The difference in Approach in five countries- Vocabulary Enrichment- Pronunciation of words-Mark the stress on appropriate syllable-split the word into syllables- Speaking as an Art-Simple Oral Interaction-Body Language and Speaking- Five characteristics of an ideal GD- group discussions - role plays- short speeches-Extempore – JAM – Debate-Talk shows-Power point presentation and speaking

UNIT II:-LANGUAGE SKILLS **13**

Functional Grammar: Synonyms and Antonyms – Active and Passive Voice- Direct and Indirect Speech- Conditional Clauses- collocations- rearrange the jumbled sentences and make meaningful sentences- Language functions: apologising, greeting, clarifying, inviting, advising, agreeing, disagreeing, refusing, thanking, interrupting, expressing obligation, expressing preferences, CV / application letters- Job interviews-FAQ's – e- mail etiquette

UNIT III:- PEOPLE SKILLS/SOFT SKILLS **8**

SWOT analysis- JOHARI window- Goal setting- speaking on Goals - goals to be achieved- modes of behaviour to achieve the goals- decision making- time management -stress management- power of positive attitude- leadership skills

UNIT IV:- COMPREHENSION SKILLS **7**

Art of Listening- listening to English news- listening to debates on current issues - Listening to dialogues for general meaning and specific information- listening to toast master speeches- -cloze exercises-open comprehension questions-Art of Listening-Reading passages –interpreting in own words- reading articles in magazines/journals/newspapers- writing articles for newspaper-reporting events-completing the middle/end of a story

UNIT V :- PERSONALITY DEVELOPMENT **9**

Define Personality- Types of Personality-Personality test- Leadership Skills - Interpersonal Skills-Team Work - Mind Mapping- concept maps- Study skills and techniques - Edward De Bono's lateral thinking-exercises-questionnaires-project

TEXT BOOK:
English for Life and the workplace through LSRW&T skills by Dr. Dolly John, Pearson Publications

REFERENCES

1. Education and Personality Development, Dr. P.K. Manoharan, APH Publishing Corporation.
2. Effective technical Communication, M. Ashraf Rizvi, Tata McGraw Hill Companies
3. Professional Speaking Skills, Aruna Koneru, Oxford University Press
4. Essential Grammar in Use, Fourth Edition by Raymond Murphy, Cambridge University Press
5. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.
6. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.

Web links for reference for Flipped classroom sessions

1. https://owl.english.purdue.edu/exercises/28/12/33
2. http://englishplaza.vn/flexpaper/pdf/english-collocations-in-use_1405952201.pdf
3. http://www.htsb.org/wp-content/uploads/2014/07/Academic-Language-Functions-toolkit.pdf
4. http://www.intelligencetest.com/puzzles/lateral.htm
5. http://www.teachingenglish.org.uk/sites/teacheng/files/mind_map.pdf
6. http://www.teachingenglish.org.uk/article/using-mind-maps-develop-writing.
7. http://www.teachingenglish.org.uk/article/jigsaw-readingArrange
8. http://www.teachthought.com/critical-thinking/10-team-building-games-that-promote-critical-thinking
9. http://www.myenglishpages.com/site_php_files/grammar-exercise-conditionals.php
10. http://flax.nzdl.org/greenstone3/flax?a=fp&sa=collActivity&c=copyrightlaw
11. http://www.humanmetrics.com/personality/type

PHA131 PHYSICS LABORATORY
(COMMON TO ALL BRANCHES)

L	T	P	C
0	0	3	1

S.No.	List of Experiments
1	Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2	Non Uniform Bending - Determination of Young's Modulus.
3	Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4	Lee's Disc - Determination of thermal conductivity of a bad conductor.
5	Air Wedge - Determination of thickness of a thin wire.
6	Spectrometer - Refractive index of a prism.
7	Semiconductor laser - Determination of wavelength of Laser using Grating.

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 30 STUDENTS

1	Torsional Pendulum	(500 gm, wt, 60 cm wire Al-Ni Alloy)	5 Nos.
2	Travelling Microscope	(X10)	15 Nos.
3	Capillary tube	(length 10cm, dia 0.05mm)	5 Nos.
4	Magnifying lens	(X 10)	15 Nos.
5	Lee's disc apparatus	(std form)	5 Nos.
6	Stop watch	(+/- 1 s)	5 Nos.
7	Meter scale	1m length	5 Nos.
8	Spectrometer	(main scale 360 deg, ver 30")	5 Nos.
9	Grating	(2500 LPI)	5 Nos.
10	Laser	(632.8 nm)	5 Nos.
11	Semi-transparent glass plate	Al coating, 65 nm thickness, 50% visibility	5 Nos.
12	Equilateral prism	(n = 1.54)	5 Nos.
13	Thermometer	+/- 1 deg	8 Nos.
14	Screw gauge	(+/- 0.001cm)	12 Nos.
15	Vernier caliper	(+/- 0.01 cm)	8 Nos.
16	Steam Boiler	1 L	5 Nos.
17	Scale	50 cms	5 Nos.
18	Cylindrical mass	100 gms	10 sets
19	Slotted wt	300 gms	5 sets
20	Heater	1.5 KW	5 Nos.
21	Transformer sodium vapour lamp	1 KW	10 Nos.
22	Sodium vapour lamp	700 W	5 Nos

23	Burette	50 mL	5 Nos
24	Beaker	250 mL	5 Nos
25	Spirit level		10 Nos

REFERENCE

- P.Mani, Engineering Physics Practicals, Dhanam Publications, Chennai, 2005.

CYA131 CHEMISTRY LABORATORY

L	T	P	C
0	0	3	1

S.No.	List of Experiments (Any five)
1	Estimation of Commercial soda by acid-base titration
2	Determination of Percentage of nickel in an alloy
3	Determination of Temporary, permanent and total hardness of water by EDTA method
4	Determination of Chloride content in a water sample
5	Potentiometric Estimation of iron
6	Conductometric Titration of a strong acid with a strong base
7	Conductometric Titration of mixture of acids.
8	Determination of Degree of polymerization of a polymer by Viscometry

List of Glassware and Equipments required for a batch of 30 students

S.No.	Items	Quanty
1	Burett (50 mL)	30 Nos.
2	Pipette(20 mL)	30 Nos.
3	Conical Flask(250 mL)	30 Nos.
4	Distilled water bottle(1 L)	30 Nos
5	Standard flask (100 mL)	30 Nos
6	Funnel (small)	30 Nos
7	Glass rod20 cm length	30 Nos
8	Reagent Bottle (250 mL)	30 Nos
9	Reagent Bottle (60 mL)	30 Nos
10	Beaker (100 mL)	30 Nos
11	Oswald Viscometer (Glass)	30 Nos
12	Measuring Cylinder(25 mL)	30 Nos
13	Digital Conductivity MeterPICO make	8 Nos.
14	Conductivity cell(K=1)	12 Nos.
15	Digital PotentiometerPICO make	8 Nos.
16	Calomel ElectrodeGlass	12 Nos.
17	Platinum Electrode - Polypropylene	12 Nos.
18	Burette Stands - Wooden	30 Nos.
19	Pipette stands - Wooden	30 Nos.

20	Retard stands - Metal	30 Nos.
21	Porcelain Tiles - Metal	30 Nos.
22	Clamps with Boss heads - Metal	30 Nos.

REFERENCES

4. J.Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantative Chemical Analysis, 6th Edition, Pearson Education, 2004.
5. C. W. Garland, J. W. Nibler, D. P. Shoemaker, ;"Experiments in Physical Chemistry, 8th ed.," McGraw-Hill, New York, 2009.
6. S. Sumathi, Engineering Chemistry Practicals, Dhanam Publications, 2011.

GEA132 ENGINEERING PRACTICES LABORATORY II

L	L	T	P	C
	0	0	3	1

LIST OF EXPERIMENTS **HOURS**

Electrical Engineering:

1. Wiring for a tube light. 6
2. Wiring for a lamp and fan. 6
3. Staircase wiring 3
4. Study of (i) Iron box and (ii) Fan with Regulator Electronics Engineering 6
5. Study of Electronic components and Equipments 3
6. Characteristics of PN junction diode & measurement of Ripple factor of half wave and full wave rectifier. 9
7. Applications of OP-AMP - Inverter, Adder and Subtractor. 9
8. Study and verification of Logic Gates 3

PRACTICAL 45

Components Required:

Electrical Engineering :

Choke	2 Nos
Starter	2 Nos
Tubelight stand	2 Nos
36W tubelight	2 Nos
Fan	2 Nos
40W lamp	5 Nos
Single way switch	10 Nos
Two way switch	5 Nos
Iron box	2 Nos
Fan with regulator opened	1 no (demo purpose)

Electronics Engineering

IC Trainer Kit, Resistors, Capacitors, CRO, Function Generator, Bread Board, Regulated Power Supply, Zener Diode, PN Junction Diode, Potentiometer, Digital Multimeter, Ammeter, Voltmeter, Wattmeter, IC 7408,IC 7432,IC 7486, IC 7400, IC 7404, IC 7402

TEXT BOOK

1. T. Jeyapoovan, M.Saravanapandian and S. Pranitha, Engineering Practices Lab Manual, 3rd Edition 2006, Vikas Publishing house (P) Ltd., New Delhi.

EEB145 BASIC ELECTRICAL AND ELECTRONICS LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES

1. To provide a basic understanding of operation and characteristics of Electrical machines and Electronic devices

LIST OF EXPERIMENTS:

1. Open circuit and load test on shunt generators
2. Load test of D.C. shunt motor
3. Load test or single phase induction motor
4. Equivalent circuit of a transformer
5. Swinturn's test
6. Diode characteristics
7. Transistor amplifier
8. SCR application
9. Frequency Response Analysis
10. Characteristics of Transducers

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Shunt Generators
2. Shunt DC motors
3. Single phase Induction motor
4. Single phase transformer
5. Three phase Squirrel Cage induction Motors
6. Diodes and Amplifiers
7. Oscilloscope
8. Transducers

SEMESTER-III

MAA 201 – ENGINEERING MATHEMATICS – III

(Common to AERO, ASP, AUTO, MECH, CSE, IT, CHEM &Bio.Tech Branches)

L	T	P	C
3	1	0	4

UNIT – I Partial Differential Equations 12(9+3)

Formation of partial differential equation differential equations by elimination arbitrary constant 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.

UNIT – II One Dimensional Wave and Heat Flow 12(9+3)

Classification of second order linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation.

UNIT – III Two Dimensional Heat Flow 12(9+3)

Steady state solution of two dimensional heat equations (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates and Polar coordinates (sector, semicircle, circle and annular regions)

UNIT – IV Fourier Transform 12(9+3)

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

UNIT – V Z – Transform and Difference Equations 12(9+3)

Z – Transform – Elementary Properties – Inverse Z – transform – Convolution theorem – Formation of Difference equations – Solution of difference equations using Z– transform.

Total: 60

Text Books:

1. M.K. Venkatraman, Mathematics, Vol – II, National Publishing Company, Chennai.
2. A.P. Santhakumaran, P. Titus, Transforms and Partial Differential Equations, Nimeric Publications

References:

1. Kandasamy. Engineering Mathematics Volume II, S. Chand & Co., New Delhi.
2. B.S. Grewal, "Engineering Maths – II, Sultem Chand, New Delhi.
3. Bali N.P & Manish Goyal, Text book of Engg. Maths, 3rd Edition, Lakshmi Publications.

L	T	P	C
3	1	0	4

MHB201	DIGITAL AND POWER ELECTRONICS	4 Credits
GOAL	To have the knowledge of basic digital electronics and power electronics circuits design	

Objectives	Outcome
The course should enable the students to: 1. To simplify the mathematical expressions using Boolean functions – simple problems. 2. Study & design the combinational & sequential circuits. 3. Study the design asynchronous circuits. 4. Get an overview of different types of power semiconductor devices and their switching characteristics. 5. Learn the inverters and converters.	The students should be able to: 1. Understand the Boolean algebra usage. 2. Understand the basics of combinational circuits & Flip flops and sequential circuits 3. Analyse about asynchronous circuits. 4. Analyse the dynamic and switching characteristics of power semiconductor devices.

UNIT I Basic Logic Gates &Boolean Algebra &Minimization: 12

Boolean theorems, Boolean algebra – AND, OR, NOT, NAND, NOR, exclusive OR&NOR operation, Minimization – Minterm, Maxterm, Karnaugh Map, K map up to 4 variables., Simplification of logic functions with K-map,tabular minimization procedures

UNIT II COMBINATIONAL & SEQUENTIAL CIRCUITS: 12

Adder / substractor, Encoder / decoder MUX/DEMUX, comparator, code converter. Introduction to PAL and PLA and their use in design.Sequential circuits – SR, JK, D, T flip flops, triggering analysis of clocked sequential circuits, ripple counter, synchronous counters. Registers – shift registers, serial to parallel, parallel to serial conversions

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS & ALGORITHMIC STATE MACHINES 12

Stable unstable states, output specifications, cycles and races, Race free assignments, reduction of state and flow tables, hazards, pulse mode sequential circuits. Introduction to ASM chart

UNIT IV POWER SEMI-CONDUCTOR DEVICES &PHASE-CONTROLLED CONVERTERS: 12

Study of switching devices, - SCR, TRIAC,BJT, IGBT, MOSFET,2-pulse, 3-pulse and 6-pulse converters,Dual converters

UNIT V INVERTERS &CONVERTERS 12

Single phase and three phase inverters, Step-down and step-up chopper, Single phase AC voltage controllers, single and three phase cycloconverters

L : 45 T : 15 TOTAL : 60

TEXT BOOKS

1. Morris Mano M., “Digital Circuits and Logic Design”, Prentice Hall of India, II Edition, 1996.
2. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006
3. Reshid, M.H., Power Electronics – Circuits Devices and Application, Prentice Hall International, New Delhi, 3rd Edition, 2004.
4. Philip T.Krein, “Elements of Power Electronics” Oxford University Press, 2004 Edition

REFERENCES

1. W.H.Gothmann, “Digital Electronics-Introduction Theory and Practice”, PHI, 1992.
2. T.L.Flloyd, “Digital Fundamentals”, PHI, 1986
3. S.C.Lee, “Digital Circuits and Logic Design”, PHI, 2000.
4. Ashfaq Ahmed Power Electronics for Technology Pearson Education, Indianreprint, 2003.
5. P.S.Bimbra “Power Electronics” Khanna Publishers, third Edition 2003.

L	T	P	C
3	1	0	4

MHB202	ELECTRICAL MACHINES & DRIVES	4 Credits
Goal	To expose the students to the concepts of various types of DC Machines and Transformers.	

Objectives	Outcome
The course will enable the students to understand: 1. Electro-mechanical energy conversions in D.C. machines and energy transfer in transformers 2. Constructional details, principle of operation, characteristics and performance of D.C. generator. 3. Constructional details, principle of operation, characteristics and speed control of D.C. motors. 4. Constructional details and principle of operation and performance of transformer **5.** Testing of D.C. machines and transformer	At the end of this course students should have knowledge in the following: 1. Various types, Principle of Operation and Characteristics of DC Motors and DC Generators. 2. Principle of Operation, types, Characteristics and parallel operation of DC Generators. 3. Principle of Operation, types, Characteristics and speed control of DC Motors. 4. Construction and Principle of Operation, Testing, Regulation , equivalent circuit of Transformers **5.** Various direct and indirect test methods to find the efficiency of DC machines and transformer.

UNIT I CIRCUITS AND TRANSFORMERS **6**

D.C. Voltage, current, power-Ohms law-series, parallel circuits – Kirchoff's laws – mesh analysis – A.C. voltage – sinusoidal waves, Phasor representation – power factor – complex power - basic idea of transformers – simple problems.

UNIT II ELECTRICAL MOTORS **12**

Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motors, universal motors, stepper motors and reluctance motor.

UNIT III SPEED CONTROL AND STARTING 9

Speed control of D.C. motors – three phase induction motors – starting methods of D.C. motor and three phase induction motor – electrical braking – simple problems.

UNIT IV ELECTRICAL DRIVES 9

Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems.

UNIT V SOLID STATE DRIVES (QUALITATIVE TREATMENT ONLY) 9

Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators.

TUTORIALS: 15

TOTAL :60

TEXT BOOK

1. N.K.De.,P.K.Sen, Electric Drives, Prentice Hall, First edition 1999.

REFERENCES

1. I.J. Nagrath, T.P. Kothari., Basic Electrical Engineering, McGraw-Hill Publishing company Ltd., Second edition, 2002.
2. S.K. Bhattacharya, Electrical Machines, second edition 1999, Tata McGraw-Hill Pvt. Company Ltd., Second edition, 1999.
3. G.K. Dubey, Fundamental Electrical Drives, second edition 2002, Narosa Publications, Second edition, 2002.
4. Pillai, S.K., A Seish course on Electrical Drives, Wilay Eastern Ltd., New Delhi, 1982.

L	T	P	C
3	1	0	4

MHB203	KINEMATICS OF MACHINERY	4 Credits
Goal	To provide an understanding of the kinematics and kinetics of simple machine elements and devices.	

Objectives	**Outcome**
The course should enable the students to 1. Know the variety of elements employed within a modern complex machine, such as an automobile, together with some historical precedents. 2. Rigid body dynamics (kinematics) of linkages, design of four bar mechanisms. 3. The direct relevance of problems discussed to engineering practice and validation of certain theoretical models through laboratory experiments.	The students should be able to 1. Understand the existing theory of mechanism, together with its shortcomings, the concepts of mobility, degrees of freedom and inertia and be able to understand how these apply to simple mechanisms and machines; 2. Calculate forces and accelerations in mechanisms 3. Apply typical analytical and graphical techniques, reinforcing and expanding Part I learning, to a variety of mechanical engineering components and systems

UNIT I BASICS OF MECHANISMS **7**

Terminology and Definitions-Degree of Freedom Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators-Design of Crank-rocker Mechanisms.

UNIT II KINEMATICS **12**

Displacement, velocity and acceleration and analysis in simple mechanisms - Graphical Method velocity and acceleration polygons - Kinematic analysis by Complex Algebra methods-Vector Approach, Computer applications in the kinematic analysis of simple mechanisms-Coincident points- Coriolis Acceleration

UNIT III KINEMATICS OF CAM **8**

Classifications - Displacement diagrams-parabolic Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

UNIT IV GEARS 10

Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing-Inter changeable gears-gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only)-Gear trains-Parallel axis gear trains-Epicyclic gear trains-Differentials

UNIT V FRICTION 8

Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives, Friction aspects in Brakes – Friction in vehicle propulsion and braking

TUTORIALS 15
TOTAL: 60

TEXT BOOKS

1. Rattan S.S, Theory of Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Shigley J.E and.Uicker J.J, Theory of Machines and Mechanisms, McGraw-Hill, Inc. 1995.

REFERENCES

1. Thomas Bevan, Theory of Machines, CBS Publishers and Distributors, 1984.
2. Ghosh A and A.K.Mallick, Theory of Mechanisms and Machines, Affiliated East - West Pvt. Ltd., New Delhi, 1988.
3. Rao J.S and Dukkipati R.V, Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C, Mechanics of Machines, Viva Low-Prices Student Edition, 1999.

L	T	P	C
3	1	0	4

MEB206	**STRENGTH OF MATERIALS**	**4 Credits**
Goal	Understand the basic concepts and techniques, both theoretical and experimental, with emphasis on the application of these to the solution of suitable problems in engineering. Provide a firm foundation for more advanced study.	

Objectives	**Outcome**
The course should enable the students to 1. Gain knowledge of simple stresses, strains and deformations components due to external loads. 2. Assess stresses and deformations through mathematical models of beams, twisting bars or combination of both. 3. Provide the Basic knowledge for use in the design courses.	The students should be able to 1. Understand the basic principles of structural elasticity, including statically determinate and indeterminate systems, and the factors which affect their strength and stiffness. 2. Assess the strength and stiffness of simple structural components. 3. Apply the effect of stress and deformation concepts in practical applications.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

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 load.

UNIT 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.

UNIT III TORSION 12

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

UNIT IV BEAM DEFLECTION 12

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

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 12

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: 60

TEXT BOOKS

1. Popov E.P, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co,Third Edition, 2002.

REFERENCES

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

L	T	P	C
0	0	3	1

MHB231	ELECTRICAL MACHINES AND DRIVES LAB	1 Credits
Goal	To expose the students to the basic operation in electrical machines and help them to develop experimental skills.	

Objectives	Outcome
To obtain performance characteristics of (i)DC machines and transformers by direct loading. (ii) DC machines and transformers by indirect methods.	At the end of the course, the student should be able to (i) Understand the operation of DC machines and Transformers . (ii) Analyze the performance under varying load conditions

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.
3. Swinburne's test
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three-phase induction motor.
6. Load test on single phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors
9. Performance characteristics of Stepper motors.
10. Performance characteristics of single phase transformer.

TOTAL : 45

LIST OF EQUIPMENTS

(For a batch of 30 students)

S.No	Equipments	Qty
1.	Shunt motor 5HP	3
2.	Single phase Induction Motor 2HP	2
3.	Three phase induction Motor 5HP	2
4.	Single phase transformer 2KVA	1
5.	Three phase quto transformer	2
6.	Single phase auto transformer	2
7.	3 point starter	3

8.	DPST, TPST	Each 2
9.	DC source 300v, 100A	1
10.	Ammeter (0-5A), (0-10A) MC	Each 2
11.	Ammeter (0-5A), (0-10A) MI	Each 2
12.	Voltmeter (0-300V) MC	3
13.	Voltmeter (0-150V), (0-300V), (0-600V) MI	Each 2
14.	Wattmeter 150/300V, 5/10A UPF	2
15.	Wattmeter 300/600V, 5/10A UPF	2
16.	Wattmeter 150/300V, 5/10A LPF	2
17.	Wattmeter 300/600V, 5/10A LPF	2
18.	Stepper motor 5Kg	1
19.	Synchronous motor 5KW	1
20.	Rheostat 360 ohm/1.2A	3
21.	Rheostat 50 ohm/5A	3
22.	Tachometer	5

L	T	P	C
0	0	3	1

MHB232	DIGITAL AND POWER ELECTRONICS LAB	1 Credit
Goal	The subject is intended to familiarize the Mechatronics students with major aspects of power electronics which has wide spread applications in today's industry such as power supplies, variable speed drives, transportation, robotics etc..	

Objectives	**Outcome**
The course will enable the students to get design a digital circuit with logic and know the different types of power semiconductor devices and their switching characteristics	The students should be able to design the digital circuit and also analyse the dynamic and switching characteristics of power semiconductor devices..

LIST OF EXPERIMENTS

- Verification of logic gates.
- Half/full adder/subtractor
- Flip flops(SR,JK,D,T)
- MUX / DEMUX
- Encoder /decoder
- Counters
- Shift registers
- Study of SCR & IGBT characteristics
- Study of Triac phase control circuit
- Study of SCR single-phase cyclo converter
- Study of IGBT chopper
- Study of SCR series and parallel inverters

TOTAL : 45

LIST OF EQUIPMENT

(For a batch of 30 students)

S.No	**Equipments**	*Qty*
1	Study of SCR, MOSFET & IGBT characteristics moduleIJT, R, RC firing circles for SCR module	1
2	Voltage & current commutated chopper module	1
3	SCR phase control circuit module	1
4	TRIAC phase control circuit module	1
5	Study of half controlled & fully controller converters module	1
6	Study of three phase AC regulator module	1
7	Speed control of DC shunt motor using three phase fully controlled converter module	1
8	SCR single phase cyclo converter module	1
9	SCR series and parallel inverters module	1
10	IGBT chopper module	1
11	IGBT based PWM inverter (single phase) module	1
12	Ammeter (0-5A) MC, (0-2A) MC, (0-2A) MI, (0-5V) MI Voltmeter (0-300V) MC, (0-600V) MC,	Each 3
13	(0-300V) MI, (0-600V) MI	Each 3
14	Multimeter	4
15	CRO	5
16	Transformer 1KVA, 1:1, 230V	4

L	T	P	C
0	0	3	1

MHB233	COMPUTER AIDED DESIGN LAB	1 Credits
Goal	To impart knowledge on all aspects of Computer Aided Design and Drafting applications in industry.	

Objectives	**Outcome**
The course should enable the students to: 1. understand and learn about design and development of various mechanical components using modelling software Train them for solving problems in short duration. 2. To provide quality education in the field of CAD recent developments	The students should be able to: 1. Present an overview of CADD and describe its applications in different fields. 2. Describe common terms associated with CADD hardware and software. 3. Outline the basic principles associated with CADD and to demonstrate common drafting techniques used by professionals. 4. Introduce the advanced capabilities of CADD and how they can be used to increase productivity. 5. Provide information about the CADD industry resources.

CAD Lab

Introduction to Computer Aided Drafting .Study Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures. Drawing of a title Block with necessary text and projection symbol.

2D – Drafting List of Exercises for 2D Drafting 20

1. Draw and Solve problems in Projections of straight lines
2. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
3. Drawing front view, top view and side view of objects from the given pictorial views
4. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
5. Drawing isometric projection of simple objects.

3D – Modeling **25**

Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model. Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Hardware and Software (For a batch of 30 students)

1. Pentium IV computer or higher hardware, with suitable graphics facility -30 No.
2. Laser Printer or Plotter to print / plot drawings – 2 No.

3. Software: AutoCAD or Mechanical Desktop or Pro / E or CATIA or IDEAS 30 Licenses or Solidworks -30 Nos.

SSA231- APTITUDE – I

L	T	P	C
1	0	1	1

PURPOSE:

The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

1. To guide thought process
2. Appear for placement aptitude tests confidently
3. To develop Communication skill
4. To build confidence
5. Acquire aptitude skills for employment

METHODOLOGY:

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group Activities + Individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure participation
5. Empirical learning

LOGICAL REASONING:

Number, Letter series, Analogies- Coding, Decoding – Blood relations, direct sense,
Operator based questions – Clock & Calendars
Distribution, Binary Logic and Puzzles – Arrangements, Selections.
Routes & Networks, Comparison – Cubes & Venn Diagrams.

VERBAL ABILITY:

Critical Reasoning – Antonym, Synonym
Odd man – fill in the blank
Sentence Construction / Completion – Idiomatic expression
Detection of errors.
Jumbled sentences, Vocabulary, Alphabetical sequence, cloze passage.

EVALUATION:

1. University Theory Question paper
2. Activities assessed by both group and individual participation
3. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION:

Marks allocated for regular participation in all oral activities in class.

SCHEME OF EXAMINATION:

Complete internal evaluation on regular basis.

SEMESTER IV

L	T	P	C
3	1	0	4

MAA204 PROBABILITY AND STATISTICS

UNIT I Probability and Random Variables 9

Axioms of Probability – Conditional Probability – Total Probability – Baye's Theorem – Random variable – Probability mass function – Probability Density functions – Properties – Moments – Moment generating functions and their properties.

UNIT II Standard distributions 9

Binomial, Poisson , Geometric, Negative binomial, Uniform, Exponential, Gamma, Weibull and normal distributions and their properties – Functions of Random Variables.

UNIT III Two-Dimensional Random Variables 9

Joint distribution – Marginal and conditional distribution - Co-variance – Correlation and Regression – Transformation of Random Variables – Central Limit Theorem.

UNIT IV Testing of Hypothesis 9

Sampling distributions – Testing of Hypothesis for mean, Variance, Proportions and differences using normal, t, Chi-square and F distribution – Tests for Independence of attributes and goodness of fit.

UNIT V Designs of Experiments 9

Analysis of variance one way classification CRD – Two way classification - RBD – Latin square.

Total: 45

Text Books:

1. Kandasamy, "Probability and Statistics", S. Chand & Co, Latest Edition

2. Sivarama Krishna Dass, "Probability and Statistics, Viji Academy, Latest Edition.

Reference Books:

1. M.B.K. Murthy, "Probability and Statistics", V.R.B., Publishers, Latest Edition.

2. T. Veerarajan "Probability and Statistics", Tata McGraw Hill, New Delhi, Latest Edition.

L	T	P	C
3	0	0	3

MEB203	**MANUFACTURING TECHNOLOGY-II**	**3 Credits**
Goal	To develop knowledge on basic machine tools and machining operations and the underlying concepts to enhance productivity	

Objectives	**Outcome**
The course should enable the students to 1. Create awareness of various types of machine tools used in the Industry and their application 2. Understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping milling, drilling grinding broaching 3. Understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming	The students should be able to 1. Select the cutting tools required for various machining operations; 2. Select the proper machine tools for a particular operation 3. Understand the concepts of CNC and to programme.

UNIT I THEORY OF METALCUTTING 8

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

UNIT II CENTRE LATHEAND SPECIALPURPOSE LATHES 10

Centre lathe, constructional features, cutting tools, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation.

Capstan and turret lathes–automatic lathes: semiautomatic, automats–single spindle: cutting off, swiss type, automatic screw type – multi spindle; cutting off, bar type.

UNIT III RECIPROCATINGAND MILLING MACHINES 10

Reciprocating machine tools: shaper, planer, slotter; milling: types, milling cutters, operations; hole making: drilling, reaming, boring, tapping.

UNIT IV ABRASIVE PROCESS, SAWING, BROACHING AND GEAR CUTTING 10

Abrasive processes:

Grinding wheel–specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet grinding.

Sawing machine: hacksaw, band saw, circular saw; broaching machines: broach construction– push, pull, surface and continuous broaching machines, gear

cutting: forming, generation, shaping, hobbing.

UNIT VCNC MACHINE TOOLSAND PART PROGRAMMING 7

Numerical control (NC) machine tools – CNC: types, constructional details, special features.

Part programming fundamentals– manual programming– computer assisted part programming–APT language.

TOTAL: 45

TEXT BOOKS

1. Rao,P.N. *ManufacturingTechnology*, *Metal Cutting and Machine Tools*, Tata McGraw–Hill,New Delhi, 2010.
2. RicherdR.Kibbe,John E.Neely,RolandO.MergesandWarrenJ.White,*MachineTool Practices*, Prentice Hall of India, 2003.

REFERENCES

1. HMT– *Production Technology*, Tata McGraw-Hill, 1998.
2. Sharma P.C.,*A Text Book of Production Engineering*, S. Chandand Co. Ltd, 2010.
3. Hajra Choudhary, *Elements of Workshop Technology – Vol. II*, Media Promoters. 2002
4. GeofreyBoothroyd, *Fundamentals of Metal Machining and Machine Tools*, McGrawhill 1984.

L	T	P	C
3	0	0	3

MHB204	**MICROPROCESSOR AND MICROCONTROLLER**	**3 Credits**
Goal	To impart knowledge on Micro Processors and microcontroller .	

Objectives	**Outcome**
The course should enable the students to: 1. Understand the basic concept of microprocessors. 2. Learn about architectures of microprocessor. 3. Learn about interfacing in microprocessors. 4. Learn about architectures of microcontroller. 5. Learn to write the program.	The students should be able to: 1. Know about microprocessor & microcontroller. 2. Start to write the program using microprocessor & microcontroller 3. Gain the detailed knowledge in microprocessor & microcontroller

UNIT I Introduction to 8 Bit and 16 Bit Microprocessors – H/W Architecture 12

Introduction to microprocessor, computer and its organization, Programming system, Address bus, data bus and control bus, Tristate bus, clock generation, Connecting Microprocessor to I/O devices, Data transfer schemes, Architectural advancements of microprocessors. Introductory System design using microprocessors, 8086 – Hardware Architecture, External memory addressing, Bus cycles, some important Companion Chips, Maximum mode bus cycle, 8086 system configuration, Memory Interfacing, Minimum mode system configuration, Maximum mode system configuration, Interrupt processing, Direct memory access.

UNIT II Introduction to 8 Bit and 16 Bit Microprocessors – H/W Architecture 12

Programmer's model of 8086, operand types, operand addressing, assembler directives, instruction set - Data transfer group, Arithmetic group, logical group, control transfer group, miscellaneous instruction groups, programming.

UNIT III Microprocessor Peripheral Interfacing 12

Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253, 8254), D-to-A converter, A-to-D converter, CRT Terminal Interface, Printer Interface.

UNIT IV 8 Bit Microcontroller- H/W Architecture, Instruction Set and Programming 12

Introduction to 8051 Micro-controller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, control transfer instructions, Programming.

UNIT V System Design Using Micro Processor & Microcontroller 12

Case studies – Traffic light control, washing machine control, RTC Interfacing using I2C Standard- Motor Control- Relay, PWM, DC & Stepper Motor

TOTAL : 45

TEXT BOOK:

1. Krishna Kant, "Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096". PHI 2007.
2. Douglas V Hall, "Microprocessors and Interfacing, Programming and Hardware" TMH, 2006.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.MCKinlay The 8051 Microcontroller and Embedded Systems, Second Edition, Pearson Education 2008.
2. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar Publishers, 2007.
3. A K Ray, K M Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2007.
4. Ajit Pal, "Microprocessors Principles and Applications", TMH, 2005.

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MHB205	FUNDAMENTALS OF CONTROL SYSTEMS	3 Credits
Goal	To acquire knowledge in designing and analyzing stable systems	

Objectives	**Outcome**
The course will enable the students to: 1. Analyze representation of systems and to derive transfer function models. 2. Provide adequate knowledge in the time response of systems and steady state error analysis. 3. Give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems. 4. Provide the concept of stability of control system and methods of stability analysis. 5. Study the three ways of designing compensation for a control system.	At the end of this course the students should 1. Be able to describe various input/output models of dynamic system. 2. Be familiar with frequency domain descriptions and dynamic analysis. 3. Understand the concept of stability and effect of feedback control on sensitivity. 4. Be able to apply the basic methods of classical control system design such as root locus and phase lead-lag compensation based on Bode plots. 5. Be able to understand the principles of control theory.

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – open and closed loop systems Examples – Mathematical model, Translational & Rotational systems – transfer function – block diagram reduction techniques – signal flow graph.

UNIT II TIME RESPONSE 9

Time response – time domain specifications – types of test inputs – I and II order system response – error coefficients – generalized error series – steady state error – P, PI, PD, PID Controller characteristics.

UNIT III FREQUENCY RESPONSE ANALYSIS AND DESIGN 9

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.

UNIT IV STABILITY OF CONTROL SYSTEMS 9

Characteristic equation – location of roots in s-plane for stability – Routh Hurwitz criterion – root locus techniques – construction – gain margin and phase margin – Nyquist stability criterion.

UNIT V COMPENSATION DESIGN 9

Design concepts – realization of basis compensation – cascade compensation in time domain and frequency domain (simple MATLAB applications to analysis and compensators design problems.)

TUTORIALS

MATLAB applications: Partial Fraction expansion, Transformation of Mathematical models, Transient response analysis, Root locus, Bode diagrams, Nyquist plots with MATLAB. Simple MATLAB applications to analysis and compensator design problems.

TUTORIALS:15

TOTAL : 60

TEXT BOOKS

1. Katsuhiko Ogata, Modern Control Engineering, 4th Edition, Pearson Education 2002 (ISBN 81-7808-579-8)
2. GopalM.Control System Principles and Design, Tata McGraw-Hill, 1998

REFERENCES

1. Chesmond C.J. Basic Control System Technology, Viva Low Priced Student Edition, 1998.
2. Datton K., Banaclough W. and Thompson S., The Art of Control Engineering, Addison Wesley 2000
3. Dorf R.C. and Bishop R.H., Modern Control systems, Addison – Wesley, 1995 (MATLAB reference)
4. Leonard N.E. and William Levine, Using MATLAB to Analyze and Design Control Systems, Addision Wesley, 1995.

WEB SITES REFERENCES

1. www.mathworks.com
2. www.relisoft.com

L	T	P	C
0	0	3	1

MHB234	**MANUFACTURING PROCESS LAB**	**1 Credit**
Goal	To impart knowledge on Mechanics of metal cutting & Machining Operations	

Objectives	**Outcome**
The course should enable the students to 1. Learn the Applications of mechanics of metal cutting 2. Have knowledge on milling and drilling and grinding operations 3. Introduce the CNC Machine.	The students should be able to 1. Select the right tool, machining condition and relevant measurement 2. Know the methods and applications of various machining operations 3. Understanding the CNC hardware and CNC Programming

EXERCISES

1. Two or More Metal Cutting Experiments (Example: Shear Angle Measurement, Cutting Force Measurement, Cutting Temperature Measurement, Tool Wear Measurement, Life Measurement etc.)
2. One or More Exercises in Milling Machines (Example: Milling Polygon Surfaces, Gear milling, Keyway milling, Helical Groove milling etc.)
3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, Cylindrical Grinding, Centreless Grinding, Lapping, Honing etc.)
4. Two or More Exercises in Machining Components for Assembly of different fits. (Example: Machining using Lathes, Shapers, Drilling, Milling, Grinding Machines etc.)
5. One or More Exercises in Capstan or Turret Lathes
6. One or More Exercises in Gear Machining (Example: Gear Cutting, Gear Shaping, Gear Hobbing etc.)
7. One or More Exercises in CNC Machines (Example: CNC Programming, CNC Tooling, CNC Machining etc.)

TOTAL : 45

LIST OF EQUIPMENTS

(For a batch of 30 students)

1. Centre Lathes	- 15 No (5 Precision Type)
2. Turret and Capstan Lathe	- 1 No each
3. Horizontal Milling Machine	- 1 No
4. Vertical Milling Machine	- 1 No
5. Surface Grinding Machine	- 1 No
6. Tool Dynamometer	- 1 No
7. Gear Hobbing Machine	- 1 No
8. CNC Lathe (Trainer or Industrial Type)	- 1No

L	T	P	C
0	0	3	1

MHB235	MICROPROCESSOR AND MICROCONTROLLER LAB	1 Credit
Goal	To study the logic and design of microprocessor and microcontrollers.	

Objectives	Outcome
The course should enable the students to provide opportunity for the students to understand the design and application of Microprocessor & Microcontroller.	The students should be able to Solve the various programming exercises and understand the application and importance of Microprocessor & Microcontroller.

LIST OF EXPERIMENTS

1. 8 bit Addition, Subtraction
2. Multiplication and Division
3. Addition with carry
4. Maximum and Minimum of block of data
5. Sorting
6. Block transfer
7. Stepper Motor Interfacing
8. Study of Microcontroller Kits.
9. 8051 / 8031 Programming Exercises.
10. D.C. motor controller interface.
11. Study of interrupt structure of 8051.

LIST OF EQUIPMENTS(for a batch of 30 students)

1. Voltmeters - 5 No.
2. Ammeters - 5 No.
3. Microprocessor Kits – 8085 - 5 No.
4. Microcontroller Kit -5 No.
5. D/A Converter Interface - 1 No.
6. Stepper Motor Interface - 1 No.
7. CRO - 1 No.
8. DC Motor – 1 No.

L	T	P	C
2	0	2	3

MHB237	FLUID MECHANICS AND MACHINERY LAB	3 CREDIT
Goal	To impart knowledge on the fluid flow concepts and to apply, understand, and validate the concepts of fluid mechanics practically	

Objectives	**Outcome**
The course should enable the students to 1. Provide knowledge on calibration Technologies 2. Measure and analyze the flow parameters 3. Understand the concepts of fluid mechanics practically	The students should be able to 1. Determine co-efficient of discharge 2. Apply Bernoulli equation for fluid flow 3. Impart knowledge on the fluid flow concepts and to validate practically

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Roto meter.
4. Determination of friction factor of given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL : 45

LIST OF EQUIPMENT (for a batch of 30 students)

1.	Orifice meter setup	- 1 No.
2.	Venturi meter setup	- 1 No.
3.	Rotometer setup	- 1 No.
4.	Pipe Flow analysis setup	- 1 No.
5.	Centrifugal pump/submergible pump setup	- 1 No.
6.	Reciprocating pump setup	- 1 No.
7.	Gear pumps setup	- 1 No.
8.	Pelton wheel setup	- 1 No.
9.	Francis turbine setup	- 1 No.
10.	Kaplan turbine setup	- 1 No.

L	T	P	C
0	0	0	2

MHB3236	**DESIGN PROJECT - 1**	**2 Credits**
Goal	To provide practical knowledge on the various components design and manufacturing aspects of a commercially available Mechanical utility.	

Objectives	**Outcome**
The course should enable the students to 1. Expose the students to actual design aspects by providing hands on skills.	The students should be able to 1. Identify various components, materials used, manufacturing process involved and assembly and dismantle of that commercial object.

Exercises:

- To Dismantle and identify the various components, material used, manufacturing process involved and to assemble any Mechatronics system.

A student will have to defend his project/thesis and credit will be given on the merit of viva-voce Examination.

L	T	P	C
1	0	1	1

SSA232 - APTITUDE – II

PURPOSE:
The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

1. To guide thought process
2. Appear for placement aptitude tests confidently
3. To develop Communication skill
4. To build confidence
5. Acquire aptitude skills for employment

METHODOLOGY:

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group Activities + Individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure participation
5. Empirical learning

QUANTITATIVE APTITUDE:

Sample Equation, Ratio, Proportion, Variation
Percentage, Profit & Loss, Partnership
Averages, Mixtures, Allegations: Simple & Compound Interest
Time Work, Time Distance
Geometry & Mensuration
Permutation, Combination & Probability
Data Interpretation & Data Sufficiency

Analytical reasoning:
Non- Verbal Reasoning
Word problem

EVALUATION:

1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION:

Marks allocated for regular participation in all oral activities in class.

SCHEME OF EXAMINATION:
Complete internal evaluation on regular basis.

SEMESTER V

L	T	P	C
3	1	0	4

MHB301	**MACHINE DYNAMICS**	**4 Credits**
Goal	To expose the students to understand the Dynamics of machinery principles, Force-motion characteristics and the Undesirable effects of unbalanced motion.	

Objectives	**Outcome**
The course should enable the students to: 1. Understand the force-motion relationship in components subjected to External Forces 2. Analyze the force-motion characteristics of standard mechanisms 3. Study the undesirable effects of unbalances resulting from prescribed motions in mechanism. 4. Visualize the effect of Dynamics of 5. Undesirable Vibrations 6. Understand the principles in mechanisms used for governing of Machines. 7. Understand the existing theory of mechanism, together with its shortcomings, the concepts of mobility, degrees of freedom and inertia and be able to understand how these apply to simple mechanisms and machines	The students should be able to: 1. Understand force analysis of Mechanisms and Balancing. 2. Understand free and Forced Vibration of Single degree of freedom systems. 3. Understanding of rigid body dynamics (kinematics) of linkages, design of four bar mechanisms, gyroscopic devices 4. Calculate forces and accelerations in mechanisms 5. Apply typical analytical and graphical techniques, reinforcing and expanding Part I learning, to a variety of mechanical engineering components and systems 6. Apply the mechanisms in practical applications.

UNIT I FORCE ANALYSIS OF MECHANISMS 12

Static, Inertia and combined force analysis – Graphical and analytical method – Slider crank mechanism and four bar mechanism, turning moment diagram and flywheel – Applications in engine, punching presses.

UNIT II BALANCING 12

Static and dynamic balancing – Balancing of rotating masses – Balancing of several masses in different planes – balancing of rotors, balancing machine, unbalance due to reciprocating parts – balancing of inline engines – Firing order – Balancing of V and W engines – Balancing of radial engines – Lanchester technique of engine balancing.

UNIT III FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS 12

Periodic motion – non harmonic periodic motion – Fourier analysis – un-damped free vibration – linear and torsion solution – natural frequency of single degree freedom system – Bifilar, Trifler suspensions – Free vibrations with viscous damping of single degree freedom system and solution – logarithmic decrement.

UNIT IV FORCED VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS 12

Forced vibration of single degree freedom system with damping – reciprocating and rotating unbalance – vibration isolation and transmissibility – base excitation – self excited vibrations with examples.

UNIT V MECHANISMS FOR CONTROL 12

Governors: Types-Centrifugalgovernors-Gravitycontrolledandspringcontrolledcentrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms.

Gyroscopes: GyroscopicforcesandTorques-Gyroscopicstabilization-Gyroscopiceffects in Automobiles, ships and airplanes

TOTAL: 60

TEXT BOOKS

1. Grover.G.K., *Mechanical vibrations*, 7th Edition, Nem Chand & Bros, Roorkee, India, 2001.
2. Thomson, W.T. *Theory of Vibration with Applications*, 3rd Edition, CBS Publishers, New Delhi, 2002.
3. Shingley, J.E. & John Joseph Uivker, Jr., *Theory of Machines and Mechanisms*, 2nd edition, McGraw – Hill International Editions, London, 1981.
4. Ghosh A. and Malik, A.M. *Theory of Mechanisms and machines*, 2nd edition, Affiliated East – West Press Pvt. Ltd., New Delhi, 1988

REFERENCES

1. Francis. TSE. Ivan E-Morse Rolland T. Hinkle, *Mechanical Vibrations*, 2nd edition, CBS Publishers and Distributed, India, 1983.
2. Rao, J.S., and Dukkipatti, R.V., *Mechanism and machinery theory*, 2nd Edition, New age international, Mumbai, 1992.

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3	0	0	3

MHB302	**METROLOGYAND MEASUREMENT**	**3 Credits**
Goal	Tounderstandtheprinciplesofmetrologyandmeasurements,methodsofmeasurementand its application in manufacturing industries.	

Objectives	**Outcome**
The course should enable the students to 1. Focus on issues related to accuracy, selection 2. Learn calibration of measuring Instruments 3. Select and use various measuring instruments used in workshops and other applications. 4. Understand the advanced concepts involved in measuring Technology (measurements)	The students should be able to 1. Use precision measurement instruments found in a workshop (metrology) 2. Examine the design critically and to understand the use of precision measuring instruments commonly found in various applications. 3. Select the right measuring tool with decided accuracy for a given application 4. Appreciate the importance of accuracy and its effects on results and its uncertainty

UNIT I CONCEPT OF MEASUREMENT 9

General concept–Generalized 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.

UNIT II LINEAR ANDANGULAR MEASUREMENT 9

Definition of Metrology - Linear measuring instruments: Vernier, Micrometer, internal Measurement, Slip gauges and classification, Interferometer, optical flats, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: Sine bar, optical bevel protractor, angle Decker – Taper Measurements

UNIT III FORM MEASUREMENT 9

Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gear-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements.

UNIT IV LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE RELATED PROPERTIES 9

Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotameter, Pitot tube. Temperature:-Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister.

TOTAL: 45

TEXT BOOKS

1. Jain R.K., *Engineering Metrology*, Khanna Publishers, New Delhi.2008.
2. Alan S. Morris, *The Essence of Measurement*, Prentice Hall of India, 1997

REFERENCES

1. Gupta S.C, *Engineering Metrology*, Dhanpatrai Publications, 1994.
2. JayalA.K, *Instrumentation and Mechanical Measurements*, Galgotia Publications 2000
3. BeckwithT.G, and N. Lewis Buck, *Mechanical Measurements*, AddisonWesley, 2009.
4. Donald D Eckman, *Industrial Instrumentation*, Wiley Eastern,New Delhi, 2004.

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3	1	0	4

MHB303	**HYDRAULICS & PNEUMATICS**	**4 Credits**
Goal	To expose the students in Hydraulic and Pneumatic Power Systems, its various components and methods of designing.	

Objectives	**Outcome**
The course should enable the students to: 1. Know the advantages and applications of Fluid Power Engineering and Power Transmission Systems. 2. LearntheApplicationsofFluidPowerSystemina utomationofMachineToolsandothers equipment.	The students should be able to: 1. Understand the advantages of Fluid Power Systems and various components of Fluid Power Systems. 2. Differentiate the merits between the Hydraulic and Pneumatic Power Systems. 3. Design the Fluid Power Systems applicable in automation of Machine Tools and other Equipment.

UNIT I FLUID POWERSYSTEMSAND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids– Fluidpower symbols. Basics of Hydraulics – Applications of Pascal's Law – Laminar and Turbulent flow–Reynolds number – Darcy's equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM & COMPONENTS 9

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 – standards and symbols

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Construction of Control Components: Direction control valve–3/2wayvalve–4/2way 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. Accumulators and Intensifiers: Types of accumulators–Accumulators circuits, sizing of accumulators, intensifier –Applications of Intensifier – Intensifier circuit.

UNIT IV PNEUMATIC SYSTEMSAND COMPONENTS 9

PneumaticComponents:Propertiesofair–Compressors–Filter,Regulator,LubricatorUnit –Air control valves, Quick exhaust valves, and pneumatic actuators.Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumatic and Hydraulic circuit, Sequential circuit design for simple applications using cascade method – standards and symbols

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportionalvalves.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.

TUTORIALS : 15

TOTAL: 45

TEXT BOOK

1 . AnthonyEsposito,*Fluid Power with Applications*, Pearson Education 2000.
2. MajumdarS.R.,*Oil Hydraulics,*Tata McGraw-Hill, New Delhi 2009.

REFERENCES

1. Majumdar S.R., *Pneumatic systems – Principles and maintenance*,Tata McGraw Hill,

New Delhi 2005.

2. Anthony Lal, *Oil hydraulics in the service of industry*, Allied publishers, 1982.

3. Harry Stevart D.B,*Practical guide to fluid power*, Taraoealasons and Port Ltd. Broadey,1976.

4. Michael J, Prinches and Ashby J. G, *Power Hydraulics*, Prentice Hall, 1989.

5. Dudelyt,A. Pease and John T. Pippenger, *Basic Fluid Power*, Prentice Hall

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0	0	3	1

MHB331	**KINEMATICS AND DYNAMICS LAB**	**1 Credit**
Goal	To expose the students about the static and dynamic behavior of the machines	

Objectives	**Outcome**
The course should enable the students to: 1. Use of various measurement methods 2. Verify the laws governing the dynamics of machines 3. Do the case studies on the field of Vibration	The students should be able to: 1. Develop the concept of various measurement methods 2. Know about the laws governing the dynamics of machines such as Balancing of Rotating and Reciprocating Mass, Jump phenomenon in Cams, Sensitivity effort in Governors Etc., 3. Know about different types of vibrations and its applications.

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. Motorized Gyroscope-Verification of laws -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. D etermination of moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibratingsystem-Springmasssystem-Determinationofdampingco-efficientofsingledegree of freedom system.
9. Determination of influence co-efficient for multi degree 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: 45

LIST OF EQUIPMENTS(For a batch of 30 students)

1. Cam analyzer.
2. Motorized gyroscope.
3. Governor apparatus - Watt, Porter, Proell and Hartnell governors.
4. Whirling of shaft apparatus.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus

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0	0	3	1

MHB332	METROLOGY AND MEASUREMENTS LAB	1 Credit
Goal	To impart the knowledge about various measurement techniques	

Objectives	Outcome
The course should enable the students to 1. Study of calibrations of measuring devices 2. Measurement of form, angle, thread etc.,	The students should be able to 1. Understand the Calibration procedures 2. Gain knowledge about form, angle and thread measurement. 3. Exposure to CMM and Surface Measurements

LIST OF EXPERIMENTS

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of GearTooth Dimensions
4. Measurement of Taper Angle using sine bar /Tool Makers microscope
5. Mmeasurement of straightness and flatness
6. Measurement of thread parameters
7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
8. Measurement of Vibration / Shock

TOTAL: 45

LIST OF EQUIPMENTS(For a batch of 30 students)

1.	Micrometer	-	5 No
2.	Vernier Caliper	-	5 No
3.	Vernier Height Gauge	-	2 No
4.	Vernier Depth Gauge	-	2 No
5.	Slip Gauge Set	-	1 No
6.	Gear Tooth Vernier	-	1 No
7.	Sine Bar	-	2 No
8.	Bevel Protractor	-	1 No
9.	Floating Carriage Micrometer	-	1 No
10.	Profile Projector	-	1 No
11.	Mechanical / Electrical / Pneumatic	-	1 No
12.	CMM	-	1 No
13.	Surface Profilometer	-	1 No
14.	Vibration / Shock Measuring	-	1
15	Interferometer	-	1
16	Autocollimator	-	1

L	T	P	C
0	0	3	1

MHB333	HYDRAULICS AND PNEUMATICS LAB	1 Credit
Goal	To expose the students about the Design of hydraulic pneumatic circuits	

Objectives	**Outcome**
The course should enable the students to: 1. Study of hydraulic and pneumatic circuits. 2. Understand the modeling and analysis of basic electrical, hydraulic, and pneumatic systems using 3. Understand the basics of simulation of hydraulic, pneumatic and electrical circuits	The students should be able to: 1. Develop the concept of designing hydraulic and pneumatic circuits 2. Test the various hydraulic and pneumatic circuits. 3. Model and simulate the basic electrical, hydraulic, and pneumatic systems 4. Develop and test the process integration for a complete automatic process.

LIST OF EXPERIMENTS

Design and testing of pneumatic circuits to understand the Pressure control, Flow control, Direction control and advanced control modes. Design of Pneumatic circuits with multiple cylinder sequences- logic controls with timer, counter and verification through Pneumatic kits with different controls.

Design and testing of hydraulic circuits to understand the Pressure control, Flow control, Direction control applications through hydraulic circuits. Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer.

Modeling and Simulation of basic electrical, hydraulic, and pneumatic systems using MATLAB/LABVIEW software or Pneumatic /Hydraulic simulation software.

Process Integration

Automatic Material handling class -material transportation class – conveyor system, and material inspection class – vision based system. AS/RS (automated storage and retrieval system) -integration by advanced programmable logic controllers (PLCs).

TOTAL: 45

LIST OF EQUIPMENT(For a batch of 30 students)

Equipments	**Qty**
Pneumatics Equipments Pneumatic trainer kit with basic FRL Unit, actuators, push buttons, DCV and other basic elements	3
Pneumatic trainer kit with electro pneumatic control	2
PLC interface Pneumatic Kits with Sensors/ magnetic reed switches	3
LABVIEW Software	5
Pneumatic simulation software	5
Hydraulic equipments Pressure relief valve, Pressure reducing valves Flow control valves, Pressure switch Limit switches, Linear actuator, Rotary actuator Double solenoid actuated DCV, Single solenoid actuated DCV	
Hydraulic power pack with 2 pumps	
PLC	
FMS for Process Integration Material handling, inspection, storage and retrieval for any two applications	2 Stations

L	T	P	C
2	0	2	3

MHB334	CONDITION MONITORING AND NON DESTRUCTIVE TESTING LAB	3 Credit
Goal	To expose the students about the Condition Monitoring and NDT Testing Methods	

Objectives	**Outcome**
The course should enable the students to: 1..Study and Understand the necessity of Condition Monitoring Techniques 2. Study of NDT Methods 3. Understand the Sensors, Calibration and Measurement procedures in Ultrasonic, Vibration, Eddy Current , Magnetic Particle, Acoustic Emission and other monitoring methods like force, strain etc.	The students should be able to: 1. Arrange and calibrate the instrumentation for NDT and Condition Monitoring. 2. Test the various defects flaws and monitor the different parameters. 3. Know the ASNT standards and procedures for testing. 4. Interpret the results using different analysis methods

LIST OF EXPERIMENTS

1. Experiments in Ultrasonic Testing, Eddy Current and MPT for the detection of defects in various applications like welding, casting etc.

2. Experiments in condition monitoring applications like shaft misalignment, bearing failure, looseness etc.

TOTAL: 45

LIST OF EQUIPMENT(For a batch of 30 students)

Equipments	**Qty**
Ultrasonic Flaw Detector	1
Acoustic Emission Sensors and Data Acquisition	1
Accelerometers with Data Acquisition – Applications	2
Eddy Current Testing	1
Magnetic Particle Testing	1
Force, Strain, Current Measurements with Data Acquisition	1 set each

SSA331 PRE-PLACEMENT PROGRAM

L	T	P	C
1	0	1	1

PURPOSE

The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

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

1. Acquire the important soft skills for employment
2. Take part is group discussions and job interviews confidently
3. Gain self confidence to face the placement process.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning.

- Resume writing
- SWOT Analysis
- Interview techniques
- Presentation Skills
- Body Language for Interview
- Rules of Group Discussion
- FAQ's

EVALUATION

1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION

Marks allocated for regular participation in all oral activities in class.

SCHEME OF EXAMINATION

Complete internal evaluation on a regular Basis.

SEMESTER VI

	T	P	C
3	0	0	3

MHB304	**SENSORS AND PLC**	**3 Credits**
Goal	To give detailed discussion on the 8051 Microcontroller and its application. In addition the basic concepts and programming of PLC is also introduced which is very much required in the emerging field of automation.	

Objectives	**Outcome**
The course should enable the students to: 1. Learn 8051 Microcontroller architecture. 2. Learn 8051 Microcontroller Design. 3. Learn 8051 Microcontroller applications. 4. Learn Programmable Logic controllers.	The students should be able to 1. Write the assembly language in8051 microcontroller. 2. Gain the detailed knowledge in 8051 microcontroller Design. 3. Write ladder logic in Programmable logic controllers.

UNIT I SENSORS AND TRANSDUCERS 9

Sensors and classifications – Characteristics environmental parameters – Inductive and capacitive sensors, Force / stress sensors using quartz resonator – Ultrasonic sensors.

UNIT II SIGNAL CONDITIONING 9

Amplification, Filtering – Level conversion – Linearisation - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter.

UNIT III DATA ACQUISITION 9

Data Acquisition conversion-General configuration-single channel & multichannel data acquisition – Digital filtering – Data Logging – Data conversion – Introduction To Digital Transmission system.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction – Parts of PLC – Principles of operation – PLC sizes – PLC hardware components – I/O section Analog I/O Section Analog I/O modules – digital I/O modules CPU processor memory module – Programming devices – PLC programming Simple instructions – Manually operated switches – Mechanically operated and Proximity switches - Output control devices - Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

UNIT V APPLICATIONS OF PLC 9

Timer Instructions On Delay, Off Delay And Retentive Timers, Up Counter, Down Counter And Up Down Counters, Control Instructions – Data Manipulating Instructions, Match Instructions: Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application.

TOTAL: 45

TEXT BOOKS

1. Patranabis. D, Sensors and Transducers, 2nd edition PHI, New Delhi, 2003.
2. Frank D. Petruzella. Programmable Logic Controllers, McGraw–Hill Book, Company, 1989.
3. David G. Alciatore and Michael B.Histand, Introduction to Mechatronics and Measurement systems, 2nd edition Tata McGraw-Hill, 2003.

REFERENCES

1. Ernest O.Doebelin, Measurement Systems – Applications and Design, Tata McGraw-Hill, 2004.

2. Murthy DVS, Transducers and Instrumentation, PHI, New Delhi – 2003.

3. C.S. Rangan, G.R. Sarma, VSV.Mani, Instrumentation Devices and Systems, 2nd edition, Tata McGraw-Hill Publishing company Ltd, 2002.

L	T	P	C
3	1	0	4

MHB305	VIRTUAL INSTRUMENTATION	4 Credits
Goal	The objective is to give an extensive information and application of virtual instrumentation for all types of measurement systems and analysis.	

Objectives	Outcome
The course should enable the students to:	The students should be able to:
1. Learn about the basics of the Virtual instrumentation	1. Know about the basics of the Virtual instrumentation
2. Learn about the architecture of LABVIEW	2. Know about the architecture of LABVIEW
3. Learn about programming in LABVIEW	3. Know about programming in LABVIEW

UNIT I INTRODUCTION TO VI **9**

Comparison of traditional instruments with Virtual Instruments- –Advantages of Virtual Instruments over conventional instruments –General functional description of a digital instrument- Block diagram of a Virtual Instrument – Physical quantities and analog interfaces- Hardware and Software – User Interfaces Architecture of a Virtual Instruments and its relation to the operating system.

UNIT II INTRODUCTION TO LabVIEW PROGRAMMING **9**

Concepts of graphical programming language LabVIEW – Concept of VIs and sub VI – Graphs & charts – Dataflow programming - Loops – Case and sequence structures - Types of data – Arrays & clusters – Formula nodes –math scrip integration - Local and global variables – String and file I/O – Building executables and installers – Web publishing tools

UNIT III DATA ACQUISITION SYSTEMS& BUS INTERFACE **9**

Basics of DAQ Hardware– Concepts of Data Acquisition and terminology- Sampling Rate, Resolution, Dynamic Range, Single & Differential End, Grounding, Sampling mode, Different type of DAQ interface to PC – Comparison and advantages of PCI, PXI, USB, Ethernet, WIFI based DAQ system – Importance of MAX, Standards RS 232, RS 485, IEEE 488.2

UNIT IV CASE STUDIES – MEASUREMENTS **9**

Analog, Digital measurements for various applications- Temperature, Pressure, Strain, Speed, Sound, Vibration etc, - Calibration- Data logging using File functions

UNIT V CASE STUDIES- ANALYSIS TOOLS IN LabVIEW **9**

Build virtual instruments like oscilloscope, FFT analyzer –Introduction Vision Development module – Introduction to Biomedical Signal processing using Biomedical toolkit –Introduction to NI Motion Toolkit - Building autonomous embedded system using FPGA target

TOTAL : 45

TEXT BOOKS

1. Garry M. Johnson, LabVIEW Graphical Programming, Tata McGraw-Hill, Edition, 1996

2. Lisa.K.Wills, LabVIEW for Everyone Prentice Hall of India, 1996.

REFERENCES

1. Labview Basics I and II Manual, National Instruments, 2003

2. Barry Paton, Sensor, Transducers and Lab VIEW, Prentice Hall, 2000.

L	T	P	C
3	0	0	3

MHB306	**CNC TECHNOLOGY**	**3 Credits**
Goal	To expose the students to different types of machining methods adopted recently with the present technologies which provides lesser manufacturing lead-time and accuracy to the components.	

Objectives	**Outcome**
The course should enable the students to: 1. Learn the fundamentals of CNC machines. 2. Understand the constructional features of CNC machines and Retrofitting. 3. Learn the concepts of control systems, Feed back devices and tooling. 4. Understand the CNC part programming 5. Learn about the economics and maintenance of CNC machines	The students should be able to: 1. Develop knowledge on the hardware of CNC machines. 2. Know the concepts of constructional features CNC machines. 3. Know the different controls, Feedback devices, tooling and their selection. 4. Develop the CNC part programming for different profiles and to get the knowledge in maintenance of CNC machines.

UNIT I FUNDAMENTALS OF CNC MACHINES 9

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

UNIT II CONSTRUCTIONAL FEATURES OF CNC MACHINES AND RETROFITTING 10

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

UNIT III CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING 10

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

UNIT IV CNC PART PROGRAMMING 9

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

UNIT V ECONOMICS AND MAINTENANCE 7

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

TOTAL : 45

TEXT BOOK

1. YoreurKoren, Computer Control of Manufacturing Systems, Pitman, London, 1987.

REFERENCES

1. Radhakrishnan P., Computer Numerical Control Machines, New Central Book Agency, 1992.
2. Berry Leatham – Jones, Computer Numerical Control, Pitman, London, 1987.
3. SteaveKrar and Arthur Gill, CNC Technology and Programming, McGraw–Hill Publishing Company, 1990.
4. Hans B.Kief andT.Frederick Waters, Computer Numerical Control Macmillan/McGraw-Hill, 1992.
5. G.E.Thyer, Computer Numerical Control of Machine Tools. Second Edition, B/H Newnes, 1993.
6. Groover, M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall, 1998.
7. Mike Mattson, CNC Programming Thomson Learning, 2003.

L	T	P	C
0	0	3	1

MHB335	PLC AND MOTION CONTROL LAB	1 Credit
Goal	To expose the students about the PLC and Motion Control Applications	

Objectives	**Outcome**
The course should enable the students to: 1. Study and Understand the PLC Hardware and programming 2. Study of Conveyor, Elevator Systems 3. Study of rotary indexing and XY axis control. 4. Understand the closed loop control application	The students should be able to: 1. Write the programming and do the looping for simple PLC applications 2. Apply the motion control for Uni-axial and dual control applications 3. Design, Programming and Interface the different subsystems of motion control applications with robot

Experiments

1. Conveyor System - Uni axial , Dual axial control applications
2. Material Elevator - Vertical material handling application
3. Linear Operation : X-Y Table , Pushing applications
4. Rotating Operation : Indexing table /Positioning applications
5. Feeding:: Feeding application like cut to length application or Labelling Application
6. Closed Loop Control of Pressure, Temperature
7. Integration Options

Equipments Required:

- Drive Systems with accessories - 2 (for dual axial control)
- Motors as required
- PLC-4
- Conveyor accessories - 1 set
- Speed, Torque control method with accessories
- Drive Systems with accessories - 2 (for dual axial control)
- Conveyor accessories - 1 set
- Servo Drive / Motion Controller
- Flying shear tool with linear motorsand control accessories (Dual Direction)
- Motors - 2
- Lead screws, Table with Other accessories - 1 set
- Encoders and accessories- 1 set
- Variable Frequency Drive
- Pressure, Temperature control using PLC - Accessories

L	T	P	C
0	0	3	1

MHB336	VIRTUAL INSTRUMENTATION LAB	1 Credit
Goal	Understand and implement the techniques of virtual instrumentation. Design real time measurement and control circuits using LabVIEW and data acquisition systems.	

Objectives	**Outcome**
The course should enable the students to: 1. Study and Understand the Virtual Instrumentation Platform like LabVIEW 2. Study of basic VI, data structures, interfacing, signal processing, analysis and documentation 3. Understand and appreciate the applications of VI applications	The students should be able to: 1. Write the GUI programming for different measurement applications 2. Create the applications y the motion control for Uni axial and dual control applications 3. Design, Programming and Interface the different subsystems of motion control applications with robot

Experiments:

1. LabVIEW simple program (Temperature conversion, calculator)
2. LabVIEW programming (loops, strings, file I/O, arrays)
3. Simulate sine signal and display in time & frequency domain
4. Design LPF, HPF, BPF using LabVIEW
5. Math script interface in LabVIEW using Math script node
6. Data acquisition from different sensors like temperature, strain, Vibration etc
7. Acquire ECG signal using NI DAQ & display in LabVIEW
8. Perform GPIB port communication
9. Perform Image processing algorithms using VISION toolkit
10. Develop a DC motor control using NI hardware and software
11. Design of PID Controller using LabVIEW
12. Real time sequential control of any batch process.

L	T	P	C
0	0	3	1

MHB337	**CNC Lab**	**1 Credit**
Goal	To expose the students in CNC manual part programming and computer assisted part of programming	

Objectives	**Outcome**
The course should enable the students to: 1. Learn the Manual part programming and operation of CNC Lathe & Milling 2. Learn the computer assisted part programming	The students should be able to: 1. Write the programming for different profiles. 2. Use the computer assisted part programming method for the generation of CNC code. 3. Perform different profiles through CNC machine/ router machine. 4. Perform simulation for CNC code generation and optimization

LIST OF EXPERIMENTS

1. STUDY OF CNC MACHINE COMPONENTS TO UNDERSTAND THE SUBSYSTEMS OF CNC, CONTROLS AND INTERFACE.

2. MANUAL PART PROGRAMMING (Using G and M Codes) in CNC lathe

Part programming for Linear and Circular interpolation, Chamfering and Grooving.
Part programming using standard canned cycles for Turning, Facing, Taper turning and Thread cutting.

3. MANUAL PART PROGRAMMING (using G and M codes) in CNC milling

Part programming for Linear and Circular interpolation and Contour motions.
Part programming involving canned cycles for Drilling, Peck drilling, and Boring.

4. CNC MACHINING OPERATION, MAINTENANCE, RELATED MEASUREMENTS AND SAFETY

5. SIMULATION AND CNC CODE GENERATION

NC code generation using CAD/CAM software-Post processing for standard CNC Controls.

5. SIMULATION: CYCLE TIME OPTIMIZATION AND COLLISION DETECTION

TOTAL: 45

LIST OF EQUIPMENTS FOR CAM LAB (For a batch of 30 students)

I . HARDWARES

1. Computer server -1 No.
2. Computer nodes or systems (Pentium IV with 256MB Ram) networked to the serve -30 Nos.
3. size plotter - 2 Nos.
4. Laser Printer -2 Nos.
5. Trainer CNC lathe -2 Nos.
6. Trainer CNC milling -2 Nos.
7. CNC Milling centre - 1 No.
8. CNC Turing Centre - 1 No.
9. CNC Laser cutting machine - 2 Nos.
10. CNC Lathe for study purpose - 1 No.

II.SOFTWARES

1. CAD/CAM Software -15 licenses
   (Pro –E or IDEAS or Unigraphics or CATIA)
2. CAM Software -15 licenses
   (CNC programming and tool path simulation for FANUC, Siemens' controller)

L	T	P	C
0	0	6	2

MHB338	**DESIGN PROJECT-II**	**2 Credits**
Goal	To make the students innovative and skilled in design and fabrication work, also to improve the conceptual knowledge of the students	

Objectives	**Outcome**
The course should enable the students to: 1. Provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems. 2. Make the students come up with new ideas in their area of interest. 3. Create interest in engineering by making them to fabricate the concept of their imagination. 4. Learn the concepts more in depth by providing guidance. 5. Enhance the knowledge and understanding of the subjects thoroughly. 6. Analyse with reasoning the various concepts involved in mechanical engineering.	The students should be able to: 1. Do experiment with his ideas. 2. Troubleshoot practical problems. 3. Understand the latest trends in fabrication 4. Relate their ideas with industrial applications 5. Have adequate knowledge and conceptual skills 6. Have confidence in facing interviews and written exams 7. Qualify in competitive exams

NOTE

1. Thestudentsinconvenientgroupsofnotmorethan4membershavetotakeonesmall item for design and fabrication. Every project work shall have guide who is the member of the faculty of the institution.
2. Students will be exposed to lecture modules on Project and Thesis work followed by assignment of individual projects involving Mechatronics design of an engineering product. An Industrial project may also be undertaken by the student to be supervised jointly by Industry personnel and the teacher.
3. A student will have to appear for a Comprehensive Viva-Voce examination covering all the subjects before a board of examiners including an external expert.

VII SEMESTER

L	T	P	C
3	0	0	3

MHB401	**DESIGN OF MECHATRONICS SYSTEM**	**3 Credits**
Goal	Toexpose the students to an integrated approach to the design of complex engineering systems involving Electrical, Mechanical and Computer Engineering.	

Objectives	**Outcome**
The course should enable the students to: 1. Introduce the Mechatronics system and system modelling 2. Learn real time interfacing. 3. Understand case studies on Data Acquisition and control. 4. Learn about advanced applications in Mechatronics.	The students should be able to: 1. Know the difference between traditional and mechatronics system and model basic electro mechanical systems 2. Get knowledge in real time interfacing. 3. Solve case studies on data acquisition and control. 4. Gain the knowledge on advanced applications in mechatronics.

UNIT I INTRODUCTION TO MECHANICS SYSTEM DESIGN **10**

Introduction to Mechatronics system – Key elements – Mechatronics Design process – Types of Design – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Man machine interface, industrial design and ergonomics, safety.

UNIT II INTERFACING AND DATA ACQUISITION **7**

Real-time interfacing – Introduction - Elements of data acquisition and control - Overview of I/O process, Analog signals, discrete signals, and Frequency signals.

UNIT III SYSTEM MODELLING

10

Basic building blocks of system modelling. Modelling of mechanical system- Modelling of mechanical and electrical systems - Simple exercises in linear, rotary motions

UNIT IV CASE STUDIES **10**

Case studies on Data Acquisition: Introduction – Cantilever Beam Force Measurement system–Vibration and Sound Measurement – Strain gauge weighing system –Force-Displacement calibration system – Rotary optical encoder – Controlling temperature of a hot/cold reservoir – pick and place robot.

UNIT V Case Studies **8**

Advanced applications in Mechatronics: Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics

TOTAL: 45

TEXT BOOK

1. Devdasshetty, Richard A. Kolk, Mechatronics System Design, Thomson Learning Publishing Company, Vikas publishing house, 2001.

REFERENCES

1. Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.

2. Brian Morriss, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, McGraw Hill International Edition, 1995.

3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.

L	T	P	C
3	0	0	3

MHB402	ROBOTICS AND MACHINE VISION SYSTEM	3 Credits
Goal	To introduce the hardware and programming concepts of industrial robots and their applications.	

Objectives	**Outcome**
The course should enable the students to 1. Learn the concepts of robot kinematics. 2. Learn the principles of robot drives and controls. 3. Learn the sensors used in robots. 4. Learn the robot cell design. 5. Learn the concepts of expert systems.	The students should be able to 1. Understand the kinematics of robots and adaptive control. 2. Understand the robot actuators and controls. 3. Get knowledge in sensors and selection of sensors for specific need. 4. Get knowledge in robot cell layouts and their applications. 5. Get knowledge in robot programming and artificial 6. intelligence and machine vision.

UNIT I DRIVES AND CONTROLS **9**

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement.

Drives and control systems: Hydraulic systems, power supply – servo valve – sump – hydraulic motor – DC servo motors – stepper motors – operation.

Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link – Road Systems, Rotary to linear motion conversion, Ract and pinion drives, ball bearing screws, speed reducers, Harmonic drives.

UNIT II KINEMATICS OF ROBOT **10**

Kinematics of Robot: Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning.

UNIT III GRIPPERS AND SENSORS 8

Robot End Effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers – Robot end effector interface.

Sensors: Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers.

UNIT IV MACHINE VISION 9

Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations.

UNIT V IMAGE PROCESSING 9

Feature Extraction: Geometry of curves – Curve approximation, Texture analysis, Image resolution – Depth and volume, Color processing, Object recognition by features, Depth measurement, specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression, Real time Image processing, Application of Vision systems.

TOTAL : 45

TEXT BOOK

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)

REFERENCES

1. M.P. Groover, Industrial Robotics – Technology, Programming and Applications, McGraw-Hill USA, 1986.
2. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991.
3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

L	T	P	C
3	0	0	3

MHB403	ARTIFICIAL INTELLIGENCE FOR MECHATRONICS SYSTEMS	3 Credits
Goal	To provide the basic exposition to goals and methods of Artificial Intelligence for mechatronics system	

Objectives	**Outcome**
The course should enable the student 1. To understand the representation of agents and agent environments. 2. To understand the searching techniques 3. To know the knowledge representation and learning 4. To enable the students to apply these techniques in application which involve perception, reasoning and learning 5. To know the features of expert systems	The students should be able to 1. Develop a basic understanding of the building blocks of AI 2. Understand the main approaches to artificial intelligence such as heuristic search, game and search. 3. Understand machine learning, neural networks and natural language processing. 4. Recognize problems that may be solved using artificial intelligence and implement artificial intelligence algorithms 5. Develop expert systems for an application.

UNIT IINTRODUCTION **9**

Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems – searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information, Case study in part recognition applications

UNIT II PRINCIPLES OF DECISION-MAKING **9**

Crisp and Fuzzy Logic-Decision Trees-Case-based Reasoning-Bayesian Belief Networks-Path Planning-Voronoi Diagrams, Case study – Washing machine

UNIT III SEARCHING TECHNIQUES **9**

Motion Planning-Compute Cost-Optimal Path-First Search Program-Expansion Grid-Dynamic Programming-Computing Value-Optimal Policy-Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision, case study – eight queens problems

UNIT IV NEURAL NETWORKS AND EXPERT SYSTEMS **9**

Evaluation and Search-Genetic Algorithms-Simulated Annealing-Particle Swarm Optimization-Neural Networks-Static Networks-Associative Networks-Cerebellar Model Articulation Controller-Expert Systems-Production Systems-Forward Chaining-Backward Chaining, Case study -Prediction system

UNIT V SLAM (Simultaneous Localization and Mapping) **9**

Localization-Planning-Fun with Parameters-SLAM-Graph SLAM-Implementing Constraints-Adding Landmarks-Matrix Modification-Untouched Fields-Landmark Position-Confident Measurements-Implementing SLAM, Case study-obstacle avoidance

TOTAL: 45

Text Books

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 2nd Edition, Pearson Education / Prentice Hall of India, 2004.
2. Donald A.Waterman, ‘A Guide to Expert Systems’, Pearson Education.

Reference Books

1. Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd., 2000.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.
3. George F. Luger, “Artificial Intelligence-Structures And Strategies For Complex Problem Solving”, Pearson Education / PHI, 2002.
4. Janakiraman, K. Sarukesi, ‘Foundations of Artificial Intelligence and Expert Systems’, Macmillan Series in Computer Science.
5. W. Patterson, ‘Introduction to Artificial Intelligence and Expert Systems’, Prentice Hall of India, 2003

L	T	P	C
0	0	3	1

MHB431	ROBOTICS AND MACHINE VISION SYSTEM LAB	1 Credit
Goal	To expose the students about the kinematics, control and programming of robots	

Objectives	**Outcome**
The course should enable the students to: 1. Learn about different types of robots 2. Learn about different types of of links and joints used in robots 3. Understanding about Robots and Programming 4. Learn the applications of vision system in robot	The students should be able to: 1. Know about different types of robots and their applications 2. Know about different types of kinematics and select a suitable robot for a specific application. 3. Do basic programming in Robots 4. Use vision for assembly and inspection

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Programming of Industrial Robot for material handling application
5. Programming of industrial robot for processing application
6. Interfacing of conveyor with industrial robot and exercises related to robot – conveyor systems
7. Robot work cell simulation – exercises
8. Robot programming exercises for various applications

(Point-to-point and continuous path programming)

9. Study of vision system and use it for assembly and inspection

LIST OF EQUIPMENT(For a batch of 30 students)

S.No	Name of the Equipment/components	No. of Items
1	Any one type of robot configuration with at least five degree of freedom.	1 set
2	Robot programming software inclusive of computer system.	15 licenses
3	Models of different types of end effectors drive systems Links and	5 each
4	Joints.	5 each
5	Models of different configuration robots	5 sets
6	Instruments for measuring accuracy	1 set
	Basic Vision System	

L	T	P	C
2	0	2	3

MHB432	BUILDING AUTOMATION SYSTEM LAB	3 Credits
Goal	. Provide the student with an advanced knowledge base and understanding of the design, simulation and safety of Building Automation System (BAS).	

Objectives	**Outcome**
The course should enable the students to 1. Identify and describe the major components in a BAS 2. Understand the controls in an HVAC control system 3. Understand the basic functions BAS 4. Describe and explain HMI basics Explain BAS in lighting, fire, security, etc.	The students should be able to 1. Select and devise different transducers, actuators and control systems for HVAC systems in a basic BAS 2. Perform simulation of simple BAS modules 3. Design and installation methods of safety sensors for simple application 4. Know the procedure for integrated and secure smart building techniques *5.* Interface of subsystems of BAS with PLC and SCADA

Exercises

1. Exercises on HVAC CONTROLS AND INSTRUMENTATION
2. Exercises on CONTROLLERS and Networking with basic functions
3. Exercises on Lightning and Air Handlers
4. Exercises on HMI, PLC and SCADA
5. Site visits for understanding the BAS in modern buildings.

L	T	P	C
2	0	2	3

ATB435	AUTOTRONICS LAB	3 Credits
Goal	This Course allows students to know about Automotive Electronics in modern automotive technology.	

Objectives	**Outcome**
The course should enable the students to Understand the basic concept of vehicle Electrical and electronics system in automobile and starting system, Charging system, ECM in & out signal, sensor and actuator.	The students should be able to Describe the functionality and trouble shoot the problem in vehicle Electrical and electronics system in automobile and starting system, charging system, ECM in & out signal, sensor and actuator.

List of experiments

- Circuit diagrams
- Field actions
- Vehicle Self-Diagnosis (VSD)
- Guided Fault Finding
- Replacing Control Modules
- Configuring Control Modules
- Reading Measuring Value Blocks
- Reading general system description
- Performing component tests on electronic systems
- Reading fault memory entries
- Input & Output Signal processing

List of Equipments :

- Off board Diagnostic Information System Service
- Test Instruments
- A/C convenience

L	T	P	C
0	0	0	2

MHB433	COMPREHENSION &VIVA-VOCE II	2 Credits
Goal	To make the students innovative and skilled in design and fabrication work, also to improve the conceptual knowledge of the students	

Objectives	**Outcome**
The course should enable the students to: 1. Provide opportunity for the students to recall the concepts of mechatronics acquired in the previous semesters. 2. Remember the basic engineering concepts and to know where it should be applied. 3. Learn the concepts more in depth by providing guidance. 4. Enhance the knowledge and understanding of the subjects thoroughly. 5. Analyse with reasoning the various concepts involved in mechatronics engineering.	The students should be able to: 1. Understand the latest trends in mechatronics and appreciate the latest techniques 2. Relate their ideas with industrial applications 3. Have adequate multi disciplinary knowledge and conceptual skills 4. Have confidence in facing interviews and written exams 5. Qualify in competitive exams

NOTE

1. Students will be reviewing theconcepts of mechatronics engineering in the previous semesters through seminars, group discussions and comprehensive examination.

2. A student will have to appear for a Comprehensive Viva-Voce examination covering all the subjects before a board of examiners including an external expert.

Semester VIII

L	T	P	C
3	0	0	3

CYA102	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**3 Credits**
Goal	To impart basic knowledge on the significance of environmental science for engineers.	

Objectives	**Outcome**
The course should enable the students to 1. To make the students aware of the existing natural resources such as forest water resources etc. and to educate them to understand the need for preserving the resources. 2. To educate the students about the functions of various ecosystems and biodiversity. 3. To provide knowledge on the various aspects of different types of pollution such as air pollution, water pollution, soil pollution etc. 4. To give a basic knowledge on the social issues such as global warming, acid rain, ozone layer depletion, nuclear hazards etc. and to educate them about the various Environmental Protection Acts and ill effects of fireworks. 5. To create an awareness among the present generation about the various aspects of human population and their effect on environment.	The students should be able to 1. The students would have understood the effects of over exploitation of water resources, forest resources etc. and their impact on day to day life on earth. 2. Knowledge on the functions of several of ecosystems will help the students to design the processes that are eco-friendly. 3. Knowledge on the different types of pollution will help the young minds to device effective control measures to reduce rate of pollution. 4. Exposure on the issues such as global warming, acid rain, ozone layer depletion, nuclear hazards and ill effects of fire-works will make the students understand the significances of sustainable development and the need to enforce Environmental Acts. 5. Educating on the various aspects of population explosion will create an awareness on population control for effective utilization of the resources and the need to explore new alternate energy resources for a healthy environment.

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

ECOSYSTEMS AND BIODIVERSITY 12

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Field study of common plants, insects, birdsField study of simple ecosystems – pond, river, hill slopes, etc.

ENVIRONMENTAL POLLUTION 10

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Soil waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Ill effects of fireworks and upkeep of clean environment: Chemical contents of fireworks- and health hazards**-**Soil pollution, water pollution, air pollution and noise pollution.

Field Study of local polluted site – Urban / Rural / Industrial / Agricultural

SOCIAL ISSUES AND THE ENVIRONMENT 7

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer

depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness

HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

TOTAL: 45

TEXT BOOKS

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., Environmental Science, International Students Edition, Thomson Learning Inc. 2004.
3. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, 1999.
4. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications, 1998.

REFERENCES

1. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India, 2004.
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopaedia, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA,

   1998.

L	T	P	C
0	0	24	6

MHB441	**Project & Viva-voce**	**6 Credits**
Goal	To develop the student's skills and make innovation in design and fabrication work from the theoretical and practical skill acquired from the previous semesters.	

Objectives	**Outcome**
The course should enable the students to: 1. Learn the objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems. 2. Make the students come up with new ideas in his area of interest. 3. Learn the concepts more in depth by providing guidance.	The students should be able to: 1. Get an idea and confidence in designing, analysing and executing the project. 2. Develop knowledge of latest trends in fabrication and relate their ideas with industrial applications 3. Have complete understanding of making a product.

NOTE:

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving the practical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

Each student will be assigned any one of the following types of project/thesis work:

(a) Industrial case study
(b) Preparation of a feasibility report
(c) Thesis by experimental research, and
(d) Design and development of equipment.

Each report must contain student's own analysis or design presented in the approved format.
sessional marks will include

(a) Evaluation of the student's progress,
(b) Degree of involvement and participation,
(c) Merit of the project.

A student will have to defend his project/thesis and credit will be given on the merit of viva-voce examination.

SYLLABUS

PROFESSIONAL ELECTIVE COURSES-PE

L	T	P	C
3	0	0	3

MHC351	PROCESS AUTOMATION	3 Credits
Goal	To provide basic knowledge of controllers, find control elements and the process	

Objectives	**Outcome**
The course should enable the students to: 1. Study the basic characteristics of first order and higher order process. 2. Get adequate knowledge about the characteristics of various controllers modes and methods of tuning of controller. 3. Study about various complex control schemes. 4. Study about the construction, characteristics and application of control valves. 5. Study the five selected unit operations and a case study of distillation column control.	The students should be able to: 1. Comprehend the characteristics of different order processes 2. Understand the characteristics of various controllers used in process industries and perform the different methods of tuning techniques for the controllers used and to analyse their performance. 3. Explain the various control schemes used in processes and their application. 4. Know the construction, classification and characteristics of final control element. 5. Understand the unit operations used and their corresponding control scheme.

UNIT I MATHEMATICAL MODELLING OF PROCESSES 12

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

UNIT II CONTROLLER CHARACTERISTICS & TUNING 12

Basic control action - Characteristics of ON-OFF, proportional, integral and derivative control modes

- Composite control modes - P+I, P+D and P+I+D control modes - Electronic controllers to realize various control actions - Evaluation criteria - IAE, ISE, ITAE and ¼ decay ratio - Tuning of controllers

- Ziegler-Nichol's method and Cohencoon method - Damped oscillation method.

UNIT III CONTROL SYSTEMS WITH MULTIPLE LOOPS 12

Cascade control - Feed forward control - Ratio control - Selective control systems - Split range control - Adaptive and inferential control.

UNIT IV FINAL CONTROL ELEMENT 12

I/P converter - Pneumatic and electric actuators - Valve positioner - Control valves characteristics - Classification of control valves - Control valve sizing - Cavitations and flashing - Selection of control valves.

UNIT V SELECTED UNIT OPERATIONS 12

Mixing - Evaporation - Drying - Heat exchanger - Distillation process - Case study of control schemes of binary distillation column.

L : 45 T : 15 TOTAL : 60

TEXT BOOKS

1. Donald P. Eckman, Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.
2. G.Stephanopoulis, Chemical Process Control, Prentice Hall of India, New Delhi, 2005.

REFERENCES

1. B.G.Liptak, Process Control, Chilton Book Company, 2003.
2. Curtis D. Johnson, Process Control InstrumentationTechnology, 7th Edition, Pearson Education, New Delhi, 2002 / PHI.
3. J.G.Balchen and K.J.Mumme, Process Control structures and Application, Van Nostrand Reinhold Co., New York, 2000.

L	T	P	C
3	0	0	3

MEC352	NON-DESTRUCTIVE TESTING METHODS	3 Credits
Goal	To impart knowledge on Non Destructive Testing procedures	

Objectives	**Outcome**
The course should enable the students to: 1. Understand principle behind various NDT techniques and study about NDT equipments and accessories. 2. Learn working procedures of various NDT techniques 3. Learn materials that could be inspected – codes, standards, specifications.	The students should be able to: 1. .Know about NDT equipments and accessories. 2. Develop the NDT techniques in practical applications. **3.** Compare and select of various NDT techniques based on the applications

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION **9**

Introduction to various non destructive methods- Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

UNIT II LIQUID PENETRANT TESTING, MAGNETIC PARTICLE TESTING **9**

Physical principles, procedure for penetrant testing, Penetrant Testing materials, Penetrant testing methods – water washable, post – Emulsifiable methods, Applications Principle of MPT, procedure used for testing a component , Equipment used for MPT, Applications

UNIT III EDDY CURRENT TESTING, ACOUSTIC EMISSION **9**

Principles, Instrumentation for ECT, Absolute - differential probes, Techniques – High sensitivity Techniques, Applications-Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT IV ULTRASONIC TESTING **9**

Principle , Ultrasonic transducers ,Inspection Methods, Normal Inscudent Pulse – Echo Inspection , Through – transmission Testing , angle Beam Pulse – Echo testing , Techniques for Normal Beam Inspection , Ultrasonic Flaw detection Equipment , Modes of display A-scan , B-Scan , C- Scan ,Applications.

UNIT V RADIOGRAPHY,COMPARISON AND SELECTION OF NDT METHODS **9**

Basic principle, Effect of radiation on Flim, Radiographic imaging , Inspection Techniques – Single wall single image , Double wall Penetration , Multiwall Penetration technique. Comparison and selection of various NDT techniques

TOTAL : 45

TEXT BOOK:

1. Baldev raj, T Jeyakumar, M. Thavasimuthu *Practical Non Destructive Testing* Narosa publishing house, New Delhi, 2002

REFERENCES:

1 Krautkramer. J., *Ultra Sonic Testing of Materials*, 1st Edition, Springer Verlag Publication, New York, 1996.

2 Peter J. Shull *Non Destructive Evaluation: Theory, Techniques and Application* Marcel Dekker, Inc., New York, 2002

3 www.ndt.net

4 Birchan.B, *Non-Destructive Testing*, Oxford, London, 1975

5 Baldev Raj and B.Venkataraman, *Practical Radiology*, Narosa Publishing House, 2004

L	T	P	C
3	0	0	3

MHC352	ELECTRONIC DEVICES AND CIRCUITS	3 Credits
Goal	To Provide Basic Knowledge about various Semiconductor Devices, analysis and design of amplifiers and their applications	

Objectives	**Outcome**
To acquaint the students with construction, theory and characteristics of the following electronic devices 1. P-N junction diode 2. Bipolar transistor , Field effect transistor 3. Common mode and differential mode analysis of differential amplifier. 4. Study the characteristics and construction of tuned amplifiers 5. LED,LCD and other photo electronic devices, Power control/regulator devices 6. To familiarize the students with the applications such as wave form generation, clippers and clampers etc.,	The students should be able to: 1. Understand the operation of P-N junction diode and Zener diode 2. Understand the operation of BJT and FET, its biasing and input-output characteristics of different configurations 3. Understand the principle of photo emissivity, photo conductivity and different photo electronic devices 4. Analyze and design small signal and large signal amplifiers. 5. Analyze and design Differential amplifiers and to explain the working of tuned amplifiers. 6. Explain the different type of negative feedback amplifiers and oscillator circuits with their design equations.

UNIT I SEMICONDUCTOR DIODE **9**

Theory of p-n junction - p-n junction as diode - p-n diode currents - Volt-amp characteristics - Diode resistance - Temperature effect of p-n junction - Transition and diffusion capacitance of p-n diode - Diode switching times.

UNIT II BI-POLAR TRANSISTOR **9**

Junction transistor - Transistor construction - Detailed study of currents in transistor - Input and output characteristics of CE, CB and CC configurations - Transistor hybrid model for CE configuration - Analytical expressions for transistor characteristics - Transistor switching times - Voltage rating - Power transistors.

UNIT III FIELD EFFECT TRANSITORS **9**

Junction field effect transistor - Pinch off voltage - JFET volt-ampere characteristics - JFET small signal model - MOSFETS and their characteristics - FET as a variable resistor - Unijunction transistor.

UNIT IV SMALL-SIGNAL AND LARGE SIGNAL AMPLIFIERS **9**

Fixed and self biasing of BJT & FET - Small signal analysis of CE, CC & Common source amplifiers - Cascade and Darlington connections, transformer coupled class A, B & AB amplifiers - Push-pull amplifiers.

UNIT V DIFFERENTIAL AND TUNED AMPLIFIERS **9**

Differential amplifiers - Common mode and differential mode analysis - DC and AC analysis - Characteristics of tuned amplifiers - Single & double tuned amplifier.

L = 45 TOTAL = 45

TEXT BOOKS

1. Jacob. Millman, Christos C.Halkias, Electronic Devices and Circuits, Tata McGraw Hill Publishing Limited, New Delhi, 2003.
2. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India Private Limited, New Delhi, 2003.

REFERENCES

1. Theodre. F. Boghert, Electronic Devices & Circuits, Pearson Education, VI Edition, 2003.
2. Ben G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education, 2002 / PHI
3. Allen Mottershead, Electronic Devices and Circuits - An Introduction, Prentice Hall of India Private Limited, New Delhi, 2003.

L	T	P	C
3	0	0	3

MHC353	APPLIED THERMODYNAMICS	3 Credits
Goal	To implement a sense of the working principle of various compressors, refrigeration and air conditioning systems	

Objectives	**Outcome**
The course will enable the students to: 1. Expose the fundamentals of thermodynamics and to be able to use it in accounting for the bulk behaviour of the sample physical systems. 2. Integrate the basic concepts into various thermal applications like IC engines, gas turbines, steam boiler, steam turbine, compressors, refrigeration and air conditioning. 3. Enlighten the various modes of heat transfer and their engineering applications. (Use of standard steam tables, refrigeration tables and heat transfer data book are permitted)	The students should be able to: 1. Learn the fundamentals of thermodynamics including first law and second law of thermodynamics and the concept of entropy. 2. Learn the concept of formation of steam and the steam power cycles. 3. Learn about the open & closed cycles of gas turbines and the working principle of IC engines, learn the working principle of various compressors, refrigeration and air conditioning systems.

UNIT I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 12

Classical approach: Thermodynamic systems - Boundary - Control volume - System and surroundings - Universe - Properties - State-process - Cycle - Equilibrium - Work and heat transfer - Point and path functions - First law of thermodynamics for open and closed systems - First law applied to a control volume - SFEE equations [steady flow energy equation]

UNIT II SECOND LAW OF THERMODYNAMICS 12

Heat engines - Refrigerators and heat pumps - Carnot cycle - Carnot theorem - Clausius inequality - Concept of entropy - Principle of increase of entropy - Basic thermodynamic relations.

UNIT III STEAM POWER CYCLES 12

Formation of steam - Properties of steam - Use of steam tables and charts - Steam power cycle (Rankine) - Steam turbines: Impulse and reaction principle - Compounding of steam turbines (qualitative treatment only)

UNIT IV GAS TURBINES AND IC ENGINES 12

Open and closed cycle gas turbines - Brayton cycle - Applications of gas turbines for aviation and power generation. Working Principle of four stroke and two stroke engines - spark ignition and compression ignition engines.

UNIT V THERMODYNAMICS APPLICATION (Qualitative Treatment Only) 12

Air compressors - Reciprocating& Rotary compressors, Refrigeration and Air conditioning systems - Basic Components, Vapour Compression cycle, Sub cooling & super heating, Type of air conditioning systems, modes of Heat Transfer - Boilers.

L : 45 T : 15 TOTAL : 60

TEXT BOOKS

1. P.K. Nag, Basic and Applied Engineering Thermodynamics , Tata McGraw Hill, New Delhi, 2002.
2. B.K. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer (SI Units), New Age International (P) Limited, Chennai, 2003.

REFERENCES

1. Rogers and Mayhew, Engineering Thermodynamics - Work and Heat Transfer, Addision Wesley, New Delhi, 1999.
2. Eastop and McConkey, Applied Thermodynamics, Addison Wesley, New Delhi. 1999.
3. M.L. Mathur and F.S. Metha, ThermalEngineering, Jain Brothers, New Delhi, 1997.

   B.K. Sankar, ThermalEngineering, Tata McGraw Hill, New Delhi, 1998.

L	T	P	C
3	0	0	3

MHC355	MATERIAL SCIENCE	3 Credits
Goal	To expose the students for an understanding of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites and the reasons for these properties to exist.	

Objectives	**Outcome**
1. To give fundamental knowledge about type of materials, their usage, properties and characteristics, which are important in engineering design. 2. It is also aimed to give a theoretical background about the analysis of behavior of engineering materials by emphasizing important relationships between internal structure and properties. 3. It attempts to present ways of modifying and control the material microstructures and especially mechanical properties by suitable heat treatment operation.	The students should be able to: 1. Qualitatively describe the bonding scheme and its general physical properties of a given type of matrial, as well as possible applications. 2. Describe physical origin, as well as strength of a given type of bond. 3. Qualitatively derive a material's Young's modulus from a potential energy curve. 4. Describe a polymer's elastic behavior above and below the glass transition. 5. Solve simple diffusion problems

UNIT I BASICS OF MATERIALS AND METALLURGY **9**

Art and science of metallurgy-structure of metals and alloys-phase and structural constitutions Equilibrium diagrams Ferrous metals and alloys-Fe-Fe3C diagram-Effect of alloying elements in steel, Classification of ferrous alloys and their applications

UNIT II APPLICATIONS OF MATERIALS **9**

Heat treatment of steel-CCT diagram-Surface hardening process-Non Ferrous Metals and alloys composition-properties and applications of copper, nickel, lead, tin, zinc, aluminium, Mg and Ti alloys-Heat treatment of Non Ferrous alloy-Non Metallic Metals and alloys-ceramic material polymers-composite material – Nano-structured materials

UNIT - III SEMICONDUCTING MATERIALS AND DEVICES **9**

Elemental and compound semi conductors.Intrinsic and extrinsic semiconductors - Properties. Carrier concentration in intrinsic and extrinsic semiconductors (qualitative).Material preparation - Czochralski's technique and zone refining technique. Hall effect - Hall coefficient in extrinsic semiconductors, experimental determination of Hall coefficient. Application of Hall effect. Semiconductor devices - Solar Cells, LED, Photodiode, LDR, LCD and Strain Gauges.

UNIT - IV MAGNETIC MATERIALS **9**

Ferro and Ferro magnetic materials - Properties. Heisenberg and domain theory of ferromagnetism. Hysteresis. Hard and soft magnetic materials. Ferrites - structure, preparation and applications. Devices and applications - Permanent magnets, transformer cores, magneto optical recording, magnetic valves and bearings, Superconducting Magnets, SQUIDS.

UNIT - V SMART MATERIALS **9**

Shape Memory alloys (SMA) - Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA. Nanophase materials - preparation - mechanical alloying and solgel technique, properties & applications. Superconductivity BCS theory of superconductivity (qualitative),Types of superconductors, properties - High Tc superconductors. Application of superconductors - SQUID, Cryotron, Magnetic levitation. Metallic glasses - Preparation, properties & applications.

Total 45

Textbook

-William D. Callister, Jr. Materials Science and Engineering: An Introduction, 5th or any other upgrade edition, John Wiley and Sons, 2000.

-Dieter G. E., „Mechanical Metallurgy", 1st Edition, McGraw Hill Co- Koga, 2002

Reference Books

- William F. Smith, Foundations of Materials Science and Engineering, 3rd Ed., McGraw-Hill, 2004.

- James F. Shackelford, Introduction to Materials Science for Engineers, 5th Ed., Prentice Hall, 2000.

- Larry D. Horath, Fundamentals of Material Science, 3rd Ed., Prentice Hall, 2006.

L	T	P	C
3	0	0	3

MHC356	EMBEDDED SYSTEM	3 Credits
Goal	To give an insight of Embedded Systems	

Objectives	**Outcome**
The course will enable the students to : 1. Get introduced to features that build an embedded system. 2. Learn about the various components within an embedded system. Learn the techniques of interfacing between processors & peripheral device related to embedded processing 3. Do the efficient programs on any dedicated processor.	The students should be able to: 1. Understand Basic building blocks of embedded systems 2. Interface various peripherals to processors 3. Program embedded systems 4. Use the basic concepts of systems programming like operating system, assembler compliers etc. and to understand the management task needed for developing embedded system

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

Introduction to functional building blocks of embedded systems - Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories.

UNIT II PROCESSOR AND MEMORY ORGANIZATION 9

Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management - Cache mapping techniques, dynamic allocation - Fragmentation.

UNIT III DEVICES & BUSES FOR DEVICES NETWORK 9

I/O devices; timer & counting devices; serial communication using I2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system - Serial port & parallel port.

UNIT IV I/O PROGRAMMING SCHEDULE MECHANISM 9

Intel I/O instruction - Transfer rate, latency; interrupt driven I/O - Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts. Multi-threaded programming - Context switching, premature & non-premature multitasking, semaphores. Scheduling - Thread states, pending threads, context switching, round robin scheduling, priority based scheduling, assigning priorities, deadlock, watch dog timers.

UNIT V REAL TIME OPERATING SYSTEM (RTOS) 9

Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS - Interrupt handling, task scheduling; embedded system design issues in system development process - Action plan, use of target system, emulator, use of software tools.

L : 45 TOTAL : 45

TEXT BOOKS

1. Raj Kamal, Embedded System -Architecture, Programming and Design, Tata McGraw Hill, 2008. 2nd Edition
2. Daniel W. Lewis Fundamentals of Embedded Software, Prentice Hall of India, 2004.

REFERENCES

1. David E. Simon, An Embedded Software Primer, Pearson Education, 2004.
2. Frank Vahid, Embedded System Design - A Unified hardware & Software Introduction, John Wiley,
3. Sriram V. Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata McGraw Hill, 2003 Edition - 1
4. Steve Heath, Embedded System Design, II edition, Elsevier, 2003.

L	T	P	C
3	0	0	3

MHC357	DESIGN OF MECHANICAL ELEMENTS	3 Credits
Goal	To expose the students in 1. The various steps involved in the Design Process 2. Understanding the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements. 3. Learning to use standard practices and standard data learning to use catalogues and standard machine components	

Objectives	**Outcome**
The course should enable the students to: 1. Apply engineering analysis principles and methods to the proper analysis of a variety of common mechanical system components. 2. Design these mechanical system components so as to perform safely their intended functions in harmony with other components of the system. 3. Use information resources to identify appropriate and elegant component solutions for mechanical system design problems, locate sources for these components, and understand the analysis and design methods for these components. 4. Confirm with the right codes and standards 5. Work in teams to analyze and design various types of brakes and clutches and present their designs orally and in writing. 6. Identify the characteristics of their designs that have safety and environmental impact.	The students should be able to: 1. Analyze and design power screws with respect to torque requirements, overhauling, and column buckling. 2. Analyze and design bolted connections with respect to static and dynamic axial loads. 3. Analyze and design bolted riveted, pinned, welded, brazed, soldered, and glued joints with respect to static and dynamic shear and bending loads. 4. Analyze and design full cylindrical hydrodynamic bearings using design charts and custom software. 5. Compute equivalent radial loads for rolling contact bearings and select appropriate bearings for the application using printed and electronic catalogue data. 6. Analyze and design spur gears with respect to tooth bending strength and surface strength specifications and apply three different theories to the design of shafts subject to combined static and dynamic loads.

UNIT I INTRODUCTION TO THE DESIGN PROCESS **12**

Factor influencing machine design, selection of materials based on mechanical properties - Direct, Bending and torsion stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - Design of curved beams - crane hook and 'C' frame Factor of safety - theories of failure - stress concentration - fatigue strength and the S-N diagram -

Soderberg, Goodman and Gerber relations

UNIT II DESIGN OF SHAFTS AND COUPLINGS **12**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of keys and key ways - Design of rigid and flexible couplings

UNIT III DESIGN OF FASTENERS AND WELDED JOINTS **12**

Threaded fasteners - Design of bolted joints including eccentric loading - Design of welded joints for pressure vessels and structures

UNIT IV DESIGN OF SPRINGS AND LEVERS **12**

Design of helical, leaf, disc and torsion springs under constant loads and varying loads - Concentric torsion springs - Belleville springs

UNIT V DESIGN OF BEARINGS **12**

Design of bearings - sliding contact and rolling contact types. - Cubic mean load - Design of journal bearings - McKee's equation - Lubrication in journal bearings - calculation of bearing dimensions

TOTAL : 45

Note: (Use of Design Data Book is permitted in the University examination)

TEXT BOOKS

1. Juvinall R.C, and Marshek K.M, Fundamentals of Machine Component Design, John Wiley & Sons, Third Edition, 2002.
2. Bhandari V.B, Design of Machine Elements, Tata McGraw-Hill Book Co, 2003.

REFERENCES

1. Norton R.L, Design of Machinery, Tata McGraw-Hill Book Co, 2004.
2. Orthwein W, Machine Component Design, Jaico Publishing Co, 2003.
3. Ugural A.C, Mechanical Design - An Integral Approach, McGraw-Hill Book Co, 2004.

L	T	P	C
3	0	0	3

MHC358	**COMPUTER INTEGRATED MANUFACTURING**	**3 Credits**
Goal	To impart knowledge on how computers are integrated at various levels of planning and manufacturing	

Objectives	**Outcome**
The course should enable the students to: 1. Introduce the flexible manufacturing system 2. Handle the product data and various software used for manufacturing 3. Understand Computer Aided Process Planning.	The students should be able to: 1. Appreciate the changing manufacturing scene 2. Develop the role of CAD/CAM **3.** Understand implementation of CIM.

UNIT I INTRODUCTION 8

The meaning and origin of CIM – the changing manufacturing and management scene- External communication- Islands of automation and software- Dedicated and open systems-Manufacturing automation protocol - Product related activities of a company- Marketing engineering - Production planning - Plant operations - Physical distribution- Business and financial management.

UNIT IIGROUPTECHNOLOGYAND COMPUTERAIDED PROCESS PLANNING 10

History of group technology-Role of G.T. in CAD/CAM integration- Part families- Classification and coding- DCLASS and MICLASS and OPITZ coding systems- Facility design using G.T.-benefits of G.T. - Cellular manufacturing.

Process planning- role of process planning in CAD/CAM integration- Approaches to computer aided process planning- Variant approach and generative approaches- CAPP and CMPP process planning systems.

UNIT III SHOPFLOOR CONTROLAND INTRODUCTION OF FMS 9

Shop floor control- phases- Factory data collection system-Automatic identification methods - Bar code technology-Automated data collection system.

FMS- components of FMS- types-FMS workstation-Material handling and storage systems- FMS layout -Computer control systems-Application and benefits.

UNIT IV CIM IMPLEMENTATIONAND DATACOMMUNICATION 10

CIM and company strategy-System modelling tools- IDEF models- Activity cycle diagram – CIM open system architecture (CIMOSA)- Manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software.

Communication fundamentals - Local area networks- Topology- LAN implementations- Network management and installations.

UNIT V OPEN SYSTEM AND DATABASE FOR CIM 8

Open systems- Open system interconnection- Manufacturing automations protocol and technical office protocol (MAP /TOP) - Development of databases -Database terminology- Architecture of database systems-Data modelling and data associations -Relational data bases - Database operators - Advantages of data base and relational database.

TOTAL: 45

TEXT BOOK

1. Mikell.P.G Roover Automation, *Production Systems and computer integrated manufacturing*, Pearson Education, New Delhi, 2008.

REFERENCES

1. Yoremkoren, *Computer Integrated Manufacturing system*, McGraw-Hill, 1983.
2. Ranky, Paul G., *Computer Integrated Manufacturing*, Prentice Hall International 1986.
3. DavidD.Bedworth, MarkR.Hendersan, Phillip M. Wolfe *Computer Integrated Design and Manufacturing*, McGraw-Hill Inc.
4. Roger Hanman*Computer Integrated Manufacturing*, Addison –Wesley, 1997.
5. Mikell.P.Groover and EmoryZimmersJr., *CAD/CAM*, Prentice hall of India Pvt.Ltd.,NewDelhi-1.1998.
6. Kant Vajpayee S, *Principles of computer integrated manufacturing*,PrenticeHallIndia, 2007.
7. RadhakrishnanP,SubramanyanS.andRajuV.,*CAD/CAM/CIM*,2nd EditionNewAge International (P) Ltd, New Delhi. 2000.

L	T	P	C
3	0	0	3

MHC359	DIGITAL IMAGE PROCESSING	3 Credits
Goal	To introduce the students to various image processing techniques	

Objectives	**Outcome**
The course should enable the students to 1. Study the image fundamentals and mathematical transforms necessary for image processing, 2. Study the image enhancement techniques 3. Study image restoration procedures 4. Study the image compression Procedures 5. Study the image segmentation and representation techniques.	The students should be able to: 1. Understand the image fundamentals and the two dimensional image transforms, 2. Understand how to improve the image quality by using enhancement techniques, 3. Restore the image by the use of various filtering techniques 4. Understand the various image compression techniques and standards 5. Understand the descriptors used to describe an image, segmentation and edge detection in images.

UNIT I DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS 9

Elements of visual perception – Image sampling and quantization, Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II IMAGE ENHANCEMENT TECHNIQUES 9

Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters –Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.

UNIT III IMAGE RESTORATION 9

Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

UNIT IV IMAGE COMPRESSION 9

Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization.

UNIT V IMAGE SEGMENTATION AND REPRESENTATION 9

Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.

TOTAL = 45

TEXT BOOK

1. Rafael C Gonzalez, Richard E Woods 3rd Edition, Digital Image Processing - Pearson Education 2007.

REFERENCES

1. William K Pratt, Digital Image Processing John Willey (2001)
2. Image Processing Analysis and Machine Vision – Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).
3. A.K. Jain, PHI, New Delhi (1995)-
4. Fundamentals of Digital Image Processing. Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall of India, 2000.

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MHC451	**MEDICAL MECHATRONICS**	**3 Credits**
Goal	The goal of the programme is to provide the knowledge of types and selection of sensors and related equipments for medical applications for diagnosis and analysis.	

Objectives	**Outcome**
The course should enable the students to: 1. Understand types of sensors. 2. Study the various equipments for medical applications. 3. Study the diagnosis	The students should be able to: 1. Gain the knowledge in medical measurements. 2. Select the equipments for medical applications. 3. To know the details of diagnosis and analysis capabilities of equipments

UNIT I INTRODUCTION **9**

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

UNIT II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION **9**

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY **9**

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply. Oscillagraphic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIT IV MEDICAL SUPPORT **10**

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethy sonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIT V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION **8**

Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis.

TOTAL : 45

Text Books

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TMH, 1989.

2. Arumugam M., “Bio Medical Instrumentation”, Anuradha agencies Pub., 2002.

References

1. Geddes L.A., and Baker, L.E., Principles of Applied Bio-medical Instrumentation, 3rd Edition, John Wiley and Sons, 1995.
2. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall of India, 1999.
3. Tompkins W.J., Biomedical Digital Signal Processing, Prentice Hall of India, 1998.

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MEC456	MAINTENANCE ENGINEERING	3 Credits
Goal	To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities	

Objectives	**Outcome**
The course should enable the students to: 1. Explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements. 2. Illustrate some of the simple instruments used for condition monitoring in industry.	The students should be able to: 1. Understand the principles, functions and practices adapted in industry for the successful management of maintenance activities. 2. Know about different maintenance practices followed in the industry like Preventive maintenance, condition monitoring and repair of machine elements

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 10

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity Importance and benefits of sound Maintenance systems - Reliability and machine availability MTBF, MTTR and MWT - Factors of availability - Maintenance organization - Maintenance economics.

UNIT IIMAINTENANCE POLICIES - PREVENTIVE MAINTENANCE 9

Maintenance categories - Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication - TPM.

UNIT III CONDITION MONITORING 9

Condition Monitoring - Cost comparison with and without CM - On-load testing and off-load testing Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 10

Repair methods for beds, slideways, spindles, gears, lead screws and bearings - Failure analysis Failures and their development - Logical fault location methods - Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 8

Repair methods for Material handling equipment - Equipment records -Job order systems- Use of computers in maintenance.

TOTAL : 45

TEXT BOOKS

1. Srivastava S.K., Industrial Maintenance Management, - S. Chand and Co., 1981
2. Bhattacharya S.N., Installation, Servicing and Maintenanc, S. Chand and Co., 1995

REFERENCES

1. White E.N., Maintenance Planning, I Documentation, Gower Press, 1979.Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
2. Higgins L.R., Maintenance Engineering Hand book, McGraw Hill, 5th Edition, 1988.
3. Armstrong, Condition Monitoring, BSIRSA, 1988.
4. Davies, Handbook of Condition Monitoring, Chapman &Hall, 1996.
5. Advances in Plant Engineering and Management, Seminar Proceedings - IIPE, 1996.

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MEC351	COMPOSITE MATERIALS & STRUCTURES	3 Credits
Goal	To expose the students to various composites available and their manufacturing methods.	

Objectives	**Outcome**
The course should enable the students to: 1. Introduce different types of composite materials, their properties and applications. 2. Understand the advantages of Composite materials over conventional materials.	The students should be able to: 1. Know about the properties, classification and applications of composites in the Industries. 2. Understand the Manufacture of composites.

UNIT I INTRODUCTION TO COMPOSITES **8**

Fundamentals of composites - need for composites - Enhancement of properties - classification of composites - Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) - Reinforcement - Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

UNIT II POLYMER MATRIX COMPOSITES **12**

Polymer matrix resins - Thermosetting resins, thermoplastic resins - Reinforcement fibres Rovings - Woven fabrics - Non woven random mats - various types of fibres. PMC processes - Hand lay up processes - Spray up processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding - Pultrusion - Filament winding - Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GFRP).

UNIT III METAL MATRIX COMPOSITES **9**

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements - particles - fibres. Effect of reinforcement - Volume fraction - Rule of mixtures. Processing of MMC - Powder metallurgy process - diffusion bonding - stir casting - squeeze casting.

UNIT IV CERAMIC MATRIX COMPOSITES **9**

Engineering ceramic materials - properties - advantages - limitations - Monolithic ceramics - Need for CMC - Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics - non oxide ceramics - aluminium oxide - silicon nitride - reinforcements - particles- fibres- whiskers. Sintering Hot pressing - Cold isostatic pressing (CIPing) - Hot isostatic pressing (HIPing).

UNIT V ADVANCES IN COMPOSITES **7**

Carbon /carbon composites - Advantages of carbon matrix - limitations of carbon matrix Carbon fibre - chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

TOTAL : 45

TEXT BOOKS

1. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 2005.
2. Chawla K.K., Composite materials, Springer - Verlag,2nd Edition , 2009.

REFERENCES

1. Clyne T.W. and Withers P.J., Introduction to Metal Matrix Composites, Cambridge University Press, 1993.
2. Strong A.B., Fundamentals of Composite Manufacturing, SME, 1989.
3. Sharma S.C., Composite materials, Narosa Publications, 2000.
4. Short Term Course on Advances in Composite Materials, Composite Technology Centre, Department of Metallurgy, IIT- Madras, December 2001.

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3	0	0	3

MHC454	RAPID PROTOTYPING	3 Credits
Goal	To expose the students about fundamental to rapid prototyping and automated fabrication, including the generation of suitable CAD models, and the impact of these technologies on society.	

Objectives	**Outcome**
The student will be able to demonstrate 1. Describe the current available rapid prototyping systems, their fundamental operating principles, and their characteristics 2. Describe complementary, secondary fabrication processes commonly used with the above rapid prototyping systems 3. Select the appropriate fabrication technology, or technologies, for a given prototyping task.	Upon completion of the subject, students will be able to 1. apply the basic principles of rapid prototyping (RP), rapid tooling (RT), and reverse engineering (RE) technologies to product development; 2. decipher the limitations of RP, RT, and RE technologies for product development; 3. realise the application of RP, RT, and RE technologies for product development. 4. Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications 5. Explain direct metal laser sintering, LOM and fusion deposition modelling processes

UNIT – I INTRODUCTION **9**

Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling. Classification of RP systems, Stereo lithography systems – Principle – process parameters – process details – machine details, Applications.

UNIT – II DIRECT METAL LASER SINTERING (DMLS) SYSTEM **9**

Principle – process parameters – process details – machine details, Applications. Fusion Deposition Modelling – Principle – process parameters – process details – machine details, Applications. Laminated Object Manufacturing – Principle – process parameters – process details – machine details, Applications.

UNIT –III SOLID GROUND CURING **9**

Principle – process parameters – process details – machine details, Applications. 3-Dimensional printers – Principle – process parameters – process details – machine details, Applications, and other concept modellers like thermo jet printers, Sander„s model maker, JP system 5, Object Quadra system

UNIT – IV APPLICATIONS OF RAPID PROTOTYPING **9**

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) – Principle. Introduction to rapid tooling – direct and indirect method, software for RP – STL files, Magics, Mimics. Application of Rapid prototyping in Medical field.

UNIT- V VIRTUAL PROTOTYPING **9**

Introduction to Virtual prototyping- End to end prototyping-simulationcomponents of virtual prototyping- effects- economics of virtual prototyping.

TEXT BOOKS:

1. Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 3e, World scientific publications, 2010.

2. Paul F Jacobs, “Rapid Prototyping and manufacturing–Fundamentals of streolithography”, Society of Manufacturing Engineering Dearborn, USA 1992

REFERENCES:

1. Pham,D.T. and Dimov.S.S., “Rapid manufacturing” , Springer, London, 2001.

2. Joe Cecil, “Virtual Enginering” , Momentum Press, 2010

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MEC358	UNCONVENTIONAL MACHINING PROCESSES	3 Credits
Goal	To expose the student in various unconventional machining processes	

Objectives	**Outcome**
The course should enable the students to: 1. Learn the course will impart a good perspective with adequate depth to understand the unconventional machining processes 2. Learn relative advantages over conventional machining techniques.	The students should be able to: 1. Know about the working principle of various Unconventional Machining Processes. 2. Understand the relative advantages over conventional techniques and their applications.

UNIT I INTRODUCTION **5**

Unconventional machining Process - Need - clarification - Brief overview of all techniques.

UNIT II MECHANICAL ENERGY BASED PROCESSES **10**

Abrasive Jet Machining - Water Jet Machining - Ultrasonic Machining. (AJM, WJM and USM).Working Principles - equipment used - Process parameters - MRR-Variation in techniques used - Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES **8**

Electric Discharge Machining (EDM)- working Principles-equipments-Process Parameters-MRRelectrode / Tool - Power Circuits-Tool Wear - Dielectric - Flushing - Wire cut EDM - Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGYBASED PROCESSES **12**

Chemical Machining and Electro-Chemical Machining (CHM and ECM)-Etchants-maskant techniques of applying maskants-Process Parameters - MRR-Applications.Principles of ECM-equipmentsMRR-Electrical circuit-Process Parameters-ECG and ECH Applications.

UNIT V THERMAL ENERGY BASED PROCESSES **10**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM). Principles-Equipment-Types-Beam control techniques - Applications.

TOTAL : 45

TEXT BOOK

1. Vijay.K. Jain Advanced Machining Processes Allied Publishers Pvt. Ltd., New Delhi (2002) ISBN 81-7764-294-4.

REFERENCES

1. Benedict. G.F. Nontraditional Manufacturing Processes Marcel DekkerInc., NewYork(1987).
2. Pandey P.C. and Shan H.S. Modern Machining Processes Tata McGraw-Hill, New Delhi 2007.
3. Mc Geough, Advanced Methods of Machining Chapman and Hall, London (1998).
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, Material and Processes in Manufacturing Prentice Hall of India Pvt. Ltd., New Delhi (8th Edition) (2001) ISBN - 81-203-1243-0.

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3	0	0	3

MHC453	PRODUCT DESIGN AND COSTING	3 Credits
Goal	To expose the students the various aspects of design process, concepts to product costing, optimisation at the design and make form to apply in practical	

Objectives	**Outcome**
The course should enable the students to: 1. Understand the several aspects of the design process and to apply them in practice. 2. Train the student in the concept of product costing and manufacturing economics in optimization of product design.	The students should be able to: 1. Develop the concepts of product costing and other manufacturing economics in optimization of product design 2. Know about the various tools available in the product design.

UNIT I PRODUCT DESIGNAND DEVELOPMENT 8

Principlesofcreativityindesign-integratedproductdevelopmentandconcurrentengineering – Productanalysis–Criteriaforproductdesign–Marketresearch–Designforcustomerand design for manufacture – Product life cycle.

UNIT II ECONOMICS OF DESIGN 9

Break seven point- Selection of optimal materials and processes– Material layout planning– Value analysis – Re-engineering and its impact on product development.

UNIT III PRODUCT MODELING 9

Product modelling– Definition of concept- fundamental issues– Role and basic requirement of process chains and product models– Types of product models– Model standardization efforts– types of process chains – Industrial demands.

UNIT IV PRODUCT COSTING 10

Bill of materials – Outline Process charts – Concepts of operational standard time - Work measurement by analytical estimation and synthesis of time – Budgets times – Labour cost and material cost at every stage of manufacture – W.I.P. costing

UNIT V RECENT ADVANCES AND CONCEPTS IN PRODUCT DESIGN 9

Fundamentals of FEM and its significance to product design– Product life cycle management – Intelligent information system – Concept of Knowledge based product and process design.

TOTAL: 45

TEXT BOOKS

1. SameulEilon–*ElementsofProductionPlanningandControl*–McMillanandCompany, 1962.
2. Jones S.W., *Product Dosing and Process Selection*, Butterworth Publications, 1973
3. Karl T. Ulrich, Stephen D.Eppinger–*Product Design and Development*,McGraw-Hill,4th Edition, 2009.

REFERENCES

1. Harry Nystrom – *Creativity and Innovation*, John Wiley & Sons, 1979
2. GeorgeE.Dieter, *Engineering Design–Materialsandprocessapproach*,TataMcGraw-Hill,3rd Edition , 2000.
3. Donald E. Carter – *Concurrent Engineering*, Addison Wesley, 1992

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3	0	0	3

MHC455	FINITE ELEMENT METHOD	3 Credits
Goal	. To train the students in the principles involved in discretisation and finite element approach	

Objectives	**Outcome**
The course should enable the students to: 1. Learn the principles involved in discretization and finite element approach 2. Form stiffness matrices and force vectors for simple elements 3. Find the various approach followed in finite element approach. 4. Use the various elements for discretisation. 5. Learn about shape functions.	The students should be able to: 1. Know about discretion techniques, matrix algebra. 2. Learn about the Classical techniques in Finite Element Method. 3. Learn about various elements and when to choose them. 4. Form the stiffness matrix and solve them. 5. Do stress calculation for the components used in the Industries using the software

UNIT I INTRODUCTION 12

Historical background– Matrix approach– Application to the continuum– Discretisation– Matrixalgebra–Gaussianelimination–Governingequationsforcontinuum– ClassicalTechniques in FEM – Weighted residual method – Ritz method

UNIT II ONE DIMENSIONAL PROBLEMS 9

Finite element modeling – Coordinates and shape functions- Potential energy approach – Galarkin approach– Assembly of stiffness matrix and load vector–Finite element equations– Quadratic shape functions –Applications to plane trusses

UNIT III TWO DIMENSIONAL CONTINUUM 9

Introduction–Finite element modelling–Scalar valued problem–Poisson equation–Laplace equation– Triangular elements–Element stiffness matrix–Force vector–Galarkin approach-Stress calculation –Temperature effects

UNIT IV AXISYMMETRIC CONTINUUM 9

Axisymmetric formulation–Element stiffness matrix and force vector– Galarkin approach– Body forces and temperature effects– Stress calculations– Boundary conditions– Applications to cylinders under internal or external pressures – Rotating discs

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM 9

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration- Stiffness integration–Stress calculations–Four node quadrilateral for axi symmetric problems.

Total: 45

Text Books

1. ReddyJ.N.,*An Introduction to Finite Element Method*, McGraw-HillInternational Student Edition, 2010
2. ChandrupatlaT.R.,and Belegundu A.D., *Introduction to Finite Elements in Engineering*, Pearson Education 2002, 3rd Edition.
3. David V Hutton *Fundamentals of Finite Element Analysis*2005. McGraw-Hill Int. Ed.

References

1. Rao S.S., *The Finite Element Method in Engineering*, Pergammon Press, 2008.
2. LoganD.L.,*A First course in the Finite Element Method*, Third Edition,ThomsonLearning, 2002.
3. Robert D.Cook.,David. S,Malkucs Michael E Plesha,*Concepts and Applications of Finite Element Analysis* 4 Ed. Wiley, 2008.
4. O.C.ZienkiewiczandR.L.Taylor,*The Finite Element Methods,Vol.1*,*The basic formulation and linear problems, Vol.1*, Butterworth Heineman, 5th Edition,2

Engineering Elective for Mechatronics Engineering

Semester –IV (Engineering Elective-II)

L	T	P	C
3	0	0	3

MHD251	MOBILE ROBOTS	3 Credits

GOAL:	Develop the skill to build mobile robots for different applications by understanding the basic concepts required.

OBJECTIVE	OUTCOME
1. Understand about sensors and actuators used in mobile robots. 2. Understand about vision based navigation for mobile robots. 3. Understand programming techniques for mobile robots. 4. Understand various applications of mobile robots in real time.	1. Students will be able to apply knowledge about sensors and actuators for selection for a typical application. 2. Students will be able to use vision system for navigation of the mobile robot. 3. Students will be able to write program for various applications of mobile robots. 4. Students will be able to design their own mobile robot for different applications.

UNIT I INTRODUCTION **9**

Introduction to mobile Robots – Laws of Robots – Robot Anatomy – Basic Mechanics of Robots – Basic Electronics for Robots, Companion Robots – Robots for Agriculture Applications – Space Robots – Defense Robots.

UNIT II SENSORS AND ACTUATORS **9**

Sensors for mobile robots – Sensor Characteristics – Classification of Sensors – Electric Actuators – DC Motors – Servo motor, stepper motor – Linear Actuators – Encoders – Motor Drives.

UNIT III VISION AND NAVIGATION **9**

Image Acquisition – Obstacle Detection and Avoidance – Localization – Path Planning Methods – Monte Carlo Methods.

UNIT IV PROGRAMMING AND INTERFACING **9**

Robot Programming using Python – Basic Embedded C Programming for Robots – Data Acquisition – Interfacing Sensors and Actuators with Robot Controller – Program for Interfacing.

UNIT VBUILDING OF MOBILE ROBOTS **9**

Building of various types of mobile robots – Use of various Sensing methods, Navigation and Vision-Demonstration and Exercises

TEXT BOOK **TOTAL: 45 PERIODS**

1. Ulrich Nehmzow,Mobile Robots - A practical introduction, Springer, 2003.

REFERENCES

1. S.R. DEB, S. DEB, Robotics Technology and Flexible Automation, McGraw-Hill, 2nd Edition, 2011.
2. Mikell P. Groover, Roger N. Nagel, Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill Companies, 2012.

Semester –V (Engineering Elective-III)

L	T	P	C
3	0	0	3

MHD351	**INDUSTRIAL ROBOTICS**	**3 Credits**

GOAL:	Develop the skill to design and work with industrial robots for different applications by understanding the basic concepts required.

OBJECTIVE	OUTCOME
1. Understand kinematics of robots. 2. Understand about sensors and actuators used in industrial robots. 3. Understand programming techniques for industrial robots. 4. Understand various applications of industrial robots in real time.	1. Students will be able to solve forward and inverse kinematics problems in industrial robots. 2. Students will be able to apply knowledge about sensors and actuators for selection for a typical application. 3. Students will be able to write program for various applications of industrial robots. 4. Students will be able to design and work with industrial robot for different applications.

UNIT I INTRODUCTION **9**

History of Robots – Robot Anatomy – Robot Configurations – Work Volume – Robot Safety.

UNIT II KINEMATICS **9**

Robot Transformations – Rotation Matrix – Forward and Inverse Kinematics – DH Representation.

UNIT III DRIVES, ACTUATORS SENSORS AND END EFFECTORS **9**

Functions of Drive Systems – AC, DC Motors – Pneumatic and Hydraulic Actuators – Selection of Sensors – Classification of Sensors – Data Acquisition – Mechanical, Vacuum and Adhesive Grippers.

UNIT IV ROBOT LANGUAGES AND PROGRAMMING **9**

Robot Languages – Classification of Languages –VAL II- Motosim, Computer Control and Robot Software.

UNIT V APPLICATIONS **9**

Robot Applications – Welding, Palletizing, Deburring, Assembly- Hands on training in material handling and processing applications, recent trends in industrial robots- Building of grippers – Exercises

TOTAL: 45 PERIODS

TEXT BOOK

1. Mikell P. Groover, Roger N. Nagel, Industrial Robotics: Technology, Programming, and Applications" McGraw-Hill Companies, 2012.

REFERENCES:

1. S.R. DEB, S. DEB, Robotics Technology and Flexible Automation, Mc-GrawHill, 2nd Edition, 2011.
2. Edquist, Flexible Automation: The Global Diffusion of New Technology, Wiley-Blackwell,1988.

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3	0	0	3

MHD352	MACHINE VISION	3 Credits

GOAL:	Develop the skill to design and work with techniques of automated inspection and morphological operations for shape recognition and template matching

OBJECTIVE	OUTCOME
The course emphasizes on: 1. Techniques for automated inspection, object recognition, mechanical metrology and robotics 2. Implementation of techniques in real time applications. 3. Providing a strong foundation in the understanding of images. 4. Enrich the knowledge of students in modern trends in industry.	The students will be able to: 1. Understand the properties of images. 2. Have adequate knowledge on machine vision system 3. Use mathematical modeling tools to represent digital images 4. Perform transformations and filtering operations in the time and frequency domains to achieve desired outputs such as edge detection, noise removal, line and corner detection, and image smoothing. 5. Apply morphological operations for shape recognition and template matching

UNIT I IMAGE FORMATION PROCESS **9**

Introduction – Elements of machine vision system – Image model: perspective geometry, image function – Radiometrical model.

UNIT IISEGMENTATION **9**

Gray level thresholding – locally adaptive thresholding – edge detection – Connected component labelling – Crack and border following – Region based segmentation – Morphological Image processing: Binary erosion – dilation – opening – closing operations – hit or miss transform – Gray scale morphology

UNIT III ENHANCEMENT **9**

Gray scale modification – Histogram modification – convolution - Image filtering: Smoothing – Sharpening – average - median

UNIT IV RECOGNITION **9**

Blob analysis – Hough transform techniques – Geometric constraints – Texture - matching - classification

UNIT V APPLICATIONS OF MACHINE VISION **9**

Inspection – Gauging – Guidance – Identification, Dimensional Checking, Color Sorting, Shape Recognition applications

TOTAL: 45 PERIODS

TEXT BOOKS

1. González, Rafael C. and Woods, Richard Eugene, Digital Image Processing, 3rd Edition, Prentice Hall, 2008.
2. Davies, E.R., Machine Vision: Theory, Algorithms, Practicalities , Academic Press, London, 1990.

REFERENCES

1. Haralick, R.M. and Shapiro, L.G., Computer and Robot Vision (Volumes I and II), Addison-Wesley, Reading Massachusetts, 1990.
2. Rosenfeld, A. and Kak, A.C., Digital Picture Processing (Volumes I and II), 2nd Edition, Academic Press, Orlando, Florida, 1982.
3. John Billingsley and Robin Bradbeer, Mechatronics and Machine Vision in Practice, Springer, 2007.
4. Ballard, D.H. and Brown, C.M., Computer Vision, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1982.

Semester –VI (Engineering Elective-IV)

L	T	P	C
3	0	0	3

MHD353	**UNDER WATER ROBOTICS**	**3 Credits**
Goal	Provide the student with an advanced knowledge base and understanding of the design, simulation and application of underwater robots.	

Objectives	**Outcome**
The course should enable the students to demonstrate knowledge and understanding of: 1. The range of underwater robotic systems in operation and their applications. 2. The impact of mission specific requirements on vehicle design. 3. Manoeuvring simulations of underwater robots. 4. Software architectures for maritime robots. 5. Practical control system design for depth and heading control of underwater robots.	To provide students with the ability to 1. Select the components for design of underwater robotics. 2. Design, configuration and operation of platforms, both autonomous underwater vehicles (AUVs) and Remotely Operated Vehicles (ROVs). 3. Use and interpretation of sensor data for control applications

UNIT I INTRODUCTION TO UNDERWATER ROBOTICS **8**

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - why it is called an perfect engineering product - Overview about Environmental Factors affecting object in water

UNIT II CONTROL OF THE UNDERWATER ROBOTICS **10**

Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Applications of Underwater Vehicles

UNIT III ENGINEERING CONCEPTS IN UNDERWATER ROBOTICS **9**

Introduction to Fluid Dynamics - Studying of FD Model - Computation Fluid Dynamics on Water Bodies Introduction to Hydraulics - Hydraulics Acting on an Object - Hydraulics as Underwater Pressure Compensator Introduction to Pressure Dynamics - Buoyancy Concept - Studying various Polymers in Buoyancy and Pressure Calculations Introduction to Electrical Power Driven Systems - Studying Different Types - PLC and HMI Interface Systems an Overlook - Electrical Archaeology of Systems

UNIT IV AUTONOMOUS UNDERWATER SYSTEM **9**

Introduction to AUVS - Development of AUV / ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used

UNIT V APPLICATIONS OF UNDERWATER ROBOTICS **9**

Case Studies and procedure for design of underwater robots- offshore oil and gas industries, applications in maritime search and rescue and environmental monitoring

TOTAL: 45 PERIODS

TEXT BOOK

1. Gianluca Antonelli, Underwater Robots (Springer Tracts in Advanced Robotics), Springer; 3rd ed. 2014.

REFERENCES

1. Steven W. Moore, Harry Bohm and Vickie, Underwater Robotics: Science, Design & Fabrication MATE Center,2013.

L	T	P	C
3	0	0	3

MHD354	APPLIED PNEUMATICS AND INDUSTRIAL AUTOMATION	3 Credits
Goal	Provide the student with an advanced knowledge base and understanding of the design, simulation and application of pneumatics systems for low cost automation	

Objectives	**Outcome**
The course should enable the students to demonstrate knowledge and understanding of: 1. Basics of Pneumatics and their applications. 2. Understand the components of pneumatic systems. 3. Know the PLC applications in pneumatics 4. Understand the basics of FMS using pneumatics	To provide students with the ability to 1. Design the air supply, distribution and conditioning for simple applications 2. Select the suitable pneumatic components for automation applications. 3. Use the PLC for controlling pneumatic circuits 4. Diagnose the fault and to maintain the pneumatic systems

UNIT I INTRODUCTION **9**

Merits of Fluid power & its utility for increasing productivity through Low Cost Automation, Transmission of Fluid Power through various types of Cylinders, Symbolic representation of Pneumatic elements, Compressors and Air supply and conditioning system including airline installations, Distribution System - ring rails systems

UNIT II BASIC PNEUMATIC CIRCUITS **9**

Pneumatic control elements (control valves & remote control system, Basic pneumatic circuits for controlling single & double acting cylinder, Basic pneumatic circuits, advanced pneumatic circuits for controlling multi cylinders- Simulation -Autosim

UNIT III ADVANCED PNEUMATIC CIRCUITS **9**

Advanced pneumatic circuits for controlling multicylinders, Electro pneumatics with relay logic, Pneumatics system with PID controls, Simulation -Autosim

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS **9**

Programmable logic controllers, introduction, architecture hardware. Components basics of PLC programming –Programming timers counters-master and jump controls-data manipulations and instructions, Programmable sequential control using pneumatic modular elements

UNIT V LOW COST AUTOMATION **9**

Low cost Automation using pneumatics, FMS – Assembly, disassembly, inspection and fault diagnosis, Maintenance of pneumatics systems

TOTAL: 45 PERIODS

TEXT BOOKS

1. A text book of Basic Pneumatics, SMC Pneumatics, 2012.
2. A text book of Electro Pneumatics, SMC Pneumatics, 2012.

REFERENCES

1. Esposito, Fluid Power with application, Prentice Hall, 2013.
2. Majumdar S.R, Pneumatics Systems Principles and Maintenance, Tata McGraw Hill, 2004.

Semester –VII (Engineering Elective-V)

L	T	P	C
3	0	0	3

MHD451	**BUILDING AUTOMATION**	**3 Credits**
Goal	Provide the student with an advanced knowledge base and understanding of the design, simulation and safety of Building Automation System (BAS).	

Objectives	**Outcome**
Identify and describe the major components in a BAS 1. Identify and describe the basic mechanical components and controls in an HVAC control system 2. Describe and explain the basic functions of DDC systems Reference codes and standards applicable to BAS 3. Describe and explain HMI basics Explain BAS in lighting, fire, security, etc. 4. Explain the process of implementing BAS and understand the Energy Conservation Strategies	Students will be able to: 1. Select and evaluate the different transducers, actuators, AC, refrigeration systems in modern Buildings 2. Identify the importance and techniques of energy conservations in BAS for simple applications 3. Design and installation methods of safety sensors for simple application 4. Know the procedure for integrated and secure smart building techniques

UNIT I INTRODUCTION 9

Introduction to Building Automation System, Features, Characteristics, Drawbacks of Building Automation system. Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System.

UNIT II BUILDING MANAGEMENT SYSTEM 9

Qualitative study- Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI.Logic Examples, CL Programming.

UNIT III ENERGY MANAGEMENT SYSTEM 9

Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving.

UNIT IV SAFETY SYSTEMS 9

Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming.

UNIT V INTEGRATED SYSTEMS 9

Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems

TOTAL: 45 PERIODS

TEXT BOOK

1. Reinhold A. Carlson Robert A. Di Giandomenico, Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building, 1 st edition, R.S. Means Company Ltd), 1991.

REFERENCES

1. Geoff Levermore, Building Energy Management Systems: An Application to Heating, Natural Ventilation, Lighting and Occupant Satisfaction, Routledge,2nd Edition, 2000.
2. Nancy G. Leveson, Engineering a Safer World: Systems Thinking Applied to Safety (Engineering Systems)1st Edition, The MIT Press, 2011.