ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

(Four Year Degree Programme) (Choice Based Credit System)

(FULL–TIME)

REGULATIONS AND SYLLABUS

REGULATIONS

Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as subjects of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamilnadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma course in Engineering of the State Board of Technical Education, Tamil Nadu (listed in Annexure-1) will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

Branches of Study in B.E.

BRANCH I	-	Civil Engineering
BRANCH II	-	Civil and Structural Engineering
BRANCH III	-	Mechanical Engineering
BRANCH IV	-	Mechanical Engineering (Manufacturing)
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Instrumentation Engineering
BRANCH VII	-	Chemical Engineering
BRANCH VIII	-	Computer Science and Engineering
BRANCH IX	-	Information Technology
BRANCH X	-	Electronics and Communication Engineering

Courses of Study

The courses of study and the respective syllabi are given separately.

Scheme of Examinations

The scheme of Examinations is given separately.

Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of

theory and practical courses. The total credits for the entire degree Programme is 176 (135 for lateral entry students).

Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has to

1. Earn a minimum of 176 credits (135 for lateral entry students).
2. Serve in any one of the Co-curricular activities such as
    - National Cadet Corps (NCC)
    - National Service Scheme (NSS)
    - National Sports Organization (NSO) and
    - Youth Red Cross (YRC)

for at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enroll as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE

Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and one credit for two hours or part thereof for laboratory or practical or drawing per week.

Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than eight years from the time of admission.

Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enroll for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 176 (135 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

The **slow learners** may be allowed to withdraw certain courses with the approval by Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses

withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

The **advance learners** may be allowed to take up the open elective subjects of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

Seminar / Industrial Training

The student has to present a seminar on the chosen topic. However, the student can select a topic duly approved by the Seminar Coordinator and the Head of the Department concerned. The student who has presented the seminar has to submit a report and appear for viva-voce examination at the end of the semester.

Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

Industrial Training (Value added courses)

One credit courses shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology. For one credit course, a relevant potential topic may be selected by a committee consisting of Head of the department concerned and the Board of Studies member from the Department and a senior faculty member from the department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two one credit courses (one each in VI and VII semesters). They shall be allowed to take one credit courses offered in other Departments with the permission of Head of the Department offering the course. A separate mark sheet shall be issued for one credit courses.

Electives

The elective courses fall under two categories: Professional Electives and Open Electives. The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned. Apart from the various Professional elective courses, a student can choose the open electives from any specialization offered in any Department in the Faculty of Engineering & Technology during the entire period of study, with the approval of the Head of the Department and the Head of the Department offering the course.

Further, the student can also credit not more than two courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent of open electives.

Assessment

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

The continuous assessment marks for the seminar / industrial training will be 40 and to be assessed by a seminar committee consisting of the Seminar Coordinator and a minimum of two members nominated by the Head of the Department. The continuous assessment marks will be awarded at the end of seminar session. 60 marks are allotted for the seminar / industrial training and viva voce examination conducted based on the seminar / industrial training report at the end of the semester.

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student

counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

Attendance requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

Temporary break of study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

The student applies for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of eight years.

Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' appears in the mark sheet for such candidates.

Passing and declaration of examination results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

Awarding degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

- For **First Class with Distinction**, the student must earn a minimum of 176 credits within four years (135 credits within three years for lateral entry students) for from the time of admission , pass all the courses in the first attempt and obtain a CGPA of 8.25 or above for all the subjects from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).
- For **First Class**, the student must earn a minimum of 176 credits within five years (135 credits within four years for lateral entry students) from the time of admission and obtain a CGPA of 6.75 or above for all the subjects from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).
- For **Second Class**, the student must earn a minimum of 176 credits within eight years (135 credits within seven years for lateral entry students) from the time of admission.

Ranking of Candidates

The candidates who are eligible to get the B.E. degree in the First Class with Distinction will be ranked together on the basis of CGPA for all the subjects of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the subjects of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

Diploma Programmes Eligible for the B.E (Lateral Entry) Programmes offered in FEAT (from 2017-2018)

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
1.	**Civil Engineering**	i. Civil Engineering ii. Civil Engineering (Architecture) iii. Environmental Engineering and Pollution Control (Full Time) iv. Architectural Assistantship v. Civil Engineering (Rural Tech.) vi. Civil and Rural Engineering
2.	**Civil and Structural Engineering.**	
3.	**Mechanical Engineering**	i. Mechanical Engineering ii. Mechanical and Rural Engineering iii. Mechanical Design and Drafting iv. Production Engineering v. Production Technology vi. Automobile Engineering vii. Automobile Technology viii. Metallurgy ix. Mechatronics Engineering x. Machine Tool Maintenance and Repairs xi. Tool and Die making xii. Tool Engineering xiii. Tool Design xiv. Foundry Technology xv. Refrigeration and Air Conditioning xvi. Agricultural Engineering xvii. Agricultural Technology xviii. Marine Engineering xix. Mechanical Engineering(Production) xx. Mechanical Engineering(Tool &Die) xxi. Mechanical Engineering (Foundry) xxii. Mechanical Engineering(R & A.C.) xxiii. Electronics(Robotics) xxiv. Mining Engineering xxv. Agricultural Engineering and Farm xxvi. Equipment Technology
4.	**Mechanical Engineering (Manufacturing Engineering)**	
5.	**Electrical and Electronics Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
6.	**Electronics and Instrumentation Engineering**	vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
7.	**Chemical Engineering**	i. Petrochemical Engineering ii. Chemical Engineering iii. Environmental Engineering and Pollution Control iv. Leather Technology (Footwear) v. Leather Technology vi. Plastic Technology vii. Polymer Technology viii. Sugar Technology ix. Textile Technology x. Chemical Technology xi. Ceramic Technology xii. Petro Chemical Technology xiii. Pulp & Paper Technology xiv. Petroleum Engineering
8.	**Computer Science and Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
9.	**Information Technology**	
10.	**Electronics and Communication Engineering**	

FT- Full Time; PT-Part Time; SW- Sandwich.

COURSES AND CREDITS - SUMMARY

Semester	No. of Courses		HS	BS	ES	PC	PE	OE	S&IT	Proj.	Total Credits
	T+P	Total									
I	4+2	**6**	3*	9	5	-	-	-	-	-	17
			1**	3	2						
II	4+4	**8**	4	13	7	-	-	-	-	-	24
			1	5	2						
III	6+2	**8**	3	4	8	8	-	-	-	-	23
			1	1	3	3					
IV	6+2	**8**	-	4	3	16	-	-	-	-	23
				1	1	6					
V	6+3	**9**	-	-	-	17	8	-	-	-	25
						6	3				
VI	6+3	**9**	-	-	-	10	11	3	-	-	24
						4	4	1			
VII	5+3	**8**	3	-	-	5	8	3	1	-	20
			1			2	3	1	1		
VIII	2+1	**3**	-	-	-	-	-	6	-	14	20
								2	-	1	
Total Courses	39+20	**59**	**4**	**10**	**8**	**21**	**10**	**4**	**1**	**1**	**-**
Total Credits		**-**	**13**	**30**	**23**	**56**	**27**	**12**	**1**	**14**	**176**

* - No of Credits ; ** - No of Courses.

DETAILS OF COURSE CODE

Code (First	Details	Code (3rd and	Details

Two digits)	
00	Common course for the faculty
01	Civil Engg. Course
02	Civil and Structural Engg. course
03	Mechanical Engg. Course
04	Mechanical Engg (Manufacturing). Course
05	Electrical and Electronics Engg. Course
06	Electronics and Instrumentation Engg. course
07	Chemical Engg. course
08	Computer Science and Engg. course
09	Information Technology course
10	Electronics and Communication Engg. course
XX	Code of the programme concerned (01 to 10)

4th Digits)	
HS	Humanities Theory
HP	Humanities Practical
BS	Basic Science Theory
BP	Basic Science Practical
ES	Engineering Science Theory
SP	Engineering Science Practical
PC	Professional Core Theory
CP	Professional Core Practical
PE	Professional Elective Theory
EP	Professional Elective Practical
ST	Seminar / Industrial Training
OE	Open Elective Theory
PV	Project and Viva-voce

5th digit represents the semester and 6th and 7th digits represent the serial number of courses.

COURSES OF STUDY AND SCHEME OF EXAMINATIONS

FIRST SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits
1.	HS-I	00HS101	Technical English	4	-	-	75	25	100	3
2.	BS-I	00BS102	Engineering Mathematics I	4	-	-	75	25	100	3
3.	BS-II	00BS103	Applied Physics I	4	-	-	75	25	100	3
4.	BS-III	00BS104	Applied Chemistry I	4	-	-	75	25	100	3
5.	ES-I Lab	00SP105	Computer Programming Laboratory	-	1	3	60	40	100	3
6.	ES-II Lab	00SP106	Engineering Workshop	-	-	3	60	40	100	2
			Total	**16**	**1**	**6**	**420**	**180**	**600**	**17**

*** Basic Civil Engg. Course** for Mech., Manuf., EEE, EIE, ECE, CSE & IT.

Basic Electrical Engg. Course for Civil, Civil and Structural, Mech., Manuf.,& Chem. Engg.

Basic Mechanical Engg. Course for Civil, Civil and Structural, EEE, EIE, ECE, CSE, IT & Chem. Engg.

L - Lecture; **T**-Tutorial; **P**-Practical;

Exam - End Semester Examination; **CA**-Continuous Assessment.

SECOND SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits
1.	BS-IV	00BS201	Engineering Mathematics-II	4	-	-	75	25	100	3
2.	BS-V	00BS202	Applied Physics-II	4	-	-	75	25	100	3
3.	BS-VI	00BS203	Applied Chemistry II	4	-	-	75	25	100	3
4.	ES-I	00ES204	Basic Engineering*	4		-	75	25	100	3
5.	HS-II	00HP205	Communication Skills and Language Laboratory	-	2	3	60	40	100	4
6.	BS-I Lab	00BP206	Applied Physics Laboratory	-	-	3	60	40	100	2
7.	BS-II Lab	00BP207	Applied Chemistry Laboratory	-	-	3	60	40	100	2
8.	ES-III Lab	00SP208	Engineering Graphics	-	2	3	60	40	100	4
			Total	**16**	**4**	**12**	**540**	**260**	**800**	**24**

THIRD SEMESTER

1.	HS-III	00HS301	Environmental Studies	4	-	-	75	25	100	3
2.	BS-VII	00BS302	Engineering Mathematics III	4	1	-	75	25	100	4
3.	ES-II	00ES303	Engineering Mechanics	4	-	-	75	25	100	3
4.	ES-III	06ES304	Fluid Mechanics and Hydraulic Machinery	4	-	-	75	25	100	3
5.	PC-I	06PC305	Circuit Theory	4	-	-	75	25	100	3
6.	PC-II	06PC306	Fundamentals of Semiconductor Devices	4	-	-	75	25	100	3
7.	ES-IV Lab	06SP307	Hydraulics Lab	-	-	3	60	40	100	2
8.	PC-I Lab	06CP308	Circuit and Devices Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**6**	**570**	**230**	**800**	**23**

FOURTH SEMESTER

1.	BS-VIII	06BS401	Probability, Random processes and Numerical Methods	4	1	-	75	25	100	4
2.	ES-IV	06ES402	Thermodynamics	4	-	-	75	25	100	3
3.	PC-III	06PC403	Electronic Circuits	4	-	-	75	25	100	3
4.	PC-IV	06PC404	Digital Electronics	4	-	-	75	25	100	3
5.	PC-V	06PC405	Analog and Digital Integrated Circuits	4	-	-	75	25	100	3
6.	PC-VI	06PC406	Transducers and Measurement System	4	-	-	75	25	100	3
7.	PC-II Lab	06CP407	Linear and Digital ICs Lab	-	-	3	60	40	100	2
8.	PC-III Lab	06CP408	Sensors and Signal Conditioning Circuits Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**6**	**570**	**230**	**800**	**23**

FIFTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits
1.	PC-VII	06PC501	Control Systems	4	1	-	75	25	100	4
2.	PC-VIII	06PC502	Industrial Instrumentation	4	-	-	75	25	100	3
3.	PC-IX	06PC503	Electronic Instrumentation and Measurement Techniques	4	-	-	75	25	100	3
4.	PC-X	06PC504	Micro Processors and Micro Controllers	4	-	-	75	25	100	3
5.	PE-I	06PE505	Professional Elective -I	4	-	-	75	25	100	3
6.	PE-II	06PE506	Professional Elective -II	4	-	-	75	25	100	3
7.	PC-IV Lab	06CP507	Control System Lab	-	-	3	60	40	100	2
8.	PC-V Lab	06CP508	Microprocessor lab	-	-	3	60	40	100	2
9.	PE-I Lab	06EP509	Professional Elective-I Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**9**	**630**	**270**	**900**	**25**

SIXTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits
1.	PC-XI	06PC601	Digital Signal Processing	4	-	-	75	25	100	3
2.	PC-XII	06PC602	Process Control	4	-	-	75	25	100	3
3.	PE-III	06PE603	Professional Elective -III	4	-	-	75	25	100	3
4.	PE-IV	06PE604	Professional Elective -IV	4	-	-	75	25	100	3
5.	PE-V	06PE605	Professional Elective -V	4	-	-	75	25	100	3
6.	OE-I	XXOE606*	Open Elective-I	4	-	-	75	25	100	3
7.	PC-VI Lab	06CP607	Instrumentation and Process Control Lab	-	-	3	60	40	100	2
8.	PC-VII Lab	06CP608	Embedded Systems Laboratory	-	-	3	60	40	100	2
9.	PE-II Lab	06EP609	Professional Elective-II Lab	-	-	3	60	40	100	2
			Total	**24**	**-**	**9**	**630**	**270**	**900**	**24**

***** First two digits indicate thecode of the Department/Branch offering the elective course.

SEVENTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	S	Exam	CA	Total	Credits
1.	HS-IV	00HS701	Engineering Ethics	4	-	-	-	75	25	100	3
2.	PC-XIII	06PC702	Computer Control of Processes	4	-	-	-	75	25	100	3
3.	PE-VI	06PE703	Professional Elective -VI	4	-	-	-	75	25	100	3
4.	PE-VII	06PE704	Professional Elective -VII	4	-	-	-	75	25	100	3
5.	OE-II	XXOE705	Open Elective-II	4	-	-	-	75	25	100	3
6.	PC-VIII Lab	06CP706	Computer Process Control Lab	-		3	-	60	40	100	2
7.	PE-III Lab	06EP707	Professional Elective-III Lab	-	-	3	-	60	40	100	2
8.	S & IT	06ST708	Seminar/Industrial Training	-	-	-	1	60	40	100	1
			Total	**20**	**-**	**6**	**1**	**555**	**245**	**800**	**20**

EIGHTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	credits
1.	OE-III	XXOE801	Open Elective-III	4	-	-	75	25	100	3
2.	OE-IV	XXOE802	Open Elective-IV	4	-	-	75	25	100	3
3.	Project	06PV803	Project Work and Viva-voce	-	-	15	60	40	100	14
			Total	**8**		**15**	**210**	**90**	**300**	**20**

SYLLABUS

FIRST SEMSTER

00HS101	TECHNICAL ENGLISH	L	T	P
		4	0	0

COURSE OBJECTIVES

- English technical communication focuses on developing the proficiency of Engineering students in communicative skills, ensuring them to face the demand of their profession with high command in English.
- At the end of the course, the learners will be able to use English for all purposes of technical communication and come out in "flying colours".

Unit–I : Listening Strategies

This unit makes the students to get exposed to the listening exercises and get registered in their minds the nuances of listening and its importance.

1. Listening process.
2. Types of listening.
3. Barriers to listening.
4. Characteristics of good listeners.
5. Team listening and note making.

Unit–II : Critical Reading and Creative Writing Skills

This unit introduces communication model like courtesy, body language, role play and good presentation in an effective manner, where the students are given an opportunity to observe, analyze, interpret, imagine and implement their ideas too.

Poem : Road not taken – Robert Frost
Ulysses – Alfred Lord Tennyson.

Prose : Of Studies – Francis Bacon
Science – Destroyer or creator – J. Bronowski

Play : Pygmalion – Bernardshaw.

Unit–III : Speaking Skill

Students shall be motivated to speak in English on familiar or unfamiliar topics. It is a platform to train the students to achieve competency in oral expression.

1. Interview Techniques
2. Group discussion
3. Making presentation and Discussing on the presentation.
4. Sample interviews

5. Dialogue writing

Unit–IV : Professional Writing

Students shall be trained to create their own proficiency in writing like - calling for quotation, asking clarification, placing orders and so on.

1. Poster making
2. Letter writing (formal and E-mail)
3. Analytical writing
4. Format of memos.
5. Report Writing

Unit–V : Theoretical writing

The nuances of English grammar may be taught to the students so as to present flawless English both in their oral and written communication

1. Vocabulary – Homonyms, Homophones, Acronyms & Abbreviations, Idioms & Phrases.
2. Single word substitution
3. Concord
4. Tag Questions
5. Active voice and passive voice

TEXT BOOK

Rizvi, Ashraf.2006. *"Effective Technical Communication"*. New Delhi. Tata Mc.Graw Hill Publication Company Ltd.

REFERENCE BOOKS

1) Raman, Meenakshi and Sangeetha Sharma, 2004. *"Technical Communication: Principles and Practice"*. New Delhi: OUP.
2) Bailey, Stephen, "*Academic Writing: A practical guide for students*". New York: Rutledge.2011.
3) Gerson, Sharon, J. and Steven M. Gerson, 2007. "*Technical Writing: Process and Product*". Delhi: Pearson prentice Hallan, 1980.

COURSE OUTCOMES

1) Understand the role of speaking in English and its contribution to their success.
2) Help the students increase the lingual power and word power, and frame suitable structures to use appropriately in different contexts.
3) Initiate the students to adopt different strategies for personal and professional writing.
4) Train the students use diversified rhetorical functions of technical English.

00BS102	ENGINEERING MATHEMATICS - I	L	T	P
		4	0	0

COURSE OBJECTIVES

To acquaint the student with the concepts in

- Matrices,
- Differential calculus,
- Multiple integrals,

- Vector calculus, which are most important in connection with practical engineering problems.

Unit–I : Matrices

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem – Orthogonal transformation of a real symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit–II : Differential Calculus

Curvature in Cartesian and parametric co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes.

Unit–III : Differential Calculus: Functions of Several Variables

Jacobians – Taylor's and Maclaurin's series expansions of functions of two variables – Maxima and Minima of functions of two variables – Constrained Maxima and Minima by Lagrange Method.

Unit–IV : Multiple Integrals

Double integration – Cartesian and polar co-ordinates – change of order of integration – area as a double integral – triple integration – Volume as a triple integral.

Unit–V : Laplace Transform

Definition, Transform of elementary functions, Properties, Derivatives and integrals of transforms, Transforms of derivatives, Convolution theorem, Transforms of periodic functions,Inverse Laplace transform, Application to solution of linear ordinary differential equations of second order with constant coefficients.

(In all units, proof of theorems are not included)

TEXT BOOKS

1) Venkataraman, M.K., Engineering Mathematics, Volumes-I (2008) and II (2009), The National Publishing Company, Chennai.
2) Veerarajan, T., Engineering Mathematics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

REFERENCE BOOKS

1) Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 40th Edition, 2007.
2) Erwin Kreysig, Advenced Engineering Mathematics, John Wiley & Sons, 8th Edition, 2002.

COURSE OUTCOMES

1) This course equips students to have knowledge and understanding in matrices, differential calculus, multiple integrals and Laplace transforms.
2) Students will be able to solve problems related to above fields in engineering applications.

00BS103	APPLIED PHYSICS – I	L	T	P
		4	0	0

COURSE OBJECTIVES:

At the end of the course the students would be exposed to fundamental knowledge in various engineering subjects and applications

- Determine the different modulus of elasticity and viscosity of the less and highly viscous liquids.
- Design of acoustically good buildings.
- Interferometric techniques in metrology, communication and civil engineering.
- Application of quantum physics to optical and electrical phenomena.
- Application of ultrasonics and acoustics.
- Structure identification of engineering materials.
- Applications of Radio isotopes and power reactor systems.

Unit–I : Properties of Matter

Introduction to elasticity - Hook's law - Different modulii of elasticity - Bending of beams – Determination of Young's modulus by Uniform and Nonuniform bending – I-shapegirder – Torsional pendulum - Theory – Experiment and its applications. Introduction to Viscosity – streamline and turbulent flow – Poiseuille's equation- capillary flow method – Stoke's law – terminal velocity – determination of viscosity by Stoke's method.

Unit–II : Sound

Introduction to Acoustics - factors affecting acoustics of buildings and their remedies– absorption coefficient– Sabine's formula for reverberation time.

Introduction to Ultrasonics – production – magnetostriction and piezo electric methods – Detection of Ultrasonic waves (Acoustics grating) – Applications.

Unit–III : Optics

Interference – Air wedge – Michelson's interferometer – Diffraction - Dispersive power of prism and grating – Polarisation – Types of Polarisation - theory of plane, Circularly and elliptically polarized light – photo elasticity -Stress optic law – Effect of a stressed model in plane polariscope – Isoclinic and Isochromatic fringes – photo elastic bench – uses.

Unit–IV : Crystal Physics

Lattice - unit cell - Bravais lattice - Atomic radius, co-ordination number, Packing factor and their calculations of SC,BCC,FCC and HCP crystal structures - Miller indices - Crystal imperfections (Point defect, Line defect, surface defect and volume defect).

Unit–V : Nuclear Physics

Introduction - General properties of Nucleus – Mass defect, Binding energy, Nuclear models – Liquid drop model and Nuclear shell model - Nuclear detector – G.M counter – Scintillation Counter – Ionisation Chamber – Fission, Fusion, Thermonuclear reaction and Stellar energy – Nuclear reactor – General nuclear reactor – Breeder nuclear reactor.

TEXT BOOKS

1) Arumugam, M., "Engineering Phyisics", Anuradha Agencies, Kumbakonam, 2000.
2) Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, New Delhi, 2003.

REFERENCE BOOKS

1) Pillai, S.O., "Solid State Physics", New Age International Publication, New Delhi, Seventh Edition, 2015
2) Palanisamy, P.K., "Physics for Engineers", Scitech Publication (India) Pvt. Ltd., Chennai, Second Edition, 2005.
3) Mani, P., "Engineering Phyisics", Dhanam Publication, Chennai, 2011.
4) Rajendran, V. and Marikani, A., "Applied Physics for Engineers", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
5) Theraja, B.L., "Modern Physics", Chand & Company Ltd., Edition 1990.
6) Tayal, D.G., "Nuclear Physics", Himalaya Publishing House, 2007.
7) Ghoshal, S.N., "Nuclear Physics", S. Chand & Company Ltd., 2012.
8) Avadhanulu, M.N. and Kshirsagar, P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.

COURSE OUTCOMES

1) The Engineering students can gain the basic knowledge in the field of optics, sound, nuclear physics and crystalline materials etc.
2) It will be useful to apply in engineering applications.

00BS104	APPLIED CHEMISTRY – I	L	T	P
		4	0	0

COURSE OBJECTIVES

To make the student conversant with the

- Water treatment techniques and disinfection methods.
- Working principle of electrochemical cells.
- Sources, refining and various types of fuels.
- Mechanism, classification, applications of lubricants and introduction adhesives.
- Surface chemistry, principle and applications of chromatography.

Unit–I : Water Treatment

Water – Hardness of water – softening of water by ion-exchange process and zeolite process – boiler feed water – specifications – boiler troubles (Sludge and scale formation, priming and foaming, caustic embrittlement and boiler corrosion) – removal of dissolved CO_2, O_2 and acids – internal treatment of boiler feed water (colloidal, carbonate, phosphate, calgon and EDTA conditioning) – disinfection of water – break point chlorination – desalination of brackish water by reverse osmosis method - Determination of total hardness by EDTA method.

Unit–II : Electrochemistrty

Electrochemical cell – EMF – determination of EMF of electrochemical cell – single electrode potential – standard electrode potential – Nernst equation –

reference electrodes – standard hydrogen electrode, calomel electrode, glass electrode – electrochemical series – concentration cell.

Unit–III : Fuels And Combustion

Classification of fuels – calorific value – HCV and LCV – Analysis of coal – proximate and ultimate analysis – carbonization of coal (HTC and LTC) – Manufacture of coke – properties of coke – flue gas analysis by Orsat's apparatus. Petroleum – Refining – Synthetic petrol – Fischer – Tropsch and Bergius process – cracking – polymerization process – knocking in petrol and diesel engines – octane number and cetane number – properties of straight run, cracked and polymer gasoline.

Unit–IV : Engineering Materials – I

Lubricants and their functions – Mechanisms of lubrication – classification of lubricants with example – lubricating oils – properties of lubricating oils (viscosity index, flash and fire points, cloud and pour points, oiliness, carbon residue and aniline point) – Solid lubricants – Greases – emulsion lubricants. Adhesives – Definition – adhesive action – development of adhesives strength – physical and chemical factors influencing adhesive action – bonding process of adhesives – adhesives for building and constructions – animal glues, casein glues.

Unit–V : Analytical Technique and Surface Chemistry

Chromatography – Definition – classifications – partition chromatography and adsorption chromatography.Surfacechemistry – Definition – types of adsorption – characteristics of adsorption – adsorption isotherms – Freundlich's adsorption isotherms and Langmuir's adsorption isotherms – applications of adsorption.

TEXT BOOKS

1) Sivasankar, B., (2012). '*Engineering Chemistry'*, Tata McGraw-Hill Publishing company Limited, NewDelhi.
2) Sivakumar, R. and Sivakumar, N., (2013). '*Engineering Chemistry'*, Tata McGraw-Hill Company Limited, NewDelhi.

REFERENCE BOOKS

1) Jain, P.C. and Monica Jain, (2010). '*Engineering Chemistry'*, DhanpatRai& Sons, New Delhi
2) Dara, S.S. and Umare, S.S., (2014)., '*Text book of Engineering Chemistry*,' S.Chand& Co. Ltd., New Delhi.
3) Gopalan, R., Venkappayya, D., and Nagarajan. S (2008)., '*Engineering Chemistry'*, Tata McGraw Hill Publishing Company Limited, New Delhi.

COURSE OUTCOMES

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

1) Understand and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.
2) Understand and apply the concepts of electrochemistry including electroplating.
3) Understand the properties, sources of fuel and the concept of combustion

4) Gain the knowledge about types of lubricants, uses & their mechanisms and to understand the binding process of adhesives, and its application in building and construction.
5) Separate and purify various organic and inorganic compounds using different chromatographic techniques.
6) Understand the concept of surface chemistry and its applications.

00SP105	COMPUTER PROGRAMMING LABORATORY	L	T	P
		0	1	3

COURSE OBJECTIVES

- To enable the students to have a good understanding about the concepts of "C" programming.
- To provide the hands on experience in basic concepts of AUTOCAD to students.

C Programs based on the following concepts:

Basic structure of C Programs – Constants – Variables - Data Types - – Keywords – Identifiers - Operators - Expressions – IF, IF-ELSE, Nested IF-ELSE, Switch, WHILE, DO, FOR and GOTO statements - Arrays: one dimensional and two dimensional – Strings - Functions.

AUTOCAD

Introduction – Terminology – Coordinates - Operations – Control keys – Commands – Utility Commands –File Commands – Edit and Inquiry Commands – Display Control Commands – Modes – Layers – Colors – Blocks.

Special Features – Dimensioning – Angular, Diameter and Radius – Hatching – Patterns – Slides – Attributes – Configuring – Plotting– Exercises in AUTOCAD (2D Drawings only)

TEXT BOOKS

1) E. Balagurusamy, Programming in Ansi C, Tata McGraw-Hill Education, (2012) 6th Edition.
2) Cheryl R. Shrock, AutoCAD Pocket Reference, BPB Publications,(2015)

REFERENCE BOOKS

1) Yashavant P. Kanetkar, Let us C, BPB Publications, 14th Edition, (2016)
2) David Byrnes, AutoCAD 2010 FOR DUMMIES, Wiley Publishing,Inc., (2010)

COURSE OUTCOMES

3) Understand the concepts of C programming.
4) Apply the syntax of conditional and looping statements for writing C programs
5) Use the features of AUTOCAD for 2D drawing

00SP106	ENGINEERING WORKSHOP	L	T	P
		0	0	3

COURSE OBJECTIVES

- To provide the students simple hands-on-experience in the basic aspects of production engineering in fitting, carpentry and sheet metal.

Workshop Practice in the Shops

Carpentry: Use of hand tools – exercises in planning and making joints namely, half lap joint, dovetail joint, mortising and tenoning.

Fitting: Use of bench tools, vice, hammers, chisels, files, hacksaw, centre punch, twist drill, taps and dies – Simple exercises in making T joint and dovetail joints.

Sheet Metal Work: Use of hand tools – Simple exercises in making objects like cone, funnel, tray, cylinder.

Smithy: Demonstration of hand forging and drop forging.

COURSE OUTCOMES

This course

1) Use basic tools of fitting, carpentry and sheet metal fabrication.
2) Experience in the fabrication of simple carpentry joints.
3) Develop skill to make simple fitting joints.
4) Train to make simple shapes of sheet material.
5) Distinguish hand forging and drop forging operation.

SECOND SEMESTER

00BS201	ENGINEERING MATHEMATICS II	L	T	P
		4	0	0

COURSE OBJECTIVES

- To acquaint the student with the concepts in ordinary differential equations and vector calculus.
- To acquaint the student with the techniques in the theory of analytic functions and complex integration.
- Above topics are most important in connection with practical engineering problems.

Unit–I : Ordinary Differential Equations

Second order linear differential equations with constant coefficients, Second order linear differential equations with variable coefficients (Euler and Legendre's linear equations), Simultaneous first order linear equations with constant coefficients, method of variation of parameters.

Unit–II : Vector Differentiation

Gradient, divergence and curl, directional derivative, unit normal vector, irrotational and solenoidal vector fields, expansion formulae for operators involving ∇.

Unit–III : Vector Integration

Line, surface and volume integrals, Green's theorem in a plane, Gauss divergence theorem, Stoke's theorem – Verification of the above theorems and evaluation of integrals using them.

Unit–IV : Analytic Functions

Functions of a complex variable, Analytic function, the necessary conditions (Cauchy-Riemann equations), sufficient conditions, Properties of analytic functions, harmonic functions, construction of Analytic function by Milne-Thomson method, Conformal mapping: $w = z^2$, $1/z$, e^z, sin z, cos z.

Unit–V : Complex Integration

Statement and application of Cauchy theorem, Cauchy integral formulas, Taylor and Laurent expansion, Singularities – Classification; Residues – Statement and application of Cauchy residue theorem, Contour integration round the unit circle.

(In all units, proof of theorems are not included)

TEXT BOOKS

1) Venkataraman M K, Engineering Mathematics, Volumes I (2008) and II (2009), The National Publishing Company, Chennai.
2) Veerarajan T, Engineering Mathematics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

REFERENCE BOOKS

1) Grewal B S, Higher Engineering Mathematics, Khanna Publishers, Delhi, 40th Edition, 2007.
2) Erwin Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 8th Edition, 2002.

COURSE OUTCOMES

1) This course equips students to have knowledge and understanding in ordinary differential equations, vector calculus and complex variables.
2) Students will be able to solve problems related to above fields in engineering applications.

00BS202	APPLIED PHYSICS – II	L	T	P
		4	0	0

COURSE OBJECTIVES

At the end of the course the students would be exposed to fundamental knowledge invarious materials and applications

- Application of lasers and fiber optics in engineering and technology.
- Astrophysics is the study of physics of the universe. In various objects, such as stars, planets and galaxies.
- To measure positions, brightness, spectra structure of gas clouds, planets, starts, galaxies, globular clusters, quasars etc.
- Physics of modern engineering materials.
- Electromagnetic phenomena and wave propagation
- Applications of nano materials, nano electronics and optoelectronic devices.
- Design of energy sources and applications of solar energy.

Unit–I : Laser and Fiber Optics

Introduction to laser - Einstein co-efficients (A&B) – properties of Laser- Types of laser – CO_2, Nd-YAG and Semiconductor lasers - Applications – Holography - Construction and reconstruction of hologram - Applications.

Fiber optics - Principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - Types of optical fibers (Material, Mode and refractive index) - Applications - Fiber Optic communication system.

Unit–II : Dielectrics and Superconductors

Introduction to Dielectrics – Types of Dielectric materials - Dielectric constant – Determination of Dielectric constant ($\sum r$) by Schering Bridge method – Different types of polarization – Local or Internal field – Clausius-Mosotti Equation – Dielectric Loss – Dielectric breakdown – Dielectric Properties and applications –

Superconductivity – Properties – Meissner effect – Type I and Type II superconductors – BCS theory- High temperature Superconductors – Applications.

Unit–III : Nano Materials

Introduction to Nanomaterials – properties – Types of nanomaterials – synthesis of nanomaterials - Top-down approaches – Mechanical grinding, Lithiography – Types of Lithiography - Bottomup approaches – physical vapour deposition method, Sol-gel method. Applications of nanomaterial. Carbon Nanotubes (CNT) – Introduction – Types of Carbon Nanotubes – Synthesis of Carbon Nanotubes – Properties and its application.

Unit–IV : Quantum Mechanics

Heisenberg uncertainty Principle - Wave particle dual nature – De Broglie's matter Waves – wave Velocity and group velocity.

The wave Equation, Schrödinger's Time dependent wave equation, Schrödinger's time independent wave equation - The Wave function and its physical significance - The particle in a box – energy quantization – Eigen values and Eigen functions.

Unit–V : Energy Physics

Introduction to energy source - Energy sources and their availability (Conventional &non-conventional energy sources) – Solar energy – Introduction – Methods of Harvesting Solar energy (Solar cells, Solar battery, Solar heat collectors and Solar water heater) - Wind energy – basic components of a WECS (Wind Energy Conversion System) – Classification of WEC Systems – Advantages and disadvantages of WECS - Biomass – Biomass conversion - Biogas Generation - Classification of Biogas plants.

TEXT BOOKS

1) Arumugam,M., "Engineering Physics", Anuradha Agencies, 2nd Edition, 1997.
2) Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, New Delhi, 2003.

REFERENCE BOOKS

1) Rajendran,V., "Engineering Physics", Tata McGraw Hill Publishers, 2009.
2) Rai, G.D., "Non-conventional Energy Sources", Khauna Publications, 1993.
3) Martin Harwit, "Astrophysical Concepts", Springer, 4th Edition, 2006.
4) Dimitri Mihalas, "Stellar Atmospheres", San Francisco, W.H. Freeman & Company, 1978.
5) Wilson, M., Kannangara, K., Smitt, G., Simmons, M. & Boguse, B., "Nanotechnology", Basic Science and Emergine Technology, Raguse Chapman Hall Publications, 2002.
6) Kenneth Klabunde, J., "Nanoscale Materials in Chemistry", A John Eiley & Sons Inc., Publication, 2001.
7) Mani, P., "Engineering Phyisics", Dhanam Publication, Chennai, 2011.
8) Agarwal, M.P., "Solar Energy", S.Chand& Co., I Edn, New Delhi, 1983.
9) John Twidell & Tony Weir, "Renewable Energy Resources" , Taylor & Francis, 2005.

10) Carroll, B.W. & D.A. Ostlie, "An Introduction to Modern Astrophysics", 2nd Edition, 2011.
11) Avadhanulu, M.N. and Kshirsagar, P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.
12) Rai, G.D., *"Solar Energy* Utilization", Volume- & 2, by Khanna Publishers, New Delhi.
13) Senthilkumar, G., Engineering Physics, VRB Publishers Pvt. Ltd., Chennai.
14) Ravikrishnan, A., Environmental Science and Engineering, Hitech Publishing Company Pvt. Ltd.
15) Rai, G.D., *"Non-Conventional Energy Sources",* Khanna Publishers.
16) Senthilnathan, S., Gnanapoongothai, T., Oudayakumar, K., Jayavarthanan,T., "Material Science", SSMP Publications.

COURSE OUTCOMES

1) The student will have the theoretical knowledge in this field of laser, dielectrics, Nano technique, energy physics etc.
2) It will be very useful to the students to apply in different field of engineering.

00BS203	APPLIED CHEMISTRY II	L	T	P
		4	0	0

COURSE OBJECTIVES

To make the students to understand the

- Types of polymers and polymerization processes.
- Phase rule with different kinds of systems.
- Different types of corrosion and their mechanism.
- Working principle and applications of primary and secondary batteries.
- Engineering materials such as refractories and abrasives.

Unit–I : Polymers

High polymers: plastics – Thermoplastics and thermosetting resins. Addition polymerization and condensation polymerization – compounding of plastics – Moulding methods – Compression, injection and blow moulding – Important engineering plastics – polyethylene, PVC, Teflon, Polystyrenes, Nylon 6,6, Bakelite, Polyurethane – Rubber – natural rubber – vulcanization of rubber – Synthetic rubber – buna-S, butyl rubber, neoprene and polyurethane foams.

Unit–II : Phase Rule

Phase rule – statements and explanation of the terms involved – condensed phase rule – construction of phase diagram – water system – sulphur system – phase rule for two component alloy systems – thermal analysis – eutectic system – Lead-Silver system – simple eutectic formation – Zinc – Magnesium alloy system.

Unit–III : Corrosion and Prevention

Corrosion: Dry and wet corrosion – Pilling-Bedworth rule – mechanism of wet corrosion – types of wet corrosion – galvanic corrosion – differential aeration corrosion – factors affecting corrosions. Corrosion control methods – design and material selection – cathodic protections – sacrificial anode and impressed current method – corrosion inhibitors – protective coatings – surface preparations –

Galvanizations, Tinning – electroplating – anodizing, phosphate coating, hot dipping.

Unit–IV : Energy Storage Devices

Types of battery – commercial voltaic cell – primary battery – secondary storage cell – lead – acid cell, nickel-cadmium cell, lithium battery – fuel cells – hydrogen-oxygen fuel cell – photovoltaic cell – principle, working and applications.

Unit–V : Engineering Materials II

Refractories – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimentional stability, porosity, thermal spalling) – fire clay bricks, alumina bricks and zirconia bricks. Abrasives – Moh's scale of hardness – natural abrasive (diamond, corundum, emery, garnets and quartz) – synthetic abrasives – silicon carbide, boron carbide and their uses.

TEXT BOOKS

1) Sivasankar, B., (2012). '*Engineering Chemistry'*, Tata McGraw-Hill Publishing Company Limited, NewDelhi.
2) Sivakumar, R. and Sivakumar, N., (2013). '*Engineering Chemistry'*, Tata McGraw-Hill Company Limited, NewDelhi.

REFERENCE BOOKS

1) Jain, P.C. and Monica Jain, (2010)., '*Engineering Chemistry'*, DhanpatRai & Sons, New Delhi.
2) Dara, S.S. and Umare, S.S. (2014)., '*Text book of Engineering Chemistry'*, S.Chand& Co. Ltd., New Delhi.
3) Gopalan, R., Venkappayya, D., and Nagarajan, S. (2008). '*Engineering Chemistry'*, Tata McGraw Hill Publishing Company Limited, New Delhi.
4) Gowariker, V.R., Viswanathan, N.V. and Jayadev Sreedhar, (2006). '*Polymer Science'*, New Age International P (Ltd.,), Chennai. (Unit I)
5) Puri, B.R., Sharma, L.R. & Pathania, M.S., (2013). '*Principles of Physical Chemistry'*, Vishal Publishing Company, NewDelhi. (Unit II)

COURSE OUTCOMES

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

1) Understand the synthesis and applications of various types of polymers and moulding processes.
2) Understand the concept of phase rule and its applications, which is applicable in alloy preparation.
3) Understand the concept of corrosion and to apply the knowledge in the protection of different metals from corrosion.
4) Gain the knowledge about various energy storage devices, especially solar energy.
5) Have the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.
6) Gain knowledge on classification, synthesis and applications of abrasives and refractories.

00ES204	BASIC ENGINEERING (CIVIL)	L	T	P
		2	0	0

COURSE OBJECTIVES

- To inculcate a knowledge on essentials of Civil Engineering.
- To expose the students on the role, significance and contributions of Civil Engineering in satisfying societal needs.
- To illustrate the concepts of various construction techniques.

Module I

Introduction to Civil Engineering - various disciplines of Civil Engineering, relevance of Civil Engineering in the overall infrastructural development of the country. Introduction to various building materials – Stone, Bricks, Steel, Cement, Concrete, Timber – its characteristics, types and uses. Various types of buildings as per nbc; Selection of suitable site for buildings, Components of a residential building – its functions, Orientation of a building, simple definitions - plinth area / built up area, floor area / carpet area – floor space index.

Module II

Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances – chain – compass: Introduction to Leveling, Total station, Remote sensing - fundamental principles and applications.

Building construction – foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry – Header, Stretcher, Flemish and English Bond.Columns, Lintels, Roofs – functions, types, roofing materials, Floors – functions, types, flooring materials. Decorative finishes – plastering, interior design.

Module III

Bridges – necessity - selection of site – components of a bridge: Dams – types – selection site - forces acting on a dam – Roads – uses - classification of roads – components of a road; Railways – basic components of permanent way – water supply – per capita requirement – sources – need for conservation of water – rain water harvesting - basic water treatment – Sewage and its disposal – basic definitions – Septic tank - components and functions.

TEXT BOOKS

1) Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2) Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS

1) Ramamrutham V, Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.
2) Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3) SatheeshGopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES

1) Understand the basic knowledge on civil engineering materials.
2) Develops the skill to satisfy the social needs.
3) Describe the suitable method of construction technique.

00ES204	BASIC ENGINEERING (ELECTRICAL)	L	T	P
		2	0	0

COURSE OBJECTIVES

- To impart the basic principles of generation of electrical energy.
- To explain the operation of electrical machines and various measuring instruments.
- To understand the basic concepts of circuit analysis.
- To provide an overview of the principles, operation and application of semiconductor devices like diodes, BJT, FET and a basic knowledge of fundamentals of Communication Systems.

Module I

Sources of Electrical energy–Generation of electrical energy – working principles of DC generators and alternators– Advantages of electrical energy over other forms of Energy.

Operating principle of DC motors– Types of DC motors– Characteristics and uses of DC motors.Working principles of Single and Three phase transformers.Operating Principle of three phase and single phase induction motors– types and uses of induction motors.

Working principles of MC and MI voltmeters and Ammeters, Dynamo meter type wattmeter, Induction type energy meter and Multimeter–types of wiring– requirements for house wiring–typical layout for a small house– earthing.

Module II

DC Circuits: Definition of current, voltage, power and energy– DC voltage and current sources– resistance, types of resistors, series and parallel connections of resistors, current and voltage division–loop method of analysis of simple circuits.

AC Circuits: Sinusoidal signals – average, r.m.s values –inductance, capacitance and their V–I relationships. Analysis of simple single phase series circuits– power and power factor–phasor diagrams– Introductions to three phase AC circuits.

Module III

Basic Electronics: Principle and characteristics, uses of PN junction Diode, Zenerdiode, BJT, FET, UJT, Thyristors,-Operating principle of Half wave, Full wave and Bridge rectifiers.

Digital Electronics and Principles of Communication Systems: Symbol, truth table and functions of basic logic gates, universal gates, Half adder, Full adder. Communication systems–Microwave, Satellite, Fibreoptic and ISDN (block diagram description only).

TEXT BOOKS

1) Nagrath, I.J., 2007. Elements of Electrical Engineering, 2nd Edition, 14th reprint, Tata McGraw Hill Publishing Co. Limited, New Delhi.

REFERENCE BOOKS

1) Gupta, B. R., 2002.Principles of Electrical Engineering, S. Chand &Co, NewDelhi.
2) Theraja. B.L &Theraja.A.K., 2000.Electrical Technology, Vol. I, II, and IV, S. Chand and Co., NewDelhi.
3) Floyd & Jain, 2009. Digital Fundamentals, 8th Edition, Person Education.
4) Anok Singh, 2006. Principles of Communication Engineering, 6th reprint, S. Chand &Company Ltd., Ram Nagar, NewDelhi.

COURSE OUTCOMES

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

1) Provide comprehensive idea about simple circuit analysis, working principles of machines and common measuring instruments
2) Analyze the behavior of any dc and ac circuits
3) Characterize semiconductor devices that include diodes, BJT and digital functions.
4) Understand fundamental principles of communication systems

00ES204	BASIC ENGINEERING (MECHANICAL)	L	T	P
		2	0	0

COURSE OBJECTIVES

- To familiarize the students the functioning of different types of Boilers, the mountings and accessories.
- To provide basic knowledge about the use of various machine tools and the basic principles of welding, brazing and soldering.
- To illustrate the concepts of various metal forming operations and metal joining techniques.

Module I

Boilers: Classification – Description and working of Simple vertical boiler, Cochran boiler, Babcock and Wilcox boiler - Description and working of boiler mountings: water level indicator, Pressure gauge, Dead weight and Spring loaded Safety value, Fusible plug, Feed check value, Steam stop value and Blow–off cock - Description and working of boiler accessories: Economiser and Super heater.

Module II

Prime Movers: Steam turbines: Principles and working of Impulse and Reaction turbines – Comparison. Gas turbines: Principles and working of Open cycle and Closed cycle gas turbines. Internal Combustion Engines: Classification – principal parts – comparison of two strike and four stroke engines – working principle of petrol and diesel engines.

Module III

Machine Tools: Description of parts and operations performed – Lathe, Shaper and Drilling machine.

Metal Forming: Hot working versus cold working; Hand forging – Principle and operations; Rolling – Principle, rolling mill configurations; Extrusion – Direct versus indirect extrusion**.**

Metal Joining: Gas welding – principle, Oxy-acetylene welding – equipment, types of flames, advantages and disadvantages – Arc welding - principle, advantages and disadvantages – Brazing – Torch brazing, dip brazing, furnace brazing, resistance brazing – Soldering – Comparison of brazing and soldering.

TEXT BOOKS

1) Prabhu T J, Jaiganesh V and Jebaraj S, Basic Mechanical Engineering, Scitech Publications Pvt. Ltd., Chennai, 2000.
2) Venugopal and Prabhuraj T J, Basic Mechanical Engineering, ARS publishers, Sirkali, 1996.

REFERENCE BOOKS

1) Hajra Choudhury S. K., Nirjhar Roy, Hajra Choudhury A. K., Elements of Workshop Technology,(Vol 1 and Vol II,) , Media Promoters, Pvt Ltd. (2008)
2) Rao P. N., Manufacturing Technology : Foundry, Forming and Welding - Vol 1,Mc Graw Hill Education, (2013)
3) Steven R. Schmid, SeropeKalpakjian, Manufacturing Processes for Engineering Materials (English) 5th Edition, Pearson India, (2009)

COURSE OUTCOMES

1) Understand the construction and working principles of boiler operations
2) Distinguish between steam turbines and gas turbines.
3) Select suitable manufacturing methods to produce a new component.

00HS205	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P
		0	2	3

COURSE OBJECTIVES

- The Language Lab focuses on the production and practices of sounds of language
- The Language Lab familiarizes the students with the use of English in everyday situations and contexts.

Theoretical Session (Internal Assessment only)

- English sound pattern
- Sounds of English
- Pronunciation
- Stress and Intonation
- Situational Dialogues/ Role play
- Oral presentations- Prepared or Extempore
- 'Just a Minute' sessions (JAM)
- Describing Objects /situations/ people
- Debate
- Giving Directions

Practical Session

- To make the students recognize the sounds of English through Audio Visual Aids
- To enable the students speak fluently without fear
- To develop their communicative skill with individual practice through the prescribed package
- The Globarena Package consists of the following exercises
    1. Reading comprehension
    2. Listening comprehension
    3. Vocabulary exercises
    4. Phonetics
    5. Role Play in dialogues
    6. Auto Speak

REFERENCE BOOKS

1) Globarena Package for communicative English
2) Cambridge Advanced Learner's English Dictionary
3) Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.
4) English Pronouncing Dictionary Daniel Jones Current Edition with CD.
5) Spoken English- R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
6) A Practical course in English Pronunciation, (with two Audio cassettes) by J. Sethi, KamleshSadanand& D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
7) A text book of English Phonetics for Indian Students by T.Balasubramanian (Macmillan)
8) English Skills for Technical Students, WBSCTE with British Council, OL.

DISTRIBUTION AND WEIGHTAGE OF MARKS

English Language Laboratory Practical Paper:

1) The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2) For the Language lab sessions, there shall be a continuous evaluation during the year for 40 sessional marks and 60 year-end Examination marks. The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

COURSE OUTCOMES

1) Help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer-based competitive exams such as GRE, TOEFL, GMAT, etc.
2) Train the students to use language effectively to face interviews, group discussions, and public speaking.
3) Initiate the students into greater use of the computer in resume preparation, reportwriting, format-making, etc.

00BP206	APPLIED PHYSICS LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

The ability to offer students a variety of research opportunities

- To determine the radius of curvature of the plano convex lens and the wavelength of the sodium light by measuring the diameter of Newton's rings. We can use a spectrometer to measure this angle of deviation.
- To measure the modulus of elastic material by torsional pendulum and bending of a beam.
- To determine the resistivity of a given steel and brass wire.
- To find the velocity of ultrasonic waves in a liquid.
  Less viscosity of the liquid by poiseuille's method.

List of Experiments (Any Ten)

1) Non-Uniform Bending - Determination of Young's modulus of the given scale or beam.
2) Newton's rings- Determination of Radius of curvature of the given Plano convex lens.
3) Viscosity –Determination of co-efficient of Viscosity of a highly viscous liquid by Stoke's method.
4) Spectrometer – Dispersive power of a given prism.
5) Torsional Pendulum – Determination of Moment of Inertia of the metallic disc and
6) Rigidity Modulus of the material of a wire.
7) Field along the axis of a coil- Determination of horizontal earth magnetic flux density.
8) Air wedge – Determination of thickness of a given thin wire and paper.
9) Viscosity - Determination of co-efficient of Viscosity of a less viscous liquid by Capillary flow method
10) Uniform bending- Determination of Young's modulus of the given scale or beam.
11) Spectrometer – Determination of wavelength of the prominent spectral lines using Grating.
12) Semiconductor diode laser – Determination of wavelength of Laser source using Grating.
13) Band gap determination of a Semiconductor.

COURSE OUTCOMES

1) To determine resistivity of a given steel and brass wire.
2) To find the velocity of ultrasonic waves in a liquid.
3) To measure the thickness of a thin materials.
4) To determine the band gap of a given semiconductor.
5) Diffraction patterns can be formed by light passing through a series of fine lines.
6) Applications of optoelectronic devices.

00BP207	APPLIED CHEMISTRY LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

- To appreciate the practical significance of acidimetry, alkalimetry and permanganometry
- To analyse quantitatively the amount of a substance present in a given sample.
- To assess the composition of an alloy
- To test the water quality standards.

LIST OF EXPERIMENTS

1) Estimation of Potassium hydroxide
2) Estimation of Acetic acid in vinegar
3) Estimation of Temporary hardness of water sample
4) Estimation of Total hardness of water sample
5) Estimate separate amount of sodium carbonate and sodium hydroxide in a mixture .
6) Estimation of Ferrous sulphate
7) Estimation of Mohr's salt
8) Estimation of ferrous iron
9) Estimation of Oxalic acid
10) Determination of available free chlorine in a water sample.
11) Estimation of copper in brass by iodometry
12) Estimation of iron by dichrometry
13) Estimation of nickel in an alloy

COURSE OUTCOMES

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

1) Gain knowledge in the quantitative chemical analysis of water quality related parameters, acid-base, red-ox and iodometry titrations.

00SP 208	ENGINEERING GRAPHICS	L	T	P
		2	0	3

COURSE OBJECTIVES

- To develop the ability to produce simple engineering drawing and sketches based on current practice.
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others though drawing.
- To develop the skills to read manufacturing and construction drawings used in industry.
- To develop a working knowledge of the layout of plant and equipment.
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators.
- To expose the international standards of technical drawing

Unit–I

Introduction to Engineering Drawing, Use of drafting instruments– Lettering and dimensioning.

Construction of conic sections -Ellipse, Parabola & Hyperbola (Eccentricity Method, Rectangle method, Intersecting arcs method) - Special curves- Simple cycloids and involutes– Tangent and normal at points on the curves only.

Unit–II

Orthographic projections - Projections of Points- Projections of Straight lines (given the projections, to determine the true length and true inclinations).

UNIT–III

Projections of Solids like prism, pyramid, cylinder, cone, tetrahedron and octahedron in simple positions.

Auxiliary Projections of prism, pyramid, cylinder, cone when the axis is inclined to one plane only.

Unit–IV

Sections of prism, pyramid, cylinder, cone in simple position – true shape of sections.Intersection of surfaces - cylinder to cylinder and cylinder to cone with axis intersecting at right angles. Development of lateral surfaces of prism, pyramid, cylinder, cone and cut solids.

Unit–V

Isometric Projections of simple solids and combinations.Perspective Projections of simple solids. Conversion of Pictorial view of simple objects into Orthographic views

TEXT BOOKS

1) Bhatt, N.D Engineering Drawing -Charotar Bookstall, Anand – 388001.
2) Venugopal, K Engineering Drawing and graphics – New age international (P) Ltd., Publishers, Chennai.

REFERENCE BOOKS

1) Gopalakrishna, K.R. Engineering Drawing Vol.I and Vol. II – Subhas stores, Avenue Road, Bangalore – 560002.
2) Kumar, M.S Engineering Graphics – DD Publications, Chennai – 6400048.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Construct, read, and understand the Title and Revision Block.
2) Usage of common drafting tools to construct engineering drawings enhances
3) Apply dimensions on engineering drawing.
4) Ability of converting sketches to engineered drawings will increase.
5) Developing cognitive and psychomotor skills, visualize images and their dimensions.
6) Develop good communication skills and team work.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

- To establish state of the art facilities related to diverse dimensions in the field of Instrumentation Engineering.
- To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering.
- To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources.
- To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's career.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

1. To nurture in a spirit of self-confidence, tolerance and adaptability among the graduates pursuing this programme.
2. To inculcate echelons of technical skill and academic excellence for enabling the graduates to choose their field of expertise.
3. To foster curricular and extra-curricular attributes with a perspective to ensure the graduates accomplish their professional career.
4. To promote awareness among graduates for lifelong learning and inculcate professional ethics

PROGRAMME OUTCOMES (PO)

After the successful completion of the B.E. (Electronics and Instrumentation Engineering) degree programme, the students will be able to:

PO 1: INTEGRATION OF KNOWLEDGE

Apply the knowledge of mathematics, science and engineering fundamentals in analog and digital electronic systems, instrumentation and control engineering.

PO 2: PROBLEM ANALYSIS

Formulate, solve and analyze complex problems in electrical circuits, electronic systems, instrumentation and control engineering.

PO 3: DESIGN AND DEVELOPMENT OF SOLUTIONS

Apply the acquired knowledge for designing systems/processes to address the specific needs and to pull off solution, with appropriate consideration for health, safety, and environmental issues.

PO 4: USE OF MODERN TOOLS AND TECHNIQUES

Select and apply appropriate modern engineering tools including prediction and modelling software packages, Distributed Control System, Programmable Controllers and advanced processors.

PO 5: COLLABORATIVE AND MULTIDISCIPLINARY APPROACH

Gain exposure to attain knowledge and understand interdisciplinaryand multidisciplinary engineering sciences.

PO 6: ETHICAL PRACTICES AND SOCIAL RESPONSIBILITIES

Acquire professional and intellectual integrity, professional code of conduct, ethics on professional practices, understanding responsibilities and norms for sustainable development of society.

PO 7: COMMUNICATION SKILLS

Interact with the engineering community and with society at large, regarding intricate engineering activities on technical perspectives and emerge as an efficient motivator.

PO 8: PROJECT MANAGEMENT

Understand the engineering and management concepts and demonstrate the knowledge as an entrepreneur or member/leader in teams and multidisciplinary tasks in their profession.

PO 9: LIFE LONG LEARNING

Appreciate the need for self preparation and life-long learning independently in the broadest context of technological challenges.

Mapping PO with PEO									
Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PEO1	✓	✓	✓						
PEO2				✓	✓				
PEO3					✓	✓	✓	✓	
PEO4						✓			✓

LIST OF PROFESSIONAL ELECTIVES

1) Electrical Measurements
2) Electrical Technology
3) Signals and Systems
4) Virtual Instrumentation and Smart Sensors
5) Digital System Design
6) Instrumentation System Design
7) Real Time Operating Systems
8) Computer Networks and DCS
9) Analytical Instrumentation
10) Power Electronics, Drives and Control
11) Advanced Topics in PID Control
12) Soft Computing Techniques
13) VLSI System Design
14) Biomedical Instrumentation

15) Power Plant Instrumentation
16) Fibre Optics and Laser Instrumentation
17) Unit Operations and Control
18) Non-linear Control Systems
19) Optimal Control
20) Model Predictive Control
21) Fault Detection and Diagnosis
22) Microcontroller Based System Design
23) Embedded Systems

LIST OF PROFESSIONAL ELECTIVE LABS

1) Electrical Measurements Laboratory
2) Instrumentation System Design Laboratory
3) Virtual Instrumentation Laboratory
4) Industrial Instrumentation Laboratory
5) Industrial Automation Laboratory
6) Programming Laboratory
7) Digital System Design Laboratory
8) MEMS Laboratory
9) Bio Medical Instrumentation Laboratory

LIST OF OPEN ELECTIVES

10) Robotics and Automation
11) Nano Materials and Nano Electronics
12) Micro Electro Mechanical Systems
13) Operating Systems and Networking
14) Internet of Things
15) Cloud Computing
16) Biology for Engineers
17) Disaster Management
18) Entrepreneurship
19) Human rights
20) National Service Scheme

THIRD SEMESTER

01HS301	ENVIRONMENTAL STUDIES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To realize the importance of environment for engineering students.
- To understand the basis of ecosystems
- To make aware the student about global environmental problems and natural disasters.
- To give the ideas about advance technologies of Engineering that will useful to protect environment.

Unit–I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness.

Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest 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, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. 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.

Unit–II

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 following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical 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.

Unit–IV

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management : floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection 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.

Unit–V

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.

Field work

Visit to a local area to document environmental assets-river/forest/grassland hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds -Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS

1) Agarwal, K.C. Environmental Biology, Nidi Publ, Ltd. Bikaner, 2001
2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net

REFERENCE BOOKS

1) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2) Clark R.S., Marine Pollution, Clanderson Press Oxford
3) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
4) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5) Down to Earth, Centre for Science and Environment
6) Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p.
7) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
8) Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. press 1140p.
9) Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10) Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11) Mhaskar A.K., Matter Hazardous, Techno-Science Publication
12) Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co.
13) Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
14) Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15) Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut Survey of the Environment, The Hindu (M)
16) Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.

17) Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media.

18) Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication.

19) Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

COURSE OUTCOMES

At the end students can able to

1) Understandthe importance of environment.
2) Analyzethe importance ofenvironment in engineering.
3) Applytheirownideasanddemonstrateadvancedtechnologiesthatwillbeusefultoprotect environment.
4) Employ awarenessamong the society about environmental problemsand natural disasters.
5) Practice according to the present and future environmental issues.

00BS302	ENGINEERING MATHEMATICS III	L	T	P
		4	1	0

COURSE OBJECTIVES

- To learn, partial differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z-transforms.
- To gain knowledge of the method to find the Solution of difference equations.

Unit–I : Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit–II : Fourier Series

Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit–III : Boundary value problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit–IV : Fourier Transform

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

Z -transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

TEXT BOOKS

1) Kandasamy P , Tilagavathy K and Gunavathy K, "Engineering Mathematics", 6th edition., (Vol I & II) S.Chand& Co Ltd. 2006, New Delhi.
2) Ventakataraman M K, "Engineering Mathematics", The National Publishing Co., Chennai,2003.

REFERENCE BOOKS

1) Veerarajan T, "Engineering Mathematics", 3 rd edition, TataMcGraw Hill Pub., 2005.
2) Singaravelu A, "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

At the end of the course the students will be able to acquire knowledge on

1) Partial differential equations.
2) Fourier series.
3) Fourier transform.
4) Z-transforms and the methods of solving them.
5) Solving boundary value problems.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2	✓		✓						
CO3	✓		✓						
CO4	✓		✓						
CO5	✓		✓						

00ES303	ENGINEERING MECHANICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand and predict the forces and its related motions.

Unit–I : Statics of Particles

Introduction-Units and Dimensions-Laws of Mechanics-Lami's Theorem-Parallelogram, Triangular and Polygon Law of Forces-Classification of Forces-Vectorial Representation of Forces-Coplanar Forces-Resolution of Forces.

Equilibrium of Particle-Vector representation of Space Force-Equilibrium of Particle in Space-Equivalent System of Forces-Principle of Transmissibility.

Unit–II : Equilibrium of Rigid Bodies

Free Body Diagram-Types of Supports- Types of loads- Types of beams-Action and Reaction of Forces-Moments and Couples-Moment of a Force-Vectorial Representation of Moments and Couples. Varignon's Theorem- Stable Equilibrium-

Single Equivalent Force-Equilibrium of Rigid Bodies in Two Dimensions and Three Dimensions.

Unit–III : Geometrical Properties of Surfaces and Solids

Centroid and Centre of Gravity-Determination of Centroid of Sections of Different Geometry- Centre of Gravity of a Body-Area Moment of Inertia-Parallel Axis Theorem-Perpendicular Axis Theorem-Determination of Moment of Inertias of Rectangular, Triangular, Circular and Semi-circular- Moment of Inertias of structural Steel Sections of Standard and Composite Sections.

Polar Moment of Inertia-Radius of Gyration-Principal Moment of Inertia-Mass Moment of Inertia- Determination of Mass Moment of Inertia of a Thin Rectangular Plate, Thin Circular Disc, Solid Cylinder, Prism, Sphere and Cone from first principles.

Unit–IV : Dynamics of Particles

Introduction-Kinematics and Kinetics-Displacements, Velocity and Acceleration-Equations of Motion-Types of Motion-Rectilinear Motion-Relative Motion-Curvilinear Motion-Projectiles.

Newton's Laws of Motion-Linear Momentum-Impulse and Momentum-D'Alembert's Principle-Dynamic Equilibrium- Work Energy Equations-Law of Conservation of Energy-Principle of Work and Energy.

Unit–V : Friction and Elements of Rigid Body Dynamics

Friction Force-Laws of Sliding Friction-Equilibrium Analysis of simple systems with Sliding Friction-Wedge Friction.

Rolling Resistance-Translation and Rotation of Rigid Bodies-Velocity and Acceleration-General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc/Wheel and Sphere.

TEXT BOOKS

1) Palanichamy M.S and Nagan S, "Engineering Mechanics (Statics and Dynamics)", Tata McGraw Hill Publishing Company, Ltd., New Delhi,2010.
2) Beer F P and Johnson, R, "Vector Mechanics for Engineers (Statics)", McGraw-Hill Book company, New Delhi, 2004.

REFERENCE BOOKS

1) S.S.Bhavikatti and K.G.Rajasekarappa, "Engineering Mechanics", New Agent International (P) Ltd., 1999.
2) Sadhu Sing, "Engineering Mechanics", Oxford & IBH Publishing Co., New Delhi, 2000.
3) Irving H. Shames, "Engineering Mechanics", Prentice Hall of India Ltd., New Delhi, 2006.
4) Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Pearson Education, 2010.
5) Natesan S.C., "Engineering Mechanics (Statics and Dynamics)", First edition, Umesh Publications, New Delhi, 2002.

COURSE OUTCOMES

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

1) Explain the forces and its related laws of mechanics in static and dynamic conditions.
2) Analyse the forces and its motions on particles, rigid bodies and structures.
3) Solve the moment of inertia of any sections and masses for the structural members.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓		✓				
CO2					✓				
CO3	✓		✓						

06ES304	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli's equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I : Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton's law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II : Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler's equation of motion - Bernoulli's equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III : Flow in Open Channels

Classification of flow in channels - Chezy's and Manning's formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.

Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.

Unit–IV : Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.

Turbines: General layout of a hydroelectric power plant - Classification of turbines - velocity triangles for turbines - work done and efficiency, specific speed - Impulse turbine - Pelton Wheel – Reaction turbine - Francis turbine - simple problems - selection of turbines.

Unit–V : Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies - multistage pumps - specific speed - priming - cavitation.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

TEXT BOOKS

1) Dr. P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi, 2015.
2) Dr. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Chennai, 2011.

REFERENCE BOOKS

1) Dr. Jagdish Lal, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, **Ninth Edition,** New Delhi, 2014.
2) Dr. K.L. Kumar, "Engineering Fluid Mechanics" Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
3) Dr. V.P. Vasandani, "Theory and Design of Hydraulic Machines including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

COURSE OUTCOMES

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

1) Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2) Use fluid dynamics for study of flow through pipes and flow in open channels.
3) Present hydraulic design for the construction of efficient hydraulic turbines and pumps.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓				
CO2			✓		✓				
CO3			✓	✓	✓				

06PC305	CIRCUIT THEORY	L	T	P
		4	0	0

COURSE OBJECTIVES

- To analyze electrical circuits using KCL and KVL.
- To learn network theorems and apply them for circuit analysis.
- To study resonance and coupled circuits.
- To study transient analysis of RC,RL,RLC circuits.

Unit–I : Basics of Circuit Analysis

Ideal sources - linear relation between voltage and current of network elements - types of networks: active, passive, linear, nonlinear, unilateral, bilateral, lumped and distributed. Ohms law - Kirchhoff's laws - Network reduction techniques – series – parallel - series- parallel circuits - Node and mesh analysis of electrical circuits.

Unit–II : Network Theorems and Transformations

Network Theorems and Transformations: Superposition theorem - Thevenin's theorem - Norton's theorem - Millman's theorem - Tellegen's theorem - Maximum power transfer theorem - Star-Delta transformation.

Unit–III : Time Domain Analysis

Time Domain Analysis: step, ramp, sinusoidal and impulse functions - Reviewof Laplace transform - Solution of circuit problems using Laplace transform - Transient response of R, L, C circuits with different types of forcing functions - complex frequency concept - poles and zeros.

unit–IV : Analysis of AC Circuits

AC Circuits: Basic definitions - phasor and complex number representation – Steadystate analysis of R, L, C circuits - power and power factor - application of Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem in the analysis of AC circuits - Resonance in series and parallel circuits - Q factor, bandwidth of resonant circuits. Principle of duality.

Unit–V : Coupled Circuits

Coupled circuits: Analysis of magnetically coupled circuits - single and double tuned coupled circuits. Three phase circuits: Three phase sources - Analysisof three phase 3-wire and 4-wire circuits with balanced and unbalanced loads - power relations.

TEXT BOOKS

1) A. Sudhakar and Shyammohan S. Palli, " Circuits and Networks: Analysis and Synthesis", McGraw Hill Education; Fifth edition,2015.
2) R.L. Boylestad, “Introductory Circuit Analysis”, 13th edition, Pearson (23 March 2015).

REFERENCE BOOKS

1) P.Rameshbabu, “Electric Circuit Analysis”, New Scitech Publications (India) Pvt Limited, 2010.
2) A. Sudhakar & Shyammohan S Palli, “Circuits and Networks, Analysis & Synthesis”, Mcgraw Hill Higher Education,Fifth Edition, 2015.

3) M E Van Valkenburg, “Network Analysis”, Third Edition, Pearson Education India of India, 2015.

4) Mahmood Nahvi & Joseph Edminister, “Electric Circuits”, Schaum’s Outline Series, McGraw Hill Education; Sixth edition, 2014.

COURSE OUTCOMES

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

1) Understand the basics of electrical circuits and circuit reduction techniques.(Unit–I : and II)
2) Analyze DC and AC circuits. (Unit–II : and IV)
3) Design resonant and tuned circuits. (Unit–III : and V)
4) Find the transient response of RC, RL and RLC circuits. (Unit–IV :)
5) Acquire engineering analytic techniques and skills. (Unit II,III and V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓					
CO2		✓		✓					
CO3		✓		✓	✓				
CO4		✓		✓					
CO5		✓		✓					

06PC306	FUNDAMENTALS OF SEMICONDUCTOR DEVICES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the qualitative and quantitative exposition of fundamental concepts of silicon and germanium semiconductor devices.
- To understand the principle, operation and characteristics of diode, bipolar junction transistor and metal oxide field effect transistor.
- To analyze MOS capacitor, MOSFET and SPICE models.

Unit–I : Qualitative and Quantitative Theory of Semiconductors

Atomistic picture of silicon and germanium – Semiconductors: Electric current, free electron density and mobility - Current due to holes – Pure and impure semiconductors – Effect of doping on the minority carrier density - Degeneracy due to excessive doping –temperature dependence of conductivity – Charge neutrality and space charge – Diffusion of current carriers.

Calculation of free electron density and hole density – Determination of Fermi level in N-type and P-type semiconductor – Moderately doped sample – Five equations of semiconductor theory – Current calculations.

Unit–II : Qualitative and Quantitative Theory of PN Junction Diodes

P-N junction – Volt-Ampere behavior – Behavior under large forward voltage – Temperature dependence of P-N junction characteristics – Breakdown under reverse bias – Transition capacitance of a junction – Thermal equilibrium – P-N junction under forward bias – calculation of electric field and voltage drop – P-N junction under reverse bias – calculation of carrier density and current – V-I characteristics – Junction breakdown voltage – Zener breakdown.

Unit–III : Qualitative and Quantitative Theory of PN Junction Transistors

Principle of operation of the bipolar transistor – Effect of collector junction voltage on collector current – Dependence of collector current on emitter voltage – Dependence of collector current on emitter current – Common-base configuration and incremental resistance of thecollector circuit – Common-emitter configuration – Incremental collector resistance in common-emitter configuration – Common-collector configuration – Uniform base PNP transistor – forward biased emitter junction – reverse biased collector junction – V-I characteristics – temperature effects in transistor.

Unit–IV : Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

MOSFET structure – Principle of operation of N-channel and P-channel MOSFET – Ideal MOS structure under thermal equilibrium – Ideal MOS structure biased in accumulation mode – Ideal MOS structure biased in depletion mode – Threshold voltage of ideal MOS structure operation in the strong inversion region – C-V characteristics of MOS capacitor – Effect of work function difference – Effect of charges in the oxide – Threshold voltage including non-idealities – Charges in the thermal oxide of silicon and their effect on MOS characteristics.

Unit–V : Analysis of MOSFET

Qualitative analysis of MOSFET operation - static characteristics – Analytical models for the MOSFET characteristics – SPICE models – Substrate bias effect – Sub-threshold conduction in MOSFET – A.C. properties, transconductance - cut-off frequency of MOSFET.

TEXT BOOKS

1) M K Achuthan and K.N. Bhat, “Fundamentals of Semiconductor Devices”, Tata McGraw-Hill Publishing Company Limited, 2007.

REFERENCE BOOKS

1) Ben G. Streetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices”, Sixth Edition, Prentice-Hall of India Private Limited, 2007.
2) Nandita Dasgupta, Amitava Dasgupta, “Semiconductor Devices Modelling and Technology”, Prentice-Hall of India Private Limited, 2006.

COURSE OUTCOMES

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

1) Learn the principle of operation of semiconductors. (Unit I)
2) Develop the equations to determine various electronic parameters of semiconductor devices like diode, bipolar junction transistor and metal oxide field effect transistor.
3) (Unit II, III & IV)

   Solve problems on semiconductor devices. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							✓
CO2	✓	✓							✓
CO3	✓	✓							✓
CO4									

06SP307	HYDRAULICS LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharged are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments in envisaged.
- To understand the significance and role of such utilities in their further course of study.

LIST OF EXPERIMENTS

1) Determination of Co-efficient of discharge of Mouth Piece
2) Determination of Co-efficient of discharge of Venturimeter
3) Determination of Co-efficient of Head loss due to Sudden Change in Section
4) Determination of Co-efficient of Head loss due to Friction in Pipe
5) Determination of Co-efficient of discharge of Rectangular Notch
6) Determination of Co-efficient of Impact of Jet on Vanes
7) Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8) Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9) Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10) Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
11) Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12) Study of Performance characteristics of Francis Turbine (Constant Head method)
13) Determination of Metacentric Height of a floating vessel (Demo Only)
14) Study on Flow through Open Channel (Demo Only)

COURSE OUTCOMES

After completion of this course, a student will be able to:

1) Determine the properties of fluids, pressure and their measurements
2) Measure flow in pipes and determine frictional losses
3) Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits
4) Develop Characteristics of pumps and turbines.

06CP308	CIRCUIT AND DEVICES LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

- To study & verify the circuit theorems practically
- To obtain the characteristics graphically of each mentioned circuit devices
- To understand the significance of the circuit devices with their applications
- To analyse the need of each device

LIST OF EXPERIMENTS

1) (a) Analysis of DC resistive circuits and verification of Kirchhoff's Laws.
   (b) Verification of Maximum power transfer theorem.
2) (a) Verification of Thevenin's theorem.
   (b) Verification of Norton's Theorem.
3) (a) Verification of Superposition Theorem.
   (b) Verification of Tellegen's Theorem.
4) Ampere-Volt (I-V) characteristics of P-N junction semiconductor diode and Zener Diode.
5) Input and output characteristics of BJT and determination of its h-Parameters.
6) Transfer and drain characteristics of JFET and determination of its parameters.
7) Steady State sinusoidal response of RLC series circuit.
8) I-V characteristics of Silicon Controlled Rectifier.
9) Frequency response of RC coupled amplifier.
10) Study of ORCAD software (Application to circuit analysis).

COURSE OUTCOMES

Makes the students understand

1) The significance of the theorem and the practical verification of theorems.
2) The usage of the theorem in the analysis of the circuits.
3) The way of trouble shooting the circuit connection and to test the devices.
4) The circuit connections and testing points of the circuit by simulation and implementation.
5) And observe the characteristics of the devices and to find various practical parameters like input impedance ,trans-conductance , pinch-off voltage ect. Related to their applications.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							✓
CO2	✓	✓				✓	✓		✓
CO3	✓	✓				✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓			✓
CO5	✓	✓	✓		✓		✓	✓	✓

FOURTH SEMESTER

06BS401	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	L	T	P
		4	1	0

COURSE OBJECTIVES

- To expose the students to probability, random processes, and statistical methods designed
- To contribute them to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of algebraic and transcendental equations, and finding numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationarity –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III : Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation

Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval.

Numerical differentiation: Using Newton's forward and backward interpolation formula.

Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rule.

Unit–V :

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton–Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS

1) Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Probability and random processes, S.Chand & Co. Ltd.
2) Veerarajan. T., Probability theory and Random Process, Tata McGraw – Hill Co., Ltd. New Delhi 2005.

REFERENCE BOOKS

1) Venkataraman M.K., Numerical method in science and Engineering, National publishing Co., Chennai - 2003.
2) Lipschutz..S and Schiller. J, Schaums‟s outlines – introduction to probability and statistics McGraw Hill, New Delhi, 1998.
3) Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Numerical Methods, S.Chand & Co. Ltd., New Delhi. 2004.

COURSE OUTCOME

At the end of the course, the students would

1) Acquire skills in handling situations involving random variables, random processes and to solve problems for engineers in using numerical methods.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓				

06ES402	THERMODYNAMICS	L	T	P
		4	0	0

COURSE OBJECTIVES

To make the student understand the basic concepts and applications of the following.

- Basics and fundamental laws of Thermodynamics.
- Properties of steam.
- Internal combustion engines.
- Heat transfer, refrigeration and air conditioning.
- Metrology and mechanical measurements.

Unit–I : Thermodynamics

Basic concepts of thermodynamics - System properties, state and equilibrium - Process and cycle - Work - Heat and other forms of energy - Zeroth law and application - First law - Statements - Applications to closed and open systems - General energy equation and application - Second law - Statements - Reversibility, Carnot cycle and theorems - Clausius inequality - Concept of entropy - Availability and irreversibility.

Unit–II : Properties of Steam

Properties of steam - Use of steam tables - Mollier chart - Rankine cycle - Representation on P-V and T-S diagrams - Reheat cycles - calculation of efficiencies. Steam turbines - Impulse and reaction type - Governing of steam turbines - Types - Condensers.

Unit–III : Internal Combustion Engines

Internal combustion engine - Principle of operation - Two stroke and four stroke cycle engines - Petrol and diesel engines - Conventional and electronic fuel injection systems - Cooling and lubrication methods - Testing of 1C engines - Simple problems - Air standard cycles - Otto, Diesel and dual cycle - Efficiencies - Simple problems.

Unit–IV : Heat Transfer, Refrigeration and Air Conditioning

Basic concepts of heat transfer - Basic laws of conduction, convection and radiation - One dimensional heat conduction through a plane wall and cylinder - Use of fins in heat transfer - Heat exchangers - Parallel counter and cross flow- Simple problems.

Refrigeration - Units of refrigeration - Refrigerants and their properties - Types of refrigeration system - Air, vapour compression and vapour absorption systems - Air conditioning - Summer and winter air conditioning.

Unit–V : Metrology and Mechanical Measurements

Measurement and precision engineering: Linear and angular measurement - Measurement of flatness, stiffness and hardness. Comparators, side bands, slip gauges, angular gauges and auto collimeter. Measurement of pressure Mcleod vaccum gauge and electrical resistance pressure gauges - Dynamic characteristics of pressure measuring systems.

Measurement of temperature Bimetallic thermometers - Linear quartz thermometer and pyrometers. Measurement of strain: Electrical resistance strain gauge, constant current strain gauge and strain gauge bridge circuit.

(Use of Steam tables, Mollier chart and Psychrometric chart are permitted)

TEXT BOOKS

1) Nag P.K, Engineering Thermodynamics,Fifth Edition, Tata Mc Graw Hill Publishing Company Limited, New Delhi, 1991.
2) Ballaney P.L , Thermal Engineering, Khanna Publishers, Delhi, 1991 .

REFERENCE BOOKS

1) Domkundwar S, A Course in Thermodynamics and Heat Engines, Dhanpat Rai and Sons, New Delhi, 1989.
2) Mathur M.L and Sharma R.P, Internal Combustion Engines, Dhanpat Rai & Sons, New Delhi, 1992.
3) Saravanan C.G &. Ashok M.P, Thermodynamics, Scitech Publications, 2008.
4) Arora C.P, Refrigeration and Airconditioning, Tata Mc Graw Hill Publishing Company Limited, New Delhi, 1993.
5) Thomas G. Beckwith and Lewis Buck.N, Mechanical Measurements, Narosa Publishing Company. New Delhi, 1992.

COURSE OUTCOMES

Upon completion of this course, the students will be able:

1) To understand fundamental concepts and definitions of thermodynamics, thermodynamic principles in engineering applications.
2) To study the fundamentals properties of steam, gas and gas mixtures.

3) To understand the functioning and evaluate the performance of IC engines.
4) To apply the principles of refrigeration and air conditioning.
5) To distinguish the different modes of heat transfer.
6) To explain the basics of metrology and measurement systems.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				
CO2	✓				✓				
CO3	✓				✓				
CO4	✓				✓				
CO5	✓				✓				
CO6	✓				✓				

06PC403	ELECTRONIC CIRCUITS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study MOSFET structure and second order effects.
- To determine the circuit parameters of single stage MOSFET amplifier, Differential amplifier and Operational amplifier.
- To know the current mirror techniques.
- To study the different types of feedback used in oscillator and classification of oscillators.

Unit–I : MOSFET Basics and Second Order Effects

Review of MOSFET Structure, MOS Symbols, MOSFET I-V Characteristics- Second order effects- Body Effect - Channel length Modulation –Sub-threshold conduction- MOS Device layout- MOS Device Capacitance- MOS Small signal Model – Problems based on these concepts.

Unit–II : Single Stage MOSFET Amplifiers

Common Source (CS) stage - CS stage with resistive load - CS stage with diode connected load - CS stage with current source load - CS stage with Triode load - CS stage with source degeneration - Source Follower - Common Gate stage - Cascade stage - Folded cascade.

Unit–III : Basic Differential Amplifiers and Single Stage OP-AMPs

Single ended and differential operation - Basic differential pair - Qualitative analysis - Quantitative analysis - Common Mode response - Differential pair with MOS loads - Gilbert cell - Frequency response of amplifiers - Common source stage – one-stage op-amps.

Unit–IV : Current Mirrors

Basic current mirrors - Cascade current mirrors - Active current mirrors - Large signal analysis – Small signal analysis – Design of Differential amplifier using current Mirrors.

Unit–V : Feedback types and Oscillators

Feedback Topologies: Voltage-Voltage Feedback , Current-Voltage Feedback, Voltage-Current Feedback, Current-Current Feedback, General considerations, Ring oscillators, LC oscillators, Crossed-coupled oscillators, Colpitts oscillator, Voltage-controlled oscillators, Tuning in Ring oscillators.

TEXT BOOK

1) Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill International Edition, 2001.

REFERENCE BOOK

1) D.A. Johns and K. Martins, Analog Integrated Circuit Design, Second Edition, John Wiley and Sons Inc., 1997.

COURSE OUTCOMES

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

1) Understand the fundamental concepts of MOSFETs and their applications for analog electronics circuits. (Unit I)
2) Independently design MOSFET amplifier and Operational amplifier using current mirror techniques. (Unit II, III & IV))
3) Independently design oscillator for different kind of applications.(Unit V)
4) Solve problems on amplifiers and oscillator circuits. (Unit II, III & V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓					✓	✓
CO2	✓	✓	✓					✓	✓
CO3	✓	✓	✓					✓	✓
CO4	✓	✓	✓					✓	✓

06PC404	DIGITAL ELECTRONICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To impart a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To gain an intuitive understanding of the role of digital logic levels and application of knowledge to understand digital logic families.
- To understand, analyze and design digital systems using combinational logic.
- To illustrate the concept of synchronous and asynchronous sequential circuits.
- To design and study counter applications using Flip-Flops.
- To introduce the concept of memories and programmable logic devices.

Unit–I : Number Systems

Review of number system - conversion algorithm - binary arithmetic in computers- binary codes - weighted binary codes - non weighted binary codes - signed numbers - complement codes - error detecting and error correcting codes - alphanumeric codes. Boolean algebra: Basic logic operations - laws of Boolean algebra - reducing Boolean expressions - Boolean expressions and logic diagrams - universal building blocks - negative logic.

Unit–II : Logic Families

Specifications of a logic circuit - basic logic circuit, operation and characteristics of RTL, DTL, HTL, TTL, ECL, MOS, CMOS and I^2L families- comparison of logic families. TTL gate circuits- open collector - totem pole - tri state gate - buffers - schottky TTL configurations - strobed gate and expanders.Interfacing CMOS and TTL gates.Logic packages.

Unit–III : Combinational Logic

Boolean functions - canonical and standard forms - incompletely specified functions (don't cares) - simplification of Boolean functions using Karnaugh maps - Sum of Product (SOP) reduction - Product of Sum (POS) reduction - multiple output minimization - Implementation using NAND-NOR gates. Combinational circuit design - Half adder - Full Adder - Half subtractor - Full subtractor - Parallel binary adder, parallel binary subtractor - Fast Adder - Carry Look Ahead adder, code converters, magnitude comparator, parity generators and parity checkers.

Unit–IV : Sequential Circuits

Flip-flops - SR, JK, D, T, and Master-Slave - Characteristic table and equation - Edge triggering - Level Triggering - Realization of one flip flop using other flip flops. Counters- asynchronous counter design using type T flip flop, synchronous counter design using type T, type D and type JK flip flops - up/down synchronous counter design, Modulo-n counters. Shift registers - shift register counters - Johnson counter - ring counter. Analysis of clocked sequential circuits- design using state diagram.

Unit–V : Memory Devices

Classification of memories - ROM - ROM organization - PROM - EPROM - EEPROM - EAPROM, RAM - RAM organization - Write operation - Read operation - Memory cycle - Memory decoding - memory expansion - Static RAM Cell - Bipolar RAM cell - MOSFET RAM cell - Dynamic RAM cell - Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Implementation of combinational logic circuits using ROM, PLA.

TEXT BOOKS

1) M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
2) Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

REFERENCE BOOKS

1) Morris Mano M, Digital Logic and Computer Design, First edition, Pearson Education, 2004.
2) W.H Gothmann, Digital Electronics, Second Edition, Prentice Hall of India, 1994.
3) S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
4) R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.
5) Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Sixth Edition, Tata McGraw Hill, 2003.

COURSE OUTCOMES

On completion of this course the students can apply creativity in the design of digital systems, components, or processes appropriate to program objectives and will be able to:

1) Review number systems, learn binary codes and learn the Boolean algebra. (Unit I)
2) Analyze the logic families and study its significance. (Unit II)
3) Design combinational digital logic circuits. (Unit III)
4) Design sequential digital logic circuits.(Unit–IV :)
5) Gain knowledge on Programmable Logic devices and to analyze and implement the designed combinational logic circuit in PLDs. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2		✓							
CO3		✓	✓						
CO4		✓	✓						
CO5		✓	✓						

06PC405	ANALOG AND DIGITAL INTEGRATED CIRCUITS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the IC fabrication procedure and characteristics of different ICs.
- To realize circuits using ICs.
- To design for signal analysis using Op-amp ICs.
- To study the applications of Op-amp.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs.

Unit–I : Operational Amplifier (Op-Amp.)

Block diagram of an Op-Amp. - simplified internal circuit diagram of 741 - IC package types - pin identification - temperature ranges - equivalent circuit - Op. Amp with negative feedback - voltage series, voltage shunt feedback amplifier - differential amplifier. Characteristics of practical Op. Amp. Frequency response of Op. Amp: Compensating networks - frequency response of internally compensated and non-compensated Op.Amp - closed loop frequency response - slew rate.

Unit–II : Comparators and Converters

Zero crossing detector - schmitt trigger - window detector - precision rectifiers - V/F and F/V converters. D.C. and A.C. amplifiers - summing, scaling, averaging amplifiers - integrator, differentiator - instrumentation amplifier and CMRR, Optocoupler and isolation amplifier - V to I and I to V Converters.

Unit–III : Data Conversion Techniques

Charge amplifier - log amplifier - multiplier - divider - square root circuit - sample-hold Circuit. Data Converters - D/A Converters - Implementing a DAC function - Use of ladder networks - Bipolar coded DACs - Resolution, settling time transient errors. Monotonic, tracking, single-slope, dual-slope, delta-pulse modulation successive approximation and simultaneous (flash) A/D Conversion techniques and comparison - Typical ICs for D/A, A/D Conversion.

Unit–IV : Active Filters and Oscillators

Butterworth filters - first-order low pass, second-order low pass, first-order high pass, second-order high pass - higher order filters. Band pass filter - band reject filter - all-pass filter. Introduction to switched capacitor filter. Oscillators: Phase-shift type, Wien bridge and quadrature oscillators.

Unit–V : Multivibrators, Oscillators and Regulators

Astable, monostable, triangular wave and sawtooth wave generators.VCO, Timer 555 and applications. Phase-Locked Loops (PLLs): Principle, building blocks and characteristics of a PLL - Applications: frequency multiplier, modulator, FSK demodulator, synchronizer, voltage regulators.

TEXT BOOKS

1) R.A. Gayakwad, Op-Amp and Linear Integrated Circuits, Fourth Edition, Prentice Hall of India, 1992.
2) R.F. Coughlin and F.F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, Sixth Edition, Prentice-Hall of India, 2000.

REFERENCE BOOKS

1) Roy Choudhury and Shail Jain, Linear Integrated Circuits, Fourth Edition, New Age International Publisher, 2011.
2) P.Horowitz and W.Hill, The Art of Electronics, Third Edition, Cambridge University Press, 2015.

COURSE OUTCOMES

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

1) Analyze the functions and characteristics of different op-amps. (Unit I)
2) Design and realize different types of devices using op-amp comparators.(Unit II)
3) Study and analyze different types of data conversion techniques. (Unit III)
4) Design different types of analog filters with ICs. (Unit–IV :)
5) Able to design and implement op-amp circuits for different applications such as waveform generators, oscillators and regulators and PLL. (Unit V).

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓	✓	✓						
CO3	✓	✓							
CO4		✓	✓						
CO5		✓	✓			✓			

06PC406	TRANSDUCERS AND MEASURMENT SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn about the science of measurement system and its properties.
- To acquire knowledge about characteristics of measurement systems subjected to time invariant and time variant inputs .
- To understand the principle and characteristics of resistive, capacitive and inductive transducers.
- To study about characteristics and applications of fiber optics, MEMS based transducers and transducers governed by other principles such as hall effect and piezo electric effect.

Unit–I : Science of Measurements

Methods of measurement - Generalized scheme of a measurement system - Errors in measurement - types of errors- limiting error-probable error- Statistical analysis of measurement data – mean and standard deviation- Probability of errors - Gaussian distribution- Reliability of measurement systems.

Unit–II : Performance Characteristics

Static and dynamic characteristics of measurement system - transfer function – characteristics of zero, first and second order type of instruments - impulse, step, ramp and frequency responses of the above types of instruments.

Unit–III : Resistance Transducers

Transducer- Difference between sensor and transducer- basic requirements of a transducer-classification of transducers-selection of transducer.

Resistance potentiometer – types of potentiometers - Loading effect – strain gauges - gauge factor - types of strain gauges - strain measuring circuits – temperature compensation and error cancellation techniques in strain measurement system.

Principle of RTD, Thermocouple and Thermister- Hot wire anemometer - constant current and constant temperature operation.

Unit–IV : Capacitance and Inductance Transducers

Capacitive transducers - variable area type - variable air gap type - variable permitivity type - signal conditioning circuit- capacitor microphone.

Variable inductance and Variable reluctance transducers – LVDT – RVDT - Eddy current non contacting transducers.

Unit–V : Other Types of Transducers

Introduction to fibre optic sensors -types of configurations-application in temperature, pressure, flow and displacement measurements. Hall effect transducers - IC sensor for temperature and pressure measurement-Piezoelectric transducers - piezoelectric crystals, Charge amplifier-Silicon Micro sensors-Smart sensors-characteristics and applications.

TEXT BOOKS

1) E.O.Doeblin, Measurement Systems, Application and Design, McGraw-Hill, 1998.
2) A.K. Sawhney, A course in Electrical and Electronics measurement and instrumentation, Dhanpatrai and sons, 1996.

REFERENCE BOOKS

1) John B.Bentley, Principles of Measurment Systems, Longman Publishers, 2000.
2) R.K Jain, Mechanical and Industrial Measurement, Khanna Publishers, 1990.
3) D. Patranabis, Sensors and Transducers, Prentice Hall of India, 2nd edition, 2003.
4) B.C.Nakra and K.K Chaudhry, Instrumentation measurement and analysis, TMH, Third edition, 2009.
5) D.A. Krohn, Fiber Optic Sensors – Fundamentals and Applications, ISA publication, 2nd edition, 1992.
6) J.B Gupta, A course in Electronics and Electrical measurements and instrumentation, S.K.Kataria & Sons, New Delhi, Fifth Edition, 2010.

COURSE OUTCOMES

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

1) Select a measurement system to meet the requirements and will be knowledgeable about its characterization based on the type of input. (Unit I&II)
2) Choose among the various types of transducers for particular application depending on the principle, range, cost and commercial availability. (Unit III,IV&V)
3) Understand the recent trends in the development of transducers and the engineering involved in it. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓	✓	✓						
CO3	✓	✓	✓						

06CP407	LINEAR AND DIGITAL ICs LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- Testing of logic gates with their truth tables.
- Simplification of complex logic functions using reduction techniques.
- Design of analog and digital electronic circuits for industrial applications.
- Study of Electronic Work Bench Software to simulate various electronic circuits.
- Identification of malfunctioning of circuits/components and to troubleshoot the same.

LIST OF EXPERIMENTS

1) Verification of logic gates using integrated circuits.
2) Simplification of logic expressions using Karnaugh map techniques.
3) Implementation of half adder and full adder circuits using logic gates.
4) Design and verification of parity generator circuits.
5) Design and verification of electronic pendulum circuit.
6) Simulation of simple operational amplifier configurations using Electronic Work Bench (EWB) software.
7) Design of multivibrator circuits using 555 timer IC.
8) Design of low pass and high pass filter circuits.
9) Design of precision full wave rectifier circuit.
10) Design of instrumentation amplifier circuit.

COURSE OUTCOMES

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

1) Test and understand the logic gates using their truth tables which is very useful in the design of Integrated Circuits.
2) Simplify the complex logic function into simplest one so that it is possible to reduce the size of the circuit.
3) Design of various electronic circuits using the fundamental concepts both in analog and digital electronic systems for various industrial applications.
4) Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5) Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2		✓	✓						
CO3			✓		✓				
CO4				✓					
CO5	✓	✓	✓						✓

06CP408	SENSORS AND SIGNAL CONDITIONING CIRCUITS LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To familiarize the students with principle and characteristics of various transducers.
- To design and implement signal conditioning circuits for temperature, pressure and displacement.
- To impart knowledge about the design and implementation of analog and digital filters using Matlab software
- To learn the design and development procedure for V/I and I/V convertors and implementation using EWB software.

LIST OF EXPERIMENTS

1) Characteristics of Potentiometer and Potentiometer as error detector.
2) Characteristics of Synchro and application of Synchro as error detector.
3) Simulation of signal conditioning circuit for LVDT.
4) Design of Analog and Digital filters using MATLAB software.
5) Characteristics and Transfer function of RTD and Thermocouple.
6) Design, construction and testing of a signal conditioning circuit for temperature Measurement using RTD.
7) Simulation of Voltage to Current converter and its practical implementation.
8) Simulation of Current to Voltage converter and its practical implementation.
9) Measurement of pressure using strain gauge.
10) Design and testing of signal conditioning circuits using EWB software.

COURSE OUTCOMES

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

1) Select and use the proper transducer for the required application.
2) To design and implement signal conditioning circuits for process variables such as temperature, pressure and displacement.
3) Apply the Matlab and EWB software packages for the design and verification of signal conditioning circuits.

Mapping with Program Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				✓
CO2	✓	✓	✓		✓				✓
CO3	✓		✓	✓	✓				✓

FIFTH SEMESTER

06PC501	CONTROL SYSTEMS	L	T	P
		4	1	0

COURSE OBJECTIVES

- To provide a sound knowledge in the basic concepts of linear control theory and design.
- To acquire knowledge in the basics of control system and its components.
- To understand the time response and frequency response analysis.
- To study about stability analysis.
- To understand the design of compensators.

Unit–I : Control Systems and Components

Basic Elements of Control System – Open loop and Closed loop systems – Differential equation – Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems – Block diagram reduction Techniques – Signal flow graph.

Introduction to Control System Components: Potentiometers - DC tacho generators - DC servomotors - electronic servo amplifiers.

Unit–II : Time Response Analysis

Time response analysis: Standard test signals - impulse response, step response and ramp response analysis of first order system and second order systems - time response specification of a second order system - steady state error and error constants - design specification of second order systems–Compensation: derivative error, derivative output, integral error, Performance indices.

MATLAB: Commands and matrix functions - Transient response analysis of continuous - time systems.

Unit–III : Stability Analysis

Concept of stability: Necessary conditions for Stability-BIBO Stability – Routh-Hurwitz Criterion.

Root locus concept: Guidelines for sketching root loci - root contours. Root-Locus plots for continuous-time systems using MATLAB.

Unit–IV : Frequency Response Analysis

Frequency response specifications - polar plots - Bode plots - all-pass and minimum phase systems. Stability in frequency domain: Nyquist stability criterion - assessment of relative stability using Nyquist plots and Bode plots. Frequency response plots using MATLAB.

Unit–V : Compensator Design

Introduction to design - lag, lead and lag-lead configurations: Effects on system response and their realization - design of cascade compensators in the time domain - design of cascade compensators in the frequency domain.

TEXT BOOKS

1) J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2) M. Gopal, Control Systems Principles and Design, McGraw-Hill Education, Fourth edition, 2012.

REFERENCE BOOKS

1) K. Ogata, Solving Control Engineering Problems with MATLAB, Prentice Hall, 1994.
2) B. C. Kuo, Automatic Control Systems, Prentice Hall of Indian, Sixth Edition, 1991.
3) K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited, Fifth Edition, 2010.

COURSE OUTCOMES

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

1) Understand the basics of control system for the design and analysis (Unit I)
2) Understand the issues related to time response analysis. (Unit II)
3) Perform frequency response and stability analysis. (Unit–III : & IV)
4) Design compensators in time and frequency domain. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				
CO2		✓		✓				✓	✓
CO3		✓		✓				✓	✓
CO4		✓		✓				✓	✓

06PC502	INDUSTRIAL INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand load cell, strain gauge and torque measurement.
- To understand pressure measuring devices like Manometers, Bourdon gauge and vacuum pressure measurement.
- To analyze the concept of temperature sensors like RTD, Thermocouple and Pyrometers.
- To study the variable head type and variable area type flow meters.
- To understand air purge system and boiler drum level measurement.

Unit–I : Measurement of Force, Torque and Speed

Electric balance - Load cell - Hydraulic, Pneumatic, strain gauge-Magnetoelastic and Piezoelectric load cells - Torque measurement- Relative angular twist-Speed measurement-Capacitive tacho-Drag cup type tacho-D.C and A.C tachogenerators - Stroboscope.

Unit–II : Pressure Measurement

Units of pressure - Manometers, different types, Elastic type pressure gauges, Bourdon tube, bellows and diaphragms - Electrical methods- Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum-McLeod gauge-Thermal conductivity gauge-Ionization gauges - Cold cathode type and hot cathode type - Calibration of pressure gauges - Dead weight tester.

Unit–III : Temperature Measurement

Definitions and standards - Primary and secondary fixed points - Calibration of thermometers - Different types of filled in system thermometers - Sources of errors in - filled in systems and their compensation - Bimetallic thermometers - RTD - characteristics and signal conditioning-3 lead and 4 lead RTDs – Thermistors- Thermocouples - Laws of thermocouple- Commercial circuits for cold junction compensation - Response of thermocouple, Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers.

Unit–IV : Flow Measurement

Expression for flow rate through restriction -Orifice plate – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube - averaging pitot tube – installation and applications of head flow meters - Positive displacement flow meters – Nutating disc, Reciprocating piston and Oval gear flow meters – Turbine flow meter – Variable Area flow meter– Rotameter – Mass flow

meter - Coriolis type mass flow meters – Calibration of flow meters- Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

Unit–V : Level Measurement

Float gauges - Displacer type – Air purge level system – Electrical types – Conductivity level sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement – Hydrastep method - Solid level measurement. Miscellaneous Measurement:Viscosity - Saybolt viscometer-Rotameter type viscometer, Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell –Moisture – Moisture measurement in solids-Conductivity sensor.

TEXT BOOKS

1) D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill, New Delhi, 2010.
2) S.K. Singh, Industrial Instrumentation and Control, 3rd Edition, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.

REFERENCE BOOKS

1) E.O.Doebelin and D. N.Manik, Measurement Systems -Application and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
2) A.K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation and Control, Dhanpat Rai & Sons, New Delhi, 1997.
3) D.P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 1990.
4) B.G. Liptak, Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.
5) R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

COURSE OUTCOMES

At the end of the course the student attains the

1) Ability to understand Load cell, strain gauge, Speed measurement (Unit I)
2) Ability to understand and apply Manometers, Bourdon tube, Mcleod gauge, Piezo resistive, Ionization gauge, dead weight tester to pressure measurement. (Unit II)
3) Ability to understand temperature sensors like thermometers, RTD, thermistors, thermocouple and pyrometers. (Unit III)
4) Ability to understand and apply variable head type, variable area type flow meters, electromagnetic, ultrasonic, laser Doppler and solid type to flow measurement. (Unit–IV)
5) Ability to understand level sensors like float type, air purge, Capacitive, Nucleonic and Ultrasonic gauge, boiler drum level and viscosity, humidity and moisture measurement. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓	✓						
CO3	✓	✓	✓						
CO4	✓	✓	✓						
CO5	✓	✓	✓						

06PC503	ELECTRONIC INSTRUMENTATION AND MEASUREMENT TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce different types of electronic meters and their applications.
- To introduce different types of waveform generators, analyzers and their applications.
- To introduce digital instruments and intelligent instruments.
- To provide knowledge of cathode ray oscilloscope, other display devices & their applications.
- To introduce different types of recorders and to educate interference and screening.
- To introduce computer controlled system and to give exposure on virtual instrumentation.

Unit–I : Measurement of Voltage and Current

Electronic analog meters: DC and AC voltmeters - true R.M.S. voltmeters - differential voltmeters - a.c. current measurements – analog multimeters.

Component measuring instruments

Q-meter - vector impedance meter - Power meter.

Signal sources and Wave analyzers

Basic standard Signal generator (sine wave) – Square and pulse generator, Sweep generator. Wave analyzer - harmonic distortion analyzer- spectrum analyzer.

Unit–II : Digital Measurements

Digital methods of measuring frequency, period, phase difference, pulse width, time interval, total count, AC and DC voltage and current, true r.m.s voltage. DMM, DPM. Comparison between analog and digital techniques of measurement.

Introduction to intelligent instruments. Digital displacement transducers, incremental and absolute types – measurement of velocity, acceleration- Moire fringe transducer.

Unit–III : Oscilloscope and Display devices

Cathode Ray oscilloscopes: Block diagram of oscilloscope - CRT screen characteristics - vertical, horizontal amplifiers, input coupling - time base: synchronization, free run, auto and single sweep modes – multiple trace display: alternate, chop, X-Y modes of operation - sweep trigger sources, coupling - delayed sweep, delay lines. Special probes - high frequency considerations- Sampling oscilloscope - digital storage oscilloscope. Specifications of DSO-Typical measurements using CRO and DSO.

LED, LCD – annunciators, numeric, alphanumeric, graphics.

Unit–IV : Recorders and Interference Effects

Recorders - moving coil, potentiometric, event recorders - X-Y plotters - U.V. recorders - digital recording.

Interference and screening - component impurities and their effects on signals - electrostatic and electromagnetic interference - multiple earths and earth loops. Practical aspects of interference reduction.

Unit–V : Computer Controlled Test Systems and Virtual Instrumentation

Computer-Controlled test Systems: Testing an audio amplifier - Instruments used in Computer Controlled Instrumentation - IEEE Electrical Interface and Specifications - Block Diagram of an IEEE-488 bus Connected System and Digital Control Description.

Virtual Instrumentation: Definition, flexibility – Block diagram and architecture of virtual instruments – VI vs traditional instruments. Software in virtual instrumentation. Instrument Control - Instrument Drivers - VXI Bus.

TEXT BOOKS

1) A.K.Sawhney, A course in Electrical & Electronic measurements & Instrumentation, Dhanpat Rai & co., 2013.
2) W.D.Cooper and A.D.Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall of India, 2009.

REFERENCE BOOKS

1) H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 1995.
2) A.J.Bouwens, Digital Instrumentation, McGraw Hill, 2001.
3) LabVIEW basics, Vol.1&2 manuals, National Instruments, 2006.
4) D.F.A.Edwards, Electronic measurement techniques, Elsevier, 2014.
5) George.C.Barney, Intelligent Instrumentaion, Prentice Hall of India, 1998.
6) Jovitha Jerome, VI using LabVIEW, Prentice Hall of India, 2010.

COURSE OUTCOMES

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

1) Understand different types of electronic meters and their applications. (Unit I)
2) Understand different types of waveform generators, analyzers and their applications. (Unit I)
3) Understand digital instruments and intelligent instruments. (Unit II)
4) Gain knowledge of cathode ray oscilloscope, recorders and other display devices with their applications. (Unit III & IV)
5) Understand computer controlled system and virtual instrumentation. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓							
CO4	✓	✓							
CO5	✓	✓	✓	✓	✓				

06PC504	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	D
		4	0	0	0

COURSE OBJECTIVES

- To study the architecture of 8085 microprocessor and its programming.
- To learn the design aspects of I/O and memory interfacing circuits.
- To study interfacing devices like 8255, 8253, 8259 and 8251
- To study the architectures of 8051 microcontroller.
- To learn about the 8085 and 8051 based applications.

Unit–I : 8085 Microprocessor

Microprocessor architecture and assembly language - Organization of 8085 microprocessor – memory and I/O devices -Memory mapping-Memory interfacing-Instructions set-Instruction format, Addressing modes, counters and time delays - Stack – subroutine - interrupts - Assembly Language Programming.

Unit–II : Peripherals

8255 programmable peripheral interface - 8253 programmable interval timer-8259 programmable interrupt controller - direct memory access (DMA) and 8257 DMA controller -8279 programmable keyboard display interface -8251 and serial I/O and data communication.

Unit–III : 8051 Microcontroller

Microcontrollers Vs Microprocessors – 8051 Architecture – memory organization - register bank and stack-Special function register(SFR's)-Instruction set - Addressing Modes - Assembly language programming.

Unit–IV : 8051 Peripherals

I/O port programming – Timer programming – serial port programming – Interrupt programming –Interfacing to external memory – keyboard interfacing – ADC,DAC and sensor interfacing.

Unit–V : Applications of Microprocessor and Microcontroller

Stepper motor control- DC motor position/speed measurement and control-Data transfer between two Microprocessor/Microcontrollers- Interfacing LCD display – Temperature ON/OFF control – Traffic light control.

TEXT BOOKS

1) Ramesh Gaonkar, Microprocessor Architecture Programming and Application with the 8085/8080a, Fifth edition, Penram International Publishing (India), 2011.
2) Muhammad Ali Mazidi, Janice Gillispie Mazidi,Rolin D.Mc Kinlay "The 8051 Microcontroller and Embedded Systems", PHI Learning, 2011.

REFERENCE BOOKS

1) Badri Ram, Fundamentals of Microprocessor and MicroComputer, Dhanpat Rai and Sons, 1988.
2) Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming & Applications, Penram International Publishing (India), Mumbai, 1996.
3) 16 Bit Embedded Controllers Hand Book,Intel Corporation, New York, 1990.

4) Mazidi and D.MacKinlay, 8051 Microcontroller and Embedded Systems using Assembly and C, 2006 Pearson Education Low Price Edition.

5) A.Nagoor Kani, Microprocessors and Microcontrollers, First Edition Jan 2005, RBA Publications.

COURSE OUTCOMES

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

1) Learn basic concept of microprocessor and architecture nd implement programs on 8085 microprocessor. (Unit I)
2) Design of peripheral interfacing circuits. (Unit II)
3) Understand architecture of microcontrollers and develop simple assembly language progarm. (Unit III)
4) Programming the on-chip peripherals of microcontroller. (Unit–IV :)
5) Understand the recent trends and make use of microprocessor and microcontroller for different applications. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓		✓					✓	
CO3	✓	✓						✓	
CO4	✓							✓	
CO5	✓			✓				✓	

06CP507	CONTROL SYSTEMS LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the different methods of system representation and obtain the model of the system in time and frequency domains.
- To impart necessary knowledge in the time domain response and steady state response.
- To give basic knowledge in obtaining the open loop and closed loop time and frequency responses.

LIST OF EXPERIMENTS

1) Determination of transfer function of a DC Servomotor and its speed control.
2) Solving Control Engineering problems using MATLAB software.
3) Study of DC Position control system.
4) Design and implementation of a Phase Lead Compensator using MATLAB software.
5) Identification of a given system using frequency response characteristics.
6) Characteristics of Sample and Hold circuit.
7) Simulation of a Sampled data control system.
8) Sensitivity analysis of open loop and closed loop systems using Process Control Simulator.

9) Stability characteristics of feedback systems using Process Control Simulator.
10) Time response analysis of a Second order type-0 and type-1 system using Process Control Simulator.

COURSE OUTCOMES

After successful completion of this course, the students should be able to

1) To identify the model of any system using various techniques and investigate its performances in open and closed loops.
2) To obtain desired performance by designing and implementing suitable compensators for the taken up system.
3) To identify any type of control system with respect to system stability in time domain as well as frequency domain.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓		✓				
CO2	✓	✓	✓						
CO3	✓	✓	✓						

06CP508	MICROPROCESSOR LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To become familiar with the architecture and Instruction set of Intel 8085 microprocessor.
- To provide practical hands on experience with Assembly Language Programming.
- To provide solid foundation on interfacing the external devices to the 8085 microprocessor according to the user requirements and solutions for the real time problems.

LIST OF EXPERIMENTS

1) a) Multiplication by repeated addition and subtraction.
   b) Multibyte Decimal addition and subtraction.
2) Code conversion.
3) a) Finding Smallest/Largest number from an Array of 'n' numbers.
   b) Sorting an array of numbers in Ascending/Descending order.
4) a) Block movement of data.
   b) Interrupt using RST 5.5.
5) Switches and LED Interface.
6) ADC and DAC Interface with microprocessor.
7) 8253 Timer Interface.
8) 8259 programmable Interrupt controller.
9) Kit to Kit data transfer using USART 8251.
10) Stepper motor Interface.

COURSE OUTCOMES

1) Understand the architecture of 8085.
2) Familiarize with the assembly level programming and Impart the knowledge about the instruction set.
3) Work with standard microprocessor interfaces like Timers, Programmable peripheral interface, Programmable Interrupt controller, serial ports, digital-to-analog converters and analog-to-digital converters etc.
4) An in-depth knowledge of applying the concepts on real- time applications.

	Mapping with Programme Outcomes								
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓		✓	✓	✓			
CO2		✓		✓	✓	✓			
CO3		✓		✓	✓	✓			
CO4		✓		✓	✓	✓			

SIXTH SEMESTER

06PC601	DIGITAL SIGNAL PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn about discrete time signals and system properties.
- To acquire knowledge in the design of digital filters.
- To understand the need for frequency transformation and to implement the same by efficient computational algorithm.
- To study about the architecture and features of generic digital signal processors and their applications.

Unit–I : Discrete Time Signals and Systems

Discrete time signals: Classification of discrete time signal – Simple manipulations on discrete time signals. Discrete time systems: Classification – Response of Discrete time LTI system to arbitrary inputs –Impulse response – Frequency response – Properties of frequency response. Implementation of discrete time systems: Structures for realization of LTI systems –Cascade and Parallel structure– Lattice and Ladder structure.

Unit–II : Design of IIR Digital Filter

Definition of digital filter– Properties of IIR digital filter –Design of IIR filter using Impulse Invariant method – Bilinear transformation method – Step invariant method – Realization of IIR digital filters–Quantization noise and finite register length effects in implementation of IIR digital filter.

Unit–III : Design of FIR Digital Filter

Definition of FIR filter – Design of FIR filter using Fourier series method – Design using window functions – Hamming window – Hanning window – Kaisar window – Linear phase FIR digital filter – Design of FIR differentiator.

Unit–IV : Fast Fourier Transform (FFT) Algorithms

Discrete Fourier Transform (DFT): Definition – Properties. Fast Fourier transform radix 2 Algorithms – Decimation-in-time (DIT) FFT algorithm –

Decimation–in–frequency FFT algorithm – IDFT using Direct FFT Algorithm – Quantization noise due to FFT computation –finite register length effects in DFT computation – Application of FFT in linear filtering.

Unit–V : Digital Signal Processors

Generic DSP Architecture – Features of TMS 320C50 processor – Memory and I/O Organization – Addressing modes –Fixed point and floating point representation – Introduction to commercial DSP processors.

TEXT BOOKS

1) John G Proakis and Dimitris G Manolakis, "Digital Signal Processing - Principles, Algorithmsand Applications", Fourth Edition, Pearson India, 2007.
2) Mitra S K, "Digital Signal Processing – A Computer Based Approach", Third edition, Tata McGraw Hill, 2007.

REFERENCE BOOKS

1) Oppenheim A.V and Schaffer R.W,"Digital SignalProcessing",First edition, PrenticeHall India, 2015.
2) Ludeman L.C, "Fundamentals of Digital Signal Processing", First edition, Wiley India, 2009.
3) Emmanuel C. Ifeachor andBarrie W. Jervis, "Digital Signal Processing: A PracticalApproach", Second edition, Pearson Education, 2002.
4) Johnson J.R, "Introduction to Digital Signal Processing", First edition, Prentice Hall of India,New Delhi, 2009.
5) P.Ramesh Babu, "Digital Signal Processing", Sixth edition, Scitech Publications, 2014.
6) Simon Haykin and Barry Van Veen, "Signals and Systems", Second edition, John Wiley & Sons, 2007.
7) Venkatramani B and Bhaskar M, "Digital Signal Processors: Architecture, Programming and Applications", Second edition, Tata McGraw-Hill Education, 2002.

COURSE OUTCOMES

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

1) Develop a discrete time system to meet the requirements. (Unit I)
2) Design a filter that solves the specific problem. (Unit II)
3) Understand the issues related to implementation of digital filters. (Unit III)
4) Implement frequency transformation of signals efficiently using FFT. (Unit–IV)
5) Understand the recent trends in digital signal processor and processing technology. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓							
CO3	✓	✓							
CO4	✓	✓							
CO5	✓	✓	✓	✓					

06PC602	PROCESS CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the dynamics of various processes and modelling of physical process using first principles.
- To get adequate knowledge about the non linear systems.
- To educate the effect of various control actions and the methods of tuning the controller.
- To study about the construction, and characteristics of control valves.
- To introduce the concept of various complex control schemes.
- To study the state space modelling approach.

Unit–I : Mathematical Modelling of Processes

Process variables – degrees of freedom – mathematical model of first order liquid process, gaseous process, flow process, thermal process, mixing process – batch process and continuous process – self-regulation – inverse response.

Common non-linear elements and their models – time and frequency response characteristics unique to non-linear systems – singular points – limit cycle behavior.

MATLAB program to study inverse response, S-type response and the response of first-order system with delay.

Unit–II : Controllers and Final Control Elements

Characteristics of On-Off, proportional, single speed floating, integral and derivative control modes – composite control modes – P+I, P+D and P+I+D control modes – response of controller for different types of test inputs – integral windup – auto/manual transfer – Non linear PID Controller – selection of control mode for different processes – typical control schemes for level, flow, pressure and temperature.

Control valve – characteristics of control valves – valve positioned.

Simulation study of control modes for simple systems using SIMULINK.

Unit–III : Optimum Controller Settings

Tuning of controllers by process reaction curve method – continuous cycling method – damped oscillation method – Ziegler-Nichol's tuning – 1/4 decay ratio.

Feed Forward control – Ratio control – Cascade control – Averaging control.

Simulation study of controller tuning using SIMULINK and TUTSIM.

Unit–IV : State Variable Analysis

Concept of state variables and state models – State models for linear continuous time systems – Diagonalization – Solution of state equations – Concept of controllability and observability.

State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values.

MATLAB program to study the response of sampled data system.

Unit–V : Case Study

Distillation column – control of top and bottom product compositions – reflux ratio – control of chemical reactor – control of heat exchanger. Steam boiler-drum level control and combustion control. Piping and Instrumentation Diagram of control loops. Complete air–supply system for pneumatic control equipment – major components and their functions.

TEXT BOOKS:

1) George Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", First edition, Prentice Hall of India, 2008.
2) D.R. Coughanowr and Steven LeBlanc, "Process Systems Analysis and Control", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1) M. Gopal, "Control Systems: Principles and Design", Fourth Edition, Tata McGraw Hill, 2012.
2) TUTSIM Simulation Language Manual, TUTSIM Products Ltd., U.S.A.
3) Donald P Eckman, "Principles of Industrial Process Control", Second Edition, J. Wiley & sons, 1965.
4) Peter Harriott, "Process Control", First Edition, Tata McGraw-Hill Education, 2001.

COURSE OUTCOMES

At the completion of this course, students will be able to:

1) Understand basic principles and importance of process control in industrial process plants.(Unit I)
2) Acquire knowledge of dynamic modelling and system behaviour. (Unit II)
3) Understand the need for mathematical basis for the design of control systems. (Unit III)
4) Design and tune PID controllers. (Unit II)
5) Specify the required instrumentation and final control elements to ensure well tuned control. (Unit–II : and III)
6) Understand the state space modelling approach. (Unit–IV)
7) Apply the control system in various complex processes. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓	✓					
CO2		✓	✓	✓					
CO3		✓	✓	✓					
CO4		✓	✓	✓					
CO5		✓	✓	✓					
CO6		✓	✓	✓					
CO7	✓				✓				

06CP607	INSTRUMENTATION AND PROCESS CONTROL LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To impart knowledge about the modelling principle of level process and the characteristics of final control element and Controller.
- To design and implement tuning techniques of PID controller and verify in Matlab/Simulink environment.
- To design and implement closed loop control for processes like Air temperature, Air flow and Level.
- To familiarize the students with design and simulate cascade control for the given process.
- To Study the applications of Programmable Logic Controller.

LIST OF EXPERIMENTS

1) Modelling and simulation of a Level process using TUTSIM.
2) (a) Study of Control Valve characteristics.
   (b) Study of P&I Diagram
3) Controller tuning using Process Reaction Curve method.
4) Determination of characteristics of a PID controller using Matlab (Simulink) software.
5) Design and simulation of Cascade control system using Matlab (Simulink) software
6) Determination of Transfer function (Experimental model) of Level process.
7) Controller tuning using Continuous Cycling method.
8) Control of Air flow Process.
9) Design and Implementation of P and PI controller for an Air temperature control system.
10) Study of Programmable Logic Controller and its applications.

COURSE OUTCOMES

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

1) To model and design controllers for different processes.
2) To design and implement advanced control techniques.
3) Familiarize with TUTSIM and MATLAB software for process control applications.

Mapping with Program Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓	✓						
CO3				✓					

06CP608	EMBEDDED SYSTEMS LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the basic concepts of embedded system
- To become familiar with the architecture and Instruction set of Intel 8051 and PIC microcontroller.
- To develop skill in simple program writing for 8051 and PIC microcontroller
- To develop and demonstrate how to accomplish a given task using Assembly and "C" language on a microcontroller
- To familiarize the interfacing of various peripheral devices with 8051 and PIC microprocessor.

LIST OF EXPERIMENTS

1) Arithmetic Exercises in 8051 using RIDE package (Assembly Language Program).
2) Simple Programs in 8051 using RIDE package (Assembly Language Program).
3) Arithmetic Exercises in 8051 using RIDE package (Embedded C).
4) Simple programs in PIC Microcontroller using MPLAB.
5) Interfacing switches and LED with 8051 Microcontroller.
6) Interfacing Push button and Buzzer with 8051 Microcontroller.
7) Programming the on-chip Timer of 8051 Microcontroller.
8) Stepper motor control using 8051 Microcontroller.
9) Programming the on-chip ADC and PWM of PIC Microcontroller using MPLAB.
10) Implementation of Logic Gates and MUX/DEMUX in FPGA.

COURSE OUTCOMES

1) Understand the architecture of 8051 and PIC microcontroller.
2) Familiarize with the assembly level programming, Embedded C and impart the knowledge
3) about the instruction set.
4) Develop software for embedded system using Cross compliers like RIDE , MP lab.
5) Students will have the knowledge through hands-on experimentation the Xilinx tools for FPGA.
6) Design as well as the basics of VHDL to design, simulate and implement the digital systems.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓		✓	✓	✓			
CO2		✓		✓	✓	✓			
CO3		✓		✓	✓	✓			
CO4		✓		✓	✓	✓			
C05		✓		✓	✓	✓			

SEVENTH SEMESTER

00HS701	ENGINEERING ETHICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.

Unit–I

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit–II

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

Unit–IV

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit–V

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TEXT BOOKS

1) Govindarajan, M., Natarajan, S. and Senthilkuma, V.S., "Professional Ethics And Human Values", PHI Learning, New Delhi, 2013.
2) Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.

REFERENCE BOOKS

1) Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
2) Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3) Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4) David Ermann and Michele S. Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

COURSE OUTCOMES

1) Understand the relationship between the engineer and the society.
2) Learn the importance of codes in engineering practice.
3) Acquire knowledge on the legal, moral and ethical aspects in engineering.

06PC702	COMPUTER CONTROL OF PROCESSES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the need for computers in process control.
- To study the fundamentals required for computer control of a process.
- To expose the students the stability analysis of discrete time system.
- To design and analyze digital controllers.
- To study some of the methods to identify the process.
- To know about programmable logic controller.

Unit–I : Introduction to Computer Control System

Need for computer in a control system- Building blocks of a computer control system, Representation and analysis of Sampled data control systems-Pulse Transfer function-Zero Order Hold and First Order Hold- Sampling Theorem-Sampling frequency Consideration- stability analysis: Jury's test and bilinear transformation. Modified Z transform of systems with dead time.

Unit–II : Digital Control Algorithms

Design for Set point and load changes: Deadbeat Algorithm - Dahlin's method - Kalman's approach - ringing phenomenon in digital controller- discrete PID controller algorithms - tuning techniques - selection of sampling time - dead-time compensation: Smith Predictor algorithm.

Unit–III : System Modeling and Identification

Mathematical model for processes: first order, second order processes with and without delay - higher order systems-process modeling from step test data - pulse testing for process identification - time-domain identification-linear least square algorithm.

Unit–IV : Programmable Logic Controllers (PLCs)

PLC Hardware components: discrete, analog and digital I/O modules: typical input and output field devices and their modules - I/O signal types and typical signal conditioning circuits - common electrical devices and symbols - intelligent I/O modules - Communication I/O modules- network communication module - distributed I/O - Central Processing Unit-

Unit–V : PLC Programming

Programming Languages: Ladder Diagram(LD) - Function Blocks Diagram (FBD) - Sequential Function Chart (SFC) - Instruction List (IL) - Structured Text (ST). programming devices: hand-held programmer - personal computer based programmer - Memory types used in PLCs - memory map - assigning I/O address and internal address - scan sequence.-Basic Programming: Relay-Type Instruction-Internal Relay instruction- timers-counters- program control instruction-data manipulation

instruction-math instruction-sequencer and shift register instruction-development of programmes for typical applications -PLC Installation and maintenance.

TEXT BOOKS

1) P.B. Deshpande and R.H. Ash, Elements of Computer Process Control, Instrument Society of America, 1981.
2) Frank D.Petruzella, Programmable Logic Controllers, McGraw Hill Education India Private Limited, Fourth edition, 2016.

REFERENCE BOOKS

1) C.D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2005.
2) Stuart Bennet, Real Time Computer Control, Second Edition,Pearson Education, 2005.
3) C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 1972.
4) Donald R.Coughnowr, Process Systems Analysis and Control, Mc-Graw Hill Education, Third Edition,2008.
5) W.Bolton, Programmable Logic Controllers, Elsevier Newnes,2006

COURSE OUTCOMES

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

1) Analyze a system in discrete domain using Z-transform and modified Z-transform. (Unit I)
2) Design and develop algorithms for sampled data control system. (Unit II)
3) Understand various system identification and modeling techniques in time domain and in frequency domain.(Unit III)
4) Appreciate the application and hardware parts of a Programmable Logic Controller. (Unit–IV :)
5) Develop and implement logical programs in PLC and trouble shoot, install and maintain a PLC system. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓	✓	✓					
CO3		✓	✓	✓					
CO4				✓					
CO5		✓	✓	✓	✓			✓	

06CP706	COMPUTER PROCESS CONTROL LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the need for computers in process control and fundamentals required for computer control of processes with MATLAB software.
- To study and implement an algorithm to identify the process parameters.
- To design and implement digital controllers using TUTSIM software.
- To study programmable logic controller with GE Fanuc make.
- To study data acquisition system using LABVIEW software.

LIST OF EXPERIMENTS

1) Open loop and closed loop response of the discrete time system.
2) Design of sampled data control system with Dead-beat controller using TUTSIM.
3) Design of Dead-time compensator using smith predictor algorithm and simulation using SIMULINK.
4) Process identification using Least Square Estimator algorithm using MATLAB.
5) Design and simulation of Kalman's Controller using TUTSIM.
6) Design and realization of digital filter.
7) Design of sampled data control system with Dhalin's controller and simulation using TUTSIM.
8) Study of LABVIEW software and Data acquisition using Lab View.
9) a) Design of inverse response compensator and simulation using SIMULINK.
10) b)Study of Bio signals.
11) Study of PLC (GE Fanuc make).

COURSE OUTCOMES

1) Able to design and implement a closed loop system in discrete domain.
2) Able to understand and develop ladder logics PLC.
3) Ability to use the software tools like LABVIEW,MATLAB and TUTSIM.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓	✓						
CO3				✓					

EIGHTH SEMESTER

		L	T	P
06PV803	**PROJECT WORK AND VIVA VOCE**	**0**	**0**	**15**

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

METHOD OF EVALUATION

1) The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
2) The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
3) A project report is required at the end of the semester.

4) The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

1) On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology
2) Carrying out any experimental works on concrete and steel or any other construction material to know the behavior and properties
3) Understand the modelling, analysis and design concepts by taking up a structure.

Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓			✓		✓	
CO2	✓	✓	✓			✓		✓	✓
CO3	✓	✓	✓			✓		✓	✓

PE - PROFESSIONAL ELECTIVES

06PEXXX	ELECTRICAL MEASUREMENTS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To motivate the students to gain knowledge about the basic principles and the laws governing the operation of electrical measuring instruments.
- To familiarize the students about the functioning of different types of instruments.
- To understand the concepts of various measuring techniques.

Unit–I

D'Arsonal galvanometer, Principle, operation and constructional details of Moving-coil, Moving-iron, dynamometer type, thermal type instruments, errors and compensations, extension of range using shunt, multiplier, Principle of C.T. and V.T.

Unit–II

Power measurement – Ammeter and Voltmeter method - Electrodynamic wattmeter, errors and compensation, thermal type wattmeter, single and 3- phase power measurements.

Energy measurement - Induction type energy meter, principle, construction, errors and compensation. Calibration of wattmeters and energymeters.

Unit–III

Resistance Measurement - Series and shunt type ohmmeter. Wheatstone bridge, Kelvin bridge, Megger.

AC bridges - Maxwell bridge, Wien bridge, Anderson bridge, Hays bridge, Schering bridge - Campbell bridge to measure mutual inductance - detectors in bridge measurements.

Unit–IV

DC potentiometer – Standardization - student type, Leeds and Northrup potentiometer, Vernier potentiometer, Brooks deflection potentiometer.

AC potentiometer - Drysdale potentiometer, Gall potentiometer. Applications of AC and DC potentiometers. Maximum demand meter, Power factor meter.

Unit–V

Magnetic measurements - flux meter - testing of ring specimen - B-H curve by method of reversal and step by step method - testing of bar specimen - Hopkinson's permeameter - Iron loss measurement by Lloyd Fisher square.

TEXT BOOKS

1) E.W. Golding & F.C.Widdis, Electrical Measurements & Measuring Instrumen ts, A.H.Wheeler & Co, 2001.
2) A.K. Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpathRai& Co (P) Ltd, 2004.

REFERENCE BOOKS

1) J.B.Gupta, A Course in Electronic and Electrical Measurements and Instru mentation,S.KKataria & Sons, Delhi, 2003.
2) H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 2004.
3) Martin U. Reissland, Electrical Measurement – Fundamental Concepts and Applications, New Age International (P) Ltd, 2001.

COURSE OUTCOMES

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

1) Understand the internal structure of the instruments used in electrical measurements and to decide the types of instruments to be used for measuring AC and DC quantities. (Unit-I)
2) Understand the practical application of Wattmeters and Energy meters.(Unit-II)
3) Construct and determine the circuit parameters using AC and DC bridges. (Unit-III)
4) Construct and determine the circuit parameters using AC and DC potentiometers. (Unit-IV)
5) Explain the importance of Magnetism in electrical measuring instruments. (Unit-V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓	✓						
CO3		✓	✓	✓					
CO4		✓	✓	✓					
CO5			✓						

06PEXXX	ELECTRICAL TECHNOLOGY	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the basic theory behind electrical machines.
- To know the different types of AC and DC machines and their applications.
- To understand the construction, principle and operation of single phase and three phase transformers, classification and their applications.

Unit–I

Magnetic circuit: Magnetomotive force - magnetic field strength - permeability of free space- relative permeability - reluctance - comparison of electric and magnetic circuits - composite magnetic circuit - magnetic leakage and fringing - Kirchoff's laws for the magnetic circuit - magnetization curve - hysteresis loop - current-ring theory of magnetism - hysteresis loss - minimum volume of a permanent magnet - load line of a permanent magnet - magnetic field of a long solenoid - magnetic energy in a non-magnetic medium - magnetic pull. Inductance of a coil and factors determining inductance of a coil.

Unit–II

DC Machines: Construction details of machine - operation of DC generators - EMF equation - characteristics of different types of DC generators - commutation - armature reaction - operation of DC motors - torque equation - characteristics of different types of DC motors. Starters - breaking and speed control of DC motors.

Unit–III

Transformers: Principle - types - general constructional features of single phase transformers - phasor diagram and equivalent circuit - regulation, efficiency and all-day efficiency - open circuit and short circuit tests - applications. Auto-transformer and three phase transformer - types and applications.

Unit–IV

Induction Machines: Three phase - types - constructional features - equivalent circuit - slip - torque characteristics - starters - breaking and speed control methods. Principle of operation, types and applications of single phase induction motors.

Unit–V

Synchronous Machines: Principle - types and general constructional features - synchronous generators - characteristics - EMF equation - armature reaction - regulation - phasor diagram of synchronous motor - V curve - starting methods. Applications of synchronous generators and synchronous motors.

TEXT BOOKS

Theraja and Theraja. A Text book of Electrical Technology - Vol.II, AC and DC Machines, 23 rd Revised Edition, S.Chand & Co., Ltd. 2002.

REFERENCE BOOKS

1) R.Muthusubramanian, S. Salivahanan and K.A.Muraleedharan, Basic ElectricalElectronics and Computer Engineering, Tata McGraw – Hill Publishing Company Limited, 2000.
2) I.J.Nagrath and D.P.Kothari, Electric Machines, Second Edition, Tata McGraw – Hill Publishing Company Limited, 1997.
3) S K Bhattacharya, Electrical Machines, Third Edition, Tata McGraw - Hill Publishing Company Limited, 2009.

COURSE OUTCOMES

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

1) Acquire knowledge on magnetic circuits. (Unit-I)
2) Get the knowledge of electrical DC machines and transformers for different industrial applications. (Unit-II & Unit-III)
3) Acquire knowledge on Induction Machines. (Unit-IV)
4) Understand the applications of Synchronous Machines. (Unit-V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓	✓						
CO3	✓	✓	✓						
CO4	✓	✓	✓						

06PEXXX	SIGNALS AND SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn about continuous and discrete time signals and system properties.
- To acquire knowledge about the analysis of continuous and discrete time systems.
- To understand the need for frequency transformation and to learn the difference between various representations for continuous and discrete time signals.

Unit–I : Basics of Signals and Systems

Continuous time (CT) signal- Shannon's sampling theorem-Discrete time signal (DT)- Standard test signals (CT & DT)-Classification of signals – CT and DT systems-Classification of systems.

Unit–II : Analysis of CT Signals

Fourier series representation of continuous time periodic signals – Evaluation of Fourier coefficients-Exponential Fourier series-Properties of continuous time Fourier series – Fourier representation of aperiodic signals-Continuous time Fourier transform(CTFT)- Fourier transform (FT) of standard signals-properties of CTFT.

Unit–III : Continuous Time Systems and its Analysis

Properties of continuous time systems – Representation of continuous time Linear time invariant (LTI) systems using differential equations –Transfer function model –Analysis of continuous time LTI systems using Laplace transform – Unit impulse response of CTLTI system – Unit step response of LTI system- Convolution integral – Frequency response analysis of CTLTI system.

Unit–IV : Analysis of DT signals

Analysis of discrete time periodic signal using Discrete Fourier Series (DFS)-Analysis of discrete time aperiodic signal using Discrete time Fourier transform (DTFT) – Properties of DTFT –Discrete Fourier transform (DFT) – Circular convolution-Properties of DFT.

Unit–V : Discrete time systems and its analysis

Properties of Discrete time systems – Representation of discrete time systems using difference equation – Block diagram representation - Z Transform and its properties - Pole-Zero representation – BIBO stability – Analysis of discrete time system using Z transform.

TEXT BOOKS

1) Alan V Oppenheim, Alan S. Wilskey and S.HamidNawab: Signals and Systems, Second Edition, Prentice Hall India, 1997.
2) Simon Haykin, Barry Van Veen., Signals & Systems, John Wiley &Sons(ASIA) Pvt Ltd, 1999.

REFERENCE BOOKS

1) R.A. Gabel and R.A.Richard : Signals and linear systems, John Wileyand sons, 1987.
2) Gordan E Carlson: Signals and Linear Systems Analysis, Allied Publishers, New Delhi, 1993.
3) P. Ramesh Babu and R. Ananda Natarajan: Signals and Systems, Scitechpublications(India) Pvt. Ltd, Fourth Edition, Chennai 2010.
4) Sanjay Sharma, Signals and Systems, Seventh Edition, S.K.Kataria & Sons, New Delhi, 2011.
5) Ziemer and Tranter, Signals and Systems, Maxell Macmillan, 1993.

COURSE OUTCOMES

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

1) Distinguish between continuous time and discrete time signals. (Unit I)
2) Apply the characteristics and properties of continuous and discrete systems for the design and development to meet the requirements. (Unit III&V)
3) Implement frequency transformation of continuous time and discrete time signals to extract the useful information, analyze continuous and discrete time signals and systems and to use various types of system representations to solve the problems effectively. (Unit II,&IV)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓	✓							
CO3	✓	✓	✓						

06PEXXX	VIRTUAL INSTRUMENTATION & SMART SENSORS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the basic components of Virtual Instrumentation system.
- To learn to develop VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.
- To know about various VI Tool sets.
- To impart knowledge pertaining to Data Acquisition System.

Unit–I : Introduction

Review of Digital Instrumentation, Concept of Virtual Instrumentation-Historical perspective - need of VI advantages- definition of VI- Block diagram and architecture of a Virtual Instrument – Traditional Instruments versus Virtual Instruments - dataflow techniques, graphical programming in data flow, VI Debugging Techniques.

Unit–II : Data Acquisition and Communication Hardware

PC based data acquisition- Typical on board DAQ card- Organisation of the DAQ VI system-Data acquisition interface requirements – Embedded system buses-Selection of Data acquisition cards–Buffered data acquisition - VI Chassis requirements.

Data acquisition cards with serial and parallel communication system controllers. Ethernet - Networking basics for office & Industrial applications - VI customization-Instrument Drivers.

Unit–III : Programming Techniques

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formulae nodes, local and global variables, State machine, string and file I/O, Publishing measurement data in the web, Internet Connectivity.

Unit–IV : Analysis Tools and Application of VI

Analysis tools- Signal Processing Tool set- Fourier transforms, power spectrum, correlation methods, windowing and filtering. Math Toolsets, Hybrid Programming Concept, Control and Simulation Toolkit, On-Off controller, PID Control, Fuzzy algorithms.

Application of VI in process control designing of equipments like oscilloscope, Multimeter, Design of digital Voltmeters with transducer input- Applications of VI for Process Control and Instrumentation.

Unit–V : Smart Sensors

Definition – Sensor classification- General architecture of smart sensors-Description of smart sensor architecture- Block level design consideration for smart sensor-Importance and adoption of smart sensor-Types of smart sensors-compensation.

TEXT BOOKS

1) Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, 2006.
2) Skolkoff, Basic concepts of LABVIEW 4, PHI, 1998.

REFERENCE BOOKS

1) Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
2) J.B.Dixit, AmitYadav, "Intelligent Instrumentation for Engineers", University Science Press2012.
3) Lisa .K, Wells and Jeffrey Travis, LABVIEW for Everyone, Prentice Hall, 2009.
4) Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
5) Jovitha Jerome, Virtual Instrumentation using LabVIEW, Eastern Economy edition, PHI learning private Ltd., 2010.
6) Gupta. S, Gupta. J.P, PC Interfacing for Data Acquisition and Process Control, ISA, 1994.

WEB RESOURCES

- www.ni.com
- www.ltrpub.com

COURSE OUTCOMES

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

1) Engineering Knowledge on VI. (Unit I)
2) Data acquisition using DAQ VI's. (Unit II)
3) Understand the Virtual Instruments basis concepts. (Unit III)
4) Incorporate various VI Toolsets based on the application. (Unit–IV :)
5) Get the knowledge of Smart Sensors. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2	✓	✓	✓	✓					
CO3	✓	✓	✓	✓					
CO4	✓	✓	✓	✓	✓				
CO5	✓	✓	✓	✓	✓				

06PEXXX	DIGITAL SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To review digital design fundamentals and to emphasize VHDL in Digital design.
- To give an overview of PLD, CPLD & FPGA and basic principles in the construction of these programmable devices.
- To present several design examples with synthesizable VHDL code describing them at different levels.
- To present issues related to implementation of a digital system in FPGA.
- To introduce advanced features of VHDL, hardware testing of combinational and sequential logic and design for testability.

Unit–I : Logic Design Fundamentals

Review of logic design fundamentals - combinational logic - flip-flops and latches - Mealy sequential circuit design - Moore sequential circuit design - sequential circuit timing - tri-state logic and busses.

Unit–II : VHDL

Introduction to VHDL - VHDL description of combinational circuits - sequential statements and VHDL processes - modeling flip-flops using VHDL processes - processes using wait statements - VHDL delays - compilation, simulation and synthesis of VHDL code - VHDL data types and operators - VHDL libraries - behavioral and structural VHDL - variables, constants and signals - arrays and loops in VHDL - assert and repeat statements.

Unit–III : PLD

Introduction to Programmable Logic Devices (PLDs): overview of PLDs - simple PLDs - complex PLDs - FPGAs. Design Examples: BCD to seven segment display decoders - BCD adder - traffic light controller - state graphs for control circuits - scoreboard and controller - synchronization and de bouncing - ADD and shift multipliers.

Unit–IV : FPGA

State Machine (SM) charts - derivation of SM charts - binary multiplier design - realization of SM charts - implementation of binary multiplier controller. Designing with FPGAs: Implementing functions in FPGAs - Shanon's decomposition - carry chains - cascade chains - logic blocks in commercial FPGAs - dedicated memory in FPGAs - dedicated multipliers in FPGAs - FPGA capacity - design translation, mapping, placement and routing.

Unit–V : Design and Testing

VHDL functions - VHDL procedures - attributes - multi valued logic and signal resolution - IEEE 9-valued logic system - Generics. Hardware testing and design for testability: testing combinational logic - testing sequential logic - scan testing - boundary scan - built-in self test.

TEXT BOOKS

1) Charles H. Roth, Lizy Kurian John, Digital System Design using VHDL, Second Edition, Thomson Learning Inc., 2008.
2) Ian Grout, Digital Systems Design with FPGAs and CPLDs, Newnes imprint of Elsevier Ltd., 2010.

REFERENCE BOOKS

1) K.C. Chang, Digital Systems Design with VHDL and Synthesis - An Integrated Approach IEEE Computer Society, 1999.
2) J. Bhasker, A VHDL Primer, Third Edition, Prentice Hall of India, 1999.

COURSE OUTCOMES

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

1) Design a digital system and develop VHDL code describing them at various levels (Unit–I : & II).
2) Implement the designed digital system using programmable devices (Unit III).

3) Utilize advanced features of VHDL with FPGA in their system design (Unit–IV).
4) Develop a digital system with testability (Unit V).

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓	✓					
CO2		✓	✓						
CO3		✓	✓	✓			✓		
CO4				✓			✓		✓

06PEXXX	INSTRUMENTATION SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To impart knowledge about the design methods using orifice and rotameter type of flow transducers for flow control system.
- To understand the basics of transmitter, design principles of signal conditioning circuits for RTD and thermocouple based temperature transmitter, methods of designing cold junction compensation circuit for thermocouple.
- To study about the design of bourdon tube for the measurement of pressure and factors governing its sensitivity and to learn the design procedures of air purge pressure measurement system.
- To learn the principle behind PID controllers and the design aspects for various types of control systems.
- To understand the principle and characteristics of control valves, positioners and pumps and the design criteria involved.
- To study about the design features of alarm circuits, interlocks and micro processor based data acquisition and implementation of PID control system.

Unit–I

Analog and Digital signal conditioning – signal level and bias changes – linearization – conversion -filtering and impedance matching – concept of loading – Op-Amp circuits in instrumentation- design specifications of ADC, DAC – sample and hold circuit.

Unit–II

Orifice meter - design of orifice for given flow condition - design of rotameter - design of signal conditioning circuit for RTD based temperature transmitter - design of cold junction compensation circuit for thermocouple based temperature transmitter - zero and span adjustment in D/P transmitters and temperature transmitters.

unit–III

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube -design of Air purge system for level measurement. Electronic P+I+D controllers - design - adjustment of setpoint, bias and controller settings.

Unit–IV

Control valves - design of actuators and positioners - types of valve bodies - valve characteristics - materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications. Types of pumps - pipe work calculation - selection of pumps. I/P and P/I converters- complete air supply system for pneumatic control equipments.

Unit–V

Design of logic circuits for alarm and annunciator circuits, interlocks-annunciator sequences - design of microprocessor based system for data acquisition - design of microprocessor based P+I+D controller.

TEXT BOOKS:

1) C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, 8th Edition, 2015.
2) N.A.Anderson, Instrumentation for Process Measurement and Control, Berlin: Springer, 3rd Edition, 2000.

REFERENCE BOOKS

1) D.M.Considine, Process Instruments and Controls Handbook ,McGraw-Hill., 5th Edition, 1997.
2) R.H.Warring, Pumping Manual, Gulf Publishing Co., 1984.
3) J.P.Bentley, Principles of Measurement Systems, Pearson Education Asia Pvt. Ltd., New Delhi, 3rd Edition, 2000.

COURSE OUTCOMES

At the end of the course the student attains the

1) Ability to design signal conditioning circuit for Instrumentation systems.(Unit I)
2) Ability to design and develop flow measurement system using orifice & rotameter and to design signal conditioning circuit for temperature transmitters using RTD & thermocouple. (Unit II)
3) Ability to design and develop air purge type of level measurement system and to design electronic PID controllers. (Unit III)
4) Ability to design and select control valves and pumps for typical control applications. (Unit–IV :)
5) Ability to design alarm circuits, interlocks & the ability to develop microprocessor based data acquisition system and PID control system. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓		✓				
CO2	✓	✓	✓						
CO3	✓	✓	✓						
CO4	✓	✓	✓						
CO5	✓	✓	✓						

06PEXXX	REAL TIME OPERATING SYSTEM	L	T	P
		4	0	0

COURSE OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and user computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS.
- To discuss the application development using RTOS.

Unit–I : Review of Operating Systems

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling-Fault &recovery.

Unit–II : Overview of RTOS

RTOS Task and Task state –Multithreaded Premptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

Unit–III : Real Time Models and Languages

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

Unit–IV : Real Time Kernel

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

Unit–V : RTOs Application Domains

Case studies-RTOs for Image Processing – Embedded RTOs for Network communication – RTOs for fault-Tolerant Applications – RTOs for Control Systems.

TEXT BOOKS

1) Silberschatz,Galvin,Gagne, Operating System Concepts,6th ed,John Wiley,2003.
2) Raj Kamal, Embedded Systems- Architecture, Programming and Design, Tata McGraw Hill, 2006.

REFERENCE BOOKS

1) Herma K., Real Time Systems – Design for distributed Embedded Applications, Kluwer Academic, 1997.
2) Charles Crowley, Operating Systems-A Design Oriented approach, McGraw Hill 1997.
3) C.M. Krishna, Kang, G.Shin, Real Time Systems, McGraw Hill, 1997.

4) Raymond J.A.Bhur, Donald L.Bailey, An Introduction to Real Time Systems, PHI 1999.
5) MukeshSighal and N G Shi,Advanced Concepts in Operating System, McGraw Hill 2000.
6) D.M.Dhamdhere, Operating Systems,A Concept-Based Approch,TMH,2008.

COURSE OUTCOMES

1) Will get to know the fundamentals of interaction of OS with a computer and User computation. (Unit–I : & II)
2) Will get to know the programming logic of modeling Process based on range of OS features. (Unit–III : & IV)
3) To help the students to come with design and development of solutions using RTOS. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓		✓	✓		✓	✓
CO2	✓		✓		✓	✓		✓	✓
CO3	✓		✓		✓	✓		✓	✓

06PEXXX	COMPUTER NETWORKS AND DCS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide fundamental knowledge about computer networks.
- To provide comprehensive knowledge about the methods of internetworking.
- To give basic knowledge in the architecture and local control unit of distributed control system.
- To give adequate information in the interfaces used in DCS.
- To give basic knowledge about HART (Highway Addressable Remote Transducer) and field bus technology.

Unit–I : Data Acquisition Systems (DAS)

Review of A/D Converters - different Configurations of DAS - Multiplexing - Data Communication - transmission lines and digital signals - Practical line interface circuits – RS232, RS 485 – GPIB - USB.

Unit–II : Introduction to network

MODEM - Data coding methods - Error detection, correction and encryption -. Introduction to Networks - Network topology and media - Transmission Characteristics of network - Open System interconnection model of ISO - Data link Control protocol: HDLC.

Unit–III : Network protocols

Media access protocol: Command/response - Token passing - CSMA/CD, TCP/IPBridges - Routers - Gateways - Standard ETHERNET configuration – Industrial ETHERNET- Special requirement for networks used for Control - Networking of PLC- Introduction to SCADA.

Unit–IV : DCS

Methods of Computer Control of Processes, their configuration and comparison: direct digital control, supervisory digital control and Distributed Control System (DCS). DCS - Local Control Unit (LCU) and architecture - LCU languages - Process interfacing issues. Operator interface - Requirements - displays - alarms and alarm management. Engineering interface - requirements. Factors to be considered in selecting a DCS.

Unit–V : HART and Field bus

HART: Introduction - Evolution of Signal standard - HART Communication protocol - Communication modes – HART networks - Control System interface - HART Commands – HART field Controller implementation - HART and the OSI model.

Field Bus: General Field bus architecture - basic requirements of field bus standard - Field bus topology - Interoperability – Interchangeability - CAN bus.

TEXT BOOKS

1) Behrouz A. Forouzan, Data communications and Networking, Tata Mcgraw Hill, 2004.
2) Michale P. Lucas, Distributed Control Systems,VanNostrand Reinhold Co., 1986.

REFERENCE BOOKS

1) William L. Schweber, Data Communications, McGraw-Hill, 1988.
2) A.S. Tanenbaum, Computer Networks, Second Edition, Prentice-Hall of India, 2004.
3) Romilly Bowden, HART Application Guide, HART Communication Foundation, 1999.
4) Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
5) LawerenceM.Thompson, Industrial data Communications, ISA Press, 1997.

COURSE OUTCOMES

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

1) Understand the basic principle of communication and the modes of data transmission. (Unit I)
2) Understand the various types of bus devices used for data communication in industry.(Unit II)
3) Implement the automation concepts in a process industry. (Unit II)
4) Understand about profibus for data communication. (Unit III)
5) Use HART and FiledBus protocols for process industries. (Unit–IV and V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2		✓				✓			
CO3				✓	✓				
CO4			✓	✓					
CO5				✓				✓	

06PEXXX	ANALYTICAL INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To make the students understand basic theory and importance of instrumental analysis.
- To motivate the students learn the principles and the laws governing the operation of analytical instruments.
- To familiarize the students about the functioning of different types of analytical instruments.

Unit–I

Electromagnetic radiations - different regions - their wave lengths, frequencies and energies - interaction of EM radiations with matter - Principle of spectroscopy - emission, absorption, fluorescence spectroscopy - components of analytical instruments – radiation sources, variety and its types - monochromator - filters - detectors – photo emissive tube, PMT, photo diodes.

Unit–II

IR absorption spectroscopy – IR detectors – thermal detectors – golay pneumatic detector – sample handling techniques – Attenuated Total Reflectance – Lambert's, beer's law – single and double beam instruments – double beam spectrophotometer- non dispersive type.

Unit–III

NMR spectroscopy - Fourier Transform NMR spectroscopy – ESR spectroscopy – basic principles – instrumentation techniques and applications – principle of mass spectrometry – instrumentation techniques and applications – single focusing and double focusing mass analyzer – Quadra pole mass analyzer – TOF spectrometer.

Unit–IV

X-ray Spectroscopy – X-ray spectrometer - Production of X-rays - detection of X-rays and nuclear radiations- ionization chamber – principle of counters - proportional counter, GM counter, scintillation counter - solid state detector - gamma ray spectrometer – isotope dilution and tracer techniques for quantitative estimation and analysis.

Unit–V

Electrochemical methods - electrical conductivity of liquids – sulphur-di-oxide monitor – principle of pH measurement – Technique to measure pH – Oxygen analyzers. Principles of gas and liquid chromatography - High Performance Liquid Chromotography – Super critical fluid chromatography.

TEXT BOOKS

1) Skoog, Holler &Nicman, Principles of Instrumental Analysis. Fifth Edition – Saunders College Publishers, Harcourt Brace College Publishing, 1998.
2) H.H.Willard, L.L.Merrit, J.A. Dean and F.A. Settle, Instrumental methods of Analysis. Seventh edition – CBS, Publishers & Distributors, 1995.

REFERENCE BOOKS

1) D.A. Skoog and D.M.West, Principles of Instrumental Analysis, Second Edition, Holt–Saunders, 1980.
2) Douglas A.Skoog and James J. Leary, Principles of instrumental Analysis, Fourth Edition – Saunders College Publishing, 1992.
3) Khandpur.R.S, Handbook of Analytical Instruments, TMH,2003.
4) Bella,G.Liptak Process Measurements and Analysis, CRC press,LLP,2000.

COURSE OUTCOMES

1) Gain adequate knowledge about the analytical tools.(Unit I).
2) Understand the principles and types of spectroscopy(Unit I).
3) Importance and applications of IR spectroscopy (Unit II).
4) Importance and applications of Magnetic resonance spectroscopy and mass analyzer (Unit III).
5) Importance and applications of X-ray spectroscopy and dilution tracer analysis (Unit–IV).
6) Separation of similar materials using Chromatograph. (Unit V).

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓					
CO2	✓		✓	✓					
CO3	✓		✓	✓					
CO4	✓		✓	✓					
CO5	✓		✓	✓					
CO6	✓		✓	✓					

06PEXXX	POWER ELECTRONICS DRIVES AND CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn about semi-conductor power devices.
- To acquire knowledge about the power converters for various loads.
- To implement the power converters for the drives by efficient control algorithms.
- To understand the need for the series & parallel connections and protection circuits.
- To study about the generation of control pulses for power electronic convertersand their applications.

Unit–I : Semiconductor Power Devices

SCR characteristics - Two transistor analogy - Methods of turning on and turning off - Other members of SCR family - Series and parallel connection of SCRs - Thyristor protection. Other semiconductor devices: Power transistors, Power

MOSFETs, GTOs, IGBT.Generation of control pulses for power electronic converters.

Unit–II : Phase Controlled Rectifiers

Single phase controlled rectifiers - Half wave controlled rectifier with i) R load ii) R,L load iii) R,L load and free wheel diode iv) R,L load and battery - Full wave controlled rectifier- half controlled bridge rectifier and fully controlled bridge rectifier with the above four types of loads. Three phase controlled rectifiers: Half controlled bridge - Fully controlled bridge.

Unit–III : Single Phase Inverter

Series , Parallel & Bridge inverters - Current source inverter.

DC choppers

Various types - Step-up, step down & step up/down chopper, chopper configuration – AC Chopper. AC voltage controller. Single phase Cycloconverter.

Unit–IV : DC Motor Control

Schemes for DC motor speed control, Single phase and three phase SCR drives - reversible SCR drives - chopper controlled DC drives. Closed loop control of DC drives.

Unit–V : AC Motor Control

Speed control methods for induction motor - controlled slip system - slip power recovery scheme - braking of induction motor. Synchronous motor control.

TEXT BOOKS

1) M.D. Singh, K.B. Khanchandani, Power Electronics, Tata McGraw Hill, 2003.
2) Vedam Subrahmanyam, “Electric Drives-Concept & Applications”, Second edition, TataMcGraw Hill, 2011.

REFERENCE BOOKS

1) M.H. Rashid, Power Electronics, Prentice-Hall, 1988.
2) C.N.Pauddar, Semi conductor Power Electronics (Devices and circuits), Jain Brothers, New Delhi, 1999.
3) S.N. Singh, Text Book of Power Electronics, DhanpathRai & Co., New Delhi, 2000.
4) P.S. Bhimbhra, Power Electronics, Khanna Publishers, Third Edition, New Delhi, 2005.
5) M. Ramamoorthy, An Introduction to Thyristors and their Applications, East West Press,1991.

COURSE OUTCOMES

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

1) Understand the characteristics & applications of power semi-conductor devices. (Unit I)
2) Understand the AC to DC, DC to AC, and DC to DC converters. (Unit II)
3) To design a firing circuit that solves the specific control problem. (Unit III)
4) Understand the issues related implementation of drives & control. (Unit–IV and V)
5) Understand the recent trends in power converter technology. (Unit–I to V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓							
CO3		✓	✓						
CO4				✓	✓				
CO5				✓		✓		✓	

06PEXXX	ADVANCED TOPICS IN PID CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide knowledge about the advances in PID controller and adaptive PID control.
- To acquire knowledge in the basics of PID controller.
- To understand Anti-windup strategies.
- To study about PID controller design.
- To study about robust performance.
- To understand the need for Adaptive PID control.

Unit–I : Basics of PID Control

Introduction-feedback control-On-Off control-Three actions of PID control-Proportional, Integral and Derivative actions-Structure of PID controllers-Modifications of the basic PID control law-Problems with derivative action-set point weighting-General ISA-PID control law-Digital implementation-Choice of the controller type. Derivative filter design: Introduction-The significance of the filter in PID design-Ideal Vs series form-Simulation using Matlab.

Unit–II : Anti-Windup Strategies and Setpoint Weighting

Introduction-Integrator windup-Anti-windup techniques-Avoiding saturation-conditional Integration-Back-calculation-combined approaches-Automatic reset implementation- Simulation using Matlab.

Set point Weighting: Introduction-Constant set point weight design-Variable set point weighting: Methodology- Simulation using Matlab.

Unit–III : PID Controller Design

ZN and related methods- rule based empirical tuning- pole placement- lambda tuning- algebraic design- optimization methods- robust loop shaping and frequency response methods- IMC based PID tuning- Design for disturbance rejection.

Unit–IV : Robust Performance and Performance Assessment

Modeling uncertainty-performance in the presence of uncertainty-robust pole placement design for robust performance- PID controller performance assessment.

Unit–V : Adaptive PID Control

Auto tuning- Adaptive Technique-model based methods-rule based methods-Multi model based PID Controller design- nonlinear PID Controller design.

TEXT BOOKS

1) Antonio Visioli, Practical PID Control, Springer, 2006.
2) Karl J. Astrom and Tore Hagguland, Advanced PID Control, ISA Publications,2005.

REFERENCE BOOKS

1) G.J. Silva, Aniruddhadatta, SP.Bhattacharyya, PID control for time delay systems, Springer, 2005.
2) Q.G. Wang, Z. Ye, W.J. Cai, C.C. Hang, PID control for Multivariable Process, Springer, 2008.
3) Karl J. Astrom and Tore Hagguland, PID Controllers: Theory, Design and Tuning, Second edition, ISA Publications, 1995.

COURSE OUTCOMES

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

1) Understand the basics of PID control.(Unit I)
2) Implement Anti-windup strategies.(Unit II)
3) Design a PID controller.(Unit III)
4) Understand the robust performance.(Unit–IV :)
5) Understand the need for Adaptive PID control. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓					
CO2		✓	✓	✓					
CO3		✓	✓	✓	✓				
CO4		✓	✓	✓					
CO5		✓	✓	✓					

06PEXXX	SOFT COMPUTING TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To expose the students to the concepts of Neural Networks, Fuzzy Logic andGenetic Algorithm.
- To provide adequate knowledge of application of neural network and Fuzzy logic controllers to real time systems.
- To expose the ideas of GA in optimization and control.

Unit–I

Motivation for the development of neural networks - Biological neural networks- Artificial neural networks - Application areas- Common activation functions-Biases and thresholds- Linear seperability- Data representation- Types of learning-Basic Learning laws: Hebb's rule - Delta rule -Widrow and Hoff LMS learning rule.

Unit–II

Architecture, Algorithm, Applications: McCulloch-Pitts Neuron-Hebb Net-Perceptron-Hopfield Neural net -Standard Back Propagation Neural Net.

Unit–III

Neural Networks based on Competition: Fixed-weight competitive nets - Kohonen self-organizing Maps - Adaptive Resonance Theory. Neural Network for Control: Neuro controller - Functional block diagram - Inverse dynamics – System identification. Case studies: Neuro controller for DC motor speed control - Neuro controller for a Temperature Process.

Unit–IV

Introduction to Fuzzy Logic: Fuzzy sets- Properties of Fuzzy sets- Operations on Fuzzy sets-Fuzzy relations: Operations- Properties. Fuzzy Cardinality- Fuzzy tolerance and Equivalence relations- λ- cuts for fuzzy relations-Fuzzification - Membership functions- Membership value assignments- Linguistic variables - Linguistic approximation-Fuzzy statements: Assignment statements - conditional statements- unconditional statements. Fuzzy rule base: Canonical rule formation-decomposition of compound rules. Defuzzification methods.

Unit–V

Fuzzy logic Control system- Fuzzy logic Controller for a temperature process-Introduction to neuro-fuzzy and fuzzy-neuro control systems-Introduction to GA.

TEXT BOOKS

1) LaureneFausett, Fundamentals of Neural Networks, Pearson Education Pvt.Ltd, India, 2013.
2) Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons Ltd., India, 2014.

REFERENCE BOOKS

1) Yegna Narayanan, Artificial Neural Networks, Eight Edition, PHI Learning Pvt. Ltd. New Delhi, 2003.
2) Simon Haykin Neural Networks, Fifth Edition, Pearson Education. Pvt. Ltd, 2005.
3) Sudarshan K. Valluru and T. NageswaraRao, Introduction to Neural Networks,Fuzzy Logic and Genetic algorithms, Jaico Publishing Home, 2010.
4) David.E.Goldberg, Genetic Algorithm in Search, Optimization and Machine learning, Fourth Edition, Pearson Education Pvt. Ltd., India, 2009.
5) ChanderMohan, An introduction to Fuzzy set theory and Fuzzy Logic, MV Learning, 2015.

COURSE OUTCOMES

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

1) Understand the basics of neural networks.(Unit I)
2) Derive the different algorithms. (Unit II)
3) Understand the concept of neuro controller. (Unit III)
4) Understand the basics of fuzzy logic controller (Unit–IV)
5) Understand the concept of fuzzy control. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2		✓		✓					
CO3		✓		✓	✓			✓	✓
CO4	✓	✓		✓				✓	
CO5		✓		✓	✓			✓	✓

06PEXXX	VLSI SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide a survey of VLSI design, emphasize on Intellectual property (IP) based design, introduce basic concepts and tools for layout design.
- To understand design of combinational logic gates and functions, IP based design at gate level.
- To learn the basic model, optimization, implementation, verification and testing methods for sequential machine design.
- To learn design of subsystem level components and building of subsystem level IP.
- To acquire the knowledge of floor plan design methodologies, chip-level layout and circuit design with area, delay and power optimization.
- To learn about register transfer design, architecture design for low power systems and IP components in architecture design.

Unit–I : Digital Systems and VLSI Design

Applications and advantages of VLSI systems- A survey of VLSI manufacturing and Design- CMOS technology-Integrated circuit design techniques-Intellectual property (IP) based design.

Unit–II : Layout Design and Logic Gates

Fabrication processes-Transistors- Wires and vias- Fabrication theory and practice- Layout design and tools. Combinational logic functions-static complementary gates-switch logic-Alternative Gate circuits-Low power gates- Delay through resistive interconnect- Delay through Inductive Interconnect- Gates as IP.

Unit–III : Combinational Logic Networks and Sequential Machines

Standard cell-based Layout - Combinational network delay - Logic and interconnect design - power optimization - switch logic networks. Latches and Flip-flops-sequential systems and clocking disciplines- Performance analysis - clock generation - Sequential system design- power optimization - design validation and sequential testing.

Unit–IV : Subsystem Design and Floor Planning

Introduction - Combinational Shifters - Adders - ALUs - Multipliers - High density memory - Image sensors - FPGAs - PLAs - Buses and networks On-chips -

Data paths - Subsystems as IP. Introduction - Floor planning methods - Global interconnects - Floor Plan design - Off-chip connections.

Unit–V : Architecture Design

Register Transfer Design- Pipelining - High level synthesis- Architectures for low power design - GAL systems - Architecture testing - IP components - Design methodologies- Multiprocessor system-on-chip design.

TEXT BOOKS

1) Wayne Wolf, Modern VLSI Design, Fourth Edition, Prentice Hall India, 2010.
2) Douglas A.Pucknell and Kamran Eshraghian, Basic VLSI Design, Third Edition, Prentice Hall of India, 2011.

REFERENCE BOOKS

1) Neil H. E. Weste and David Harris, Principles of CMOS VLSI Design, Fourth Edition, Addison Wesley, 2010.
2) Caver Mead and Lynn Conway, Introduction to VLSI Systems, BS Publications, 2008.
3) M. John and S. Smith, Application-Specific Integrated Circuits, Addison-Wesley, 1997.
4) Neil H. E. Weste, Kamran Eshraghian, and Micheal John Sebastian Smith, Principles of CMOS VLSI Design - A Systems Perspective, Addison Wesley, 2001.

COURSE OUTCOMES

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

1) Perform IP based design. (Unit I)
2) Handle technology dependent parameters in the fabrication process effectively. (Unit II)
3) Perform delay analysis and testability properties of combinational logic networks including both interconnect and gates.(Unit–III & Unit–IV)
4) Design an architecture that executes the desired function and that meets area, performance and testability constraints.(Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓	✓						
CO3		✓	✓	✓					
CO4			✓	✓					✓

06PEXXX	BIOMEDICAL INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the physical foundations of biological systems and the various electrodes used in medical field.
- To have a detailed understanding about the various electro physiological measurements in the human body.
- To gain knowledge on the measurement of non-electrical parameter in the human body.
- To understand the basic concepts of various medical imaging techniques and their applications.
- Understand medical assisting and therapy equipments.

Unit–I

Introduction, generalized medical instrumentation system, components of instrumentation system, physiological systems of the body, cardiovascular system. Respiratory system, Nervous system, CNS, PNS, generation of bioelectric potentials, Action potential, Resting potential, Neuronal communication.

Unit II

The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, Pressure Transducers, Temperature transducers, pulse sensors, Basic recording system, Direct Writing recorder, UV recorders, Thermal array recorders, Electrostatic recorder, Instrumentation Tape recorder

Unit–III

Information content of an image, Modulation transfer function, Noise – equivalent bandwidth, generation of X-rays, X-ray machine, computed Tomography, Magnetic Resonance Imaging – Principle, Image reconstruction techniques, Basic NMR components, Ultrasonic Imaging systems – Types of ultrasound imaging, Applications of different scan, Bio Telemetry.

Unit IV

Electrocardiogram, Effects of artifacts on ECG recordings, ECG recorder Principles, EEG & EMG recorders, ERG, Phonocardiogram, stethoscope, BP measuring Instrument - Sphygmomanometer and cardiac catheterization, ultrasonic blood flow meter, Principle of Photoelectric calorimeter, computerized patient monitoring system. Respiratory rate – Gas volume – Flow rate of CO_2, O_2 in exhaust air - PH of blood, ESR, GSR measurements – Plethysmography.

Unit–V

Pacemaker systems – Different pacing modes of operation, Transcutaneous Electrical Nerve stimulation (TENS) – Stimulation modes & application techniques, surgical diathermy, Heart lung machine, Hemo Dialysis, Lithotripsy, Laser applications in medicine, and introduction to electrical safety.

TEXT BOOKS

1) Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, Biomedical Instrumentation and Measurements, Third Edition, PHI, 2011.
2) R.Anandanatarajan, Biomedical Instrumentation, PHI Learning, 2009.

REFERENCE BOOKS

1) Prof.Venkataram.S.K, Bio-Medical Electronics & Instrumentation, Galgotia Publications, 2000.
2) R.S. Khandpar, Hand Book of Biomedical Instrumentation and measurement, McGraw Hill publishing Co., 1990.
3) Aston, Principles of Biomedical Instrumentation and measurements, McGraw Hill publishing Co., 1990.
4) M. Arumugam, Biomedical Instrumentation, Anuradha Agencies Publishers, VidayalKaruppar, 612 606, Kumbakonam, R.M.S: 1992.
5) John. Can. Brown, Introduction to Bio Medical Equipment Technology, Pearson Education of ASIA, 2001.

COURSE OUTCOMES

1) To educate students on the various physiological systems of the human body. (Unit-I)
2) To impart knowledge on the electrodes and allied recorders so as to obtain measurements from the human body. (Unit-II)
3) To provide insight into advanced imaging systems. (Unit-III)
4) To study the various bio signals along with the principles of measurement. (Unit-IV).
5) To provide an exposure to the medical equipments/instruments used in various departments and laboratories of a hospital. (Unit-V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2			✓						
CO3			✓	✓					
CO4			✓	✓					
CO5			✓	✓					✓

06PEXXX	POWER PLANT INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce students to the general layout of thermal power plant and also construction and principle of operation of the different sensing and indicating devices used at thermal power plants.
- The combustion chemistry of boiler and its efficiency calculation will be explained to students and to study about the various control techniques used in thermal power plant.

- To explain the function of steam turbine and its associated parameter measurement and to elaborate different types of safety methods involved in thermal power plant.
- To introduce students the functions of nuclear power plant and also construction and principle of operation of the different sensing devices and control systems employed at nuclear power plants.

Unit–I : Overview of Thermal Power Generation and its Instrumentation

General layout of a typical thermal power plant-Feed water and steam flow circuit-cooling water circuit- Fuel-ash circuit-Air-flue gas circuit. Piping and Instrumentation diagram of a thermal power plant, basic processes in boilers. Fuel measurement- Review of pressure and temperature measurement- steam and water flow measurement. Instrument applications in power stations-Review of indicating and recording instruments, water level gauges for boiler drums, closed circuit television instruments, gas analysis meters, smoke measurement, dust monitor-measurement of impurities in feed water and instruments-instrument maintenance aspects.

Unit–II : Boiler Combustion Process and its Efficiency Calculation

Boiler control objectives- combustion of fuels (gaseous, liquid and solid), excess air requirement, combustion chemistry and products of combustion, requirement for excess combustion air – calculation of efficiency of boilers: input/output method, heat loss method.

Various Control methods employed in water circuit

Controls in water circuit-Boiler drum level control-Superheated steam temperature control- superheaters-steam temperature control-water side steam temperature control-strategies of steam temperature control and de-superheaters-fire side steam temperature control-Steam pressure control.

Unit–III : Various Control Methods Employed in Air-Fuel Circuit

Control in air-fuel circuit-Combustion control and Furnace draft control. Flue gas analysis trimming of combustion control systems-combustion control for liquid and gaseous fuel boilers- coal or solid fuel stokers- combustion control for stoker fired boilers-pulverised coal burning systems- combustion control for pulverised coal fired boilers.

Unit–IV : Instrumentation & Control System Used for Turbine and Safety Aspects of Boiler

Turbine monitoring and control: speed, vibration, shell temperature monitoring-lubrication for Turbo-alternator- Turbo-Alternator cooling system. Intrinsic and Electrical safety- Interlocks for Boiler operation-Computer based control and data logging systems- Application of DCS in thermal power plant.

Unit–V : Nuclear Power Plant Instrumentation

Important components in instrumentation and control for nuclear power plant-Sensors and measurement systems for nuclear power plant-nuclear reactor control systems- Digital architectures in nuclear power plant-Radiation protection and monitoring.

TEXT BOOKS

1) K.Krishnasamy and M.PonniBala, Power plant instrumentation, PHI, second edition, 2013.
2) B.G.Liptak, Instrumentation in Process industries, Vol. I and II, Chilton Book Co.,1973.

REFERENCE BOOKS

1) Sam.G.Dukelow, The control of boilers, Instrument society of America Press,1986.
2) Swapanbasu and Ajay debnath, Power Plant Instrumentation and Control Handbook: A Guide to Thermal Power Plants, Academic press, 2014.
3) Duncan Richardson, Plant Equipment & Maintenance Engineering Handbook, McGraw-Hill Education, 2014.

COURSE OUTCOMES

1) Ability to understand the function of boiler and also P&ID of thermal power plant.(Unit I)
2) Ability to understand the types of measuring equipment used in thermal power plant. (Unit–I and II)
3) Ability to identify and analyze the specific features of different types of control techniques used in Boilers.(Unit III)
4) Ability to understand the function of turbine and its lubrication method and understand the various safety methods involved in the proper functioning of thermal power plant. (Unit–IV)
5) Ability to understand the function of nuclear power plant, various sensors, control loops and safety measures employed in nuclear power plant. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				
CO2		✓							
CO3			✓	✓	✓				
CO4					✓				
CO5									

06PEXXX	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide basic knowledge of optical fibers and their properties.
- To expose adequate knowledge about the Industrial applications of optical fibers.
- To disseminate the students, the fundamental characteristics and types of optical laser.
- To illustrate the industrial applications of optical laser.
- To provide adequate facts about holography and medical applications of optical laser.

Unit–I

Principles of light propagation through a fiber - Basic optical laws and definitions - Different types of fibers and their properties, fiber characteristics – Wave Propagation-Fiber Losses– Dispersion – Connectors and splicers – Optical sources and detectors.

Unit II

Fiber optic sensors – Measurement of pressure, temperature, current, voltage and liquid level – Polarimetric fiber sensor – Interferometric method of measurement of length – Moire fringes - Optical Multiplexer.

Unit–III

Laser Principles: Absorption process – Emission process - Fundamental characteristics of lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching – Types of lasers: Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

Unit–IV

Laser for measurement of distance, length, velocity, acceleration and current, voltage – Material processing: Laser heating, welding, melting and trimming of material – Laser spectroscopy.

Unit–V

Holography - basic principles - Holography for NDT - medical application of lasers: laser and tissue interaction, laser instruments for surgery, removal of tumors of vocal chords, brain surgery, plastic surgery, gynecology, and oncology.

TEXT BOOKS

1) Keiser, Optical Fiber Communication Systems, McGraw Hill Ltd., 2008.
2) S.Nagabhushana and N.Sathyanarayana, Lasers and Optical Instrumentation, I.K.International publishing, 2010.

REFERENCE BOOKS

1) Govind P. Agrawal, Fiber-Optic Communication Systems, 4th Edition, Wiley publication, 2010.
2) Pallab Bhattacharya, Semiconductor Opto-Electronics, PHI, 2002.
3) John and Harry, Industrial lasers and their application, McGrawHill,2002.
4) Introduction to H pology, CRC press, 2012.

COURSE OUTCOMES

1) Understand the Characteristics and properties of optical fibers. (Unit I)
2) Use of optical fibers in industries. (Unit II)
3) Identify the characteristics and principles of optical lasers. (Unit III)
4) Development of optical laser in industry applications. (Unit–IV :)
5) Applications of lasers in medical electronics. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓	✓							
CO3	✓	✓							
CO4	✓	✓	✓		✓				
CO5	✓	✓	✓		✓				

06PEXXX	UNIT OPERATIONS AND CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

The objectives of this course are to:

- Cover issues related to the definitions and principles of unit operations and unit systems.
- Provide thorough knowledge of fluid mechanics and its types of flow.
- Discuss about the heat transfer and its applications elaborately.
- Explain the concepts of mass transfer and its applications in detail.
- Learn thoroughly the concepts of control systems with multiple loops and plant wide control strategy and its implementation to the unit systems.

Unit–I : Introduction

Definitions and principles: Unit Operations - Unit Systems - Dimensional analysis-Basic concepts-Fluid Mechanics: Fluid statics and its applications: Hydrostatic Equilibrium-Application of fluid statics – Fluid flow phenomena: Laminar flow, Shear rate and Shear stress- Rheological properties of fluids – Turbulence – Boundary layers - Basic equations of fluid flow: Mass balance in flowing fluid; continuity – Differential momentum balance; Equations of motion.

Unit–II : Heat Transfer and its Applications

Heat transfer by conduction: Basic law of conduction - Steady state conduction – Unsteady state conductions- Principles of heat flow in fluids: Typical heat exchange equipment – Energy balances - Heat flux and heat transfer coefficients - Rate of heat transfer – Heat exchange Equipments: Types of heat exchangers, condensers and evaporators – Performance of tubular evaporators – Vapour recompression.

Unit–III : Mass Transfer and its Applications

Mass transfer theories – Mass transfer coefficients - Distillation: Flash distillation - Continuous distillation with reflux – Reflux ratio - Batch distillation – Definition of leaching and extractions: Leaching equipment – Liquid extraction equipment – Supercritical fluid extraction method – Drying of solids: Principles of drying – Drying equipments – Membrane separation process: Separation of gases – Separation of liquids.

Unit–IV : Control Systems with Multiple Loops

Cascade control: Cascade control for jacketed CSTR, Heat exchanger, Distillation column, Process furnace – Dynamic characteristics of cascade control – Selective control systems: Override control – Protection of boiler system, compressor system and steam distribution system –Auctioneering control and its examples – Split range control: Chemical reactor and Steam header.

Unit–V : Plant Wide Control

Plant wide control: Introduction – Block diagram descriptions only: Steady-state and dynamic effects of recycle- Unit operations: Supply side Vs Demand side – Compressor control – Heat exchangers – Adiabatic plug flow reactors – The control

and optimization hierarchy – Petroleum refining example - Case Study: Reactor / Flash unit plant and Distillation columns.

TEXT BOOKS

1) Warren L. McCabe, Julian C. Smith, Peter Harriot, Unit operations of Chemical Engineering, 7th edition, McGraw Hill publication, 2014.
2) George Stephanopoulous, Chemical Process Control: Introduction to Theory and Practice, Pearson Education, 2015.

REFERENCE BOOKS

1) B. Wayne Bequette, Process Control: Modelling, Design and Simulation, Prentice Hall of India, 2004.
2) Dale E. Seborg, Thomas.F.Edgar, Duncan A.Mellichamp, Process Dynamics and Control, 3rd Edition Wiley India Publication, 2010.
3) H.ScottFogler, Elements of Chemical Reaction Engineering, 3rd Edition, Prentice Hall of India, 2015.
4) I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publication, 2013.
5) Gade Pandu Rangaiah and Vinay Kariwala, Plantwide Control: Recent Developments and Applications, Wiley Publications, 2012.
6) William L. Luyben, Bjorn D.Tyreus, Michael L.Luyben, Plantwide Process control, McGraw Hill, 1999.
7) Christie John Geankoplis, Transport Processes and Separation Process Principles, Pearson Education, 4th Edition, 2003.

WEB RESOURCES

- nptel.ac.in
- www.unitoperation.com

COURSE OUTCOMES

At the end of the course the student will be able to:

1) Understand the definitions and basic principles of unit operations and unit systems.(Unit I)
2) Acquire a thorough knowledge of fluid mechanics and its types of flow.(Unit II)
3) Gain sound knowledge on heat transfer and its applications.(Unit III)
4) Imbibe the concepts of mass transfer and master its applications.(Unit IV)
5) Analyze the significance of control systems with multiple loops and plant wide control strategy.(Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓				✓				
CO3	✓				✓				
CO4	✓				✓				
CO5	✓	✓	✓						

06PEXXX	NON LINEAR CONTROL SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To give exposure to nonlinear control and to discuss about the stability and applications of non linear systems.
- To acquire knowledge in the basics of nonlinear control.
- To understand the describing function analysis.
- To study about stability analysis.
- To study about nonlinear control system design.
- To understand the need for sliding mode control.

Unit–I : Non Linear Systems

Non-linear Systems - Behavior of non-linear systems, jump resonance, subharmonic oscillation- Phase plane analysis: Singular points - construction of phase portraits using isoclines and delta method - limit cycles-existence of limit cycles.

Unit–II : Describing Function Analysis

Describing Function Analysis: Describing Function Fundamentals-Applications of Describing Functions-Basic Assumptions and definitions-Computing Describing Functions. Common nonlinearities in control systems-Describing Functions for common nonlinearities. Describing Function Analysis of Non-linear Systems-examples.

Unit–III : Stability Analysis

Stability analysis: Stability in the sense of Lyapunov's - second method of Lyapunov's - Lyapunov's stability analysis of linear time invariant systems and nonlinear system- Krasovskii's theorem- variable gradient method of generating Lyapunov's functions.

Unit–IV : Modelling and Control of Non-Linear Systems

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification –Real-time parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies.

Feedback Linearization-Input-state and Input-output linearization using Lie derivative and lie brackets.

Unit–V : Sliding Control

Sliding Control: Sliding Surfaces- sliding condition-Filippov's construction of the equivalent dynamics –examples. Direct implementation of Switching control laws-Switching control in place of PWM and Dither signals. Continuous Approximations of switching control laws.

TEXT BOOKS

1) I.J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New AgeInternational (P) Ltd., Publishers, 2005.
2) Gibson, J.E, Nonlinear Automatic Control, McGraw Hill Book Co, 1963.

REFERENCE BOOKS

1) Hassan K Khalil, Nonlinear Systems, Prentice Hall, 2002, Third Edition, 2002.
2) HenkNimeijer, Nonlinear Dynamical Control Systems, Springer Verlag,NewYork, 1990.
3) Alberto Isidori, Nonlinear Control Systems (3rd edition), Springer Verlag, 1995.
4) Jean-Jacques Slotine and Weiping Li, Applied Nonlinear Control, Prentice Hall, New jersey, 1991.
5) K.M.Hangos,J.Bokor and G.Szederkrnyi, Analysis and control of Nonlinear Process systems, Springer

COURSE OUTCOMES

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

1) Understand the basics of nonlinear systems.(Unit I)
2) Derive the describing function. (Unit II)
3) Understand the stability analysis of nonlinear systems. (Unit III)
4) Implement modelling of nonlinear systems and feedback linearization design. (Unit–IV)
5) Understand the recent trends in sliding mode control. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				
CO2		✓							
CO3		✓		✓				✓	✓
CO4		✓		✓				✓	✓
CO5	✓				✓			✓	✓

06PEXXX	OPTIMAL CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To study about the statement of optimal control problem, formulation of optimal control problem and selection of performance measure.
- To introduce students to the fundamental concepts of calculus of variation.
- To understand the concepts of variational approach to optimal control problems.
- To derive the expression for continuous and discrete linear optimal regulator problem.
- To study about the concepts of dynamic programming and its application.

Unit–I : Optimal Control Problems and Performance Measures

Statement of optimal control problem - problem formulation and forms of optimal control - selection of performance measures.

Unit–II : Calculus of Variation

Fundamental concepts – extremum functionals involving single and several independent functions - piecewise smooth extremals - constrained extrema.

Unit–III : Variational Approach to Optimal Problems

Necessary conditions for optimal control - Pontriyagin's minimum principle - state inequality constraints - minimum time problem - minimum control effort problems.

Unit–IV : LQ Control Problem

Linear optimal regulator problem - Matrix Riccati equation and solution method - choice of weighting matrices - steady state properties of optimal regulators - linear tracking problem.

Unit–V : Dynamic Programming

Principle of optimality - recurrence relation of dynamic programming for optimal control problem - computational procedure for solving optimal control problems - characteristics of dynamic programming solution - dynamic programming application to discrete and continuous systems - Hamilton Jacobi Bellman equation.

TEXT BOOKS

1) D.E.Kirk, Optimal Control Theory-An Introduction, Dover Publications, New York, 2012.
2) Michael Athans and Peter L. Falb, Optimal Control: An Introduction to the Theory and Its Applications, Dover Publications, New York, 2007.

REFERENCE BOOKS

1) Katruhiko Ogata, Modern Control Engineering, Prentice Hall of India Ltd, Fifth Edition, 2010.
2) M.Gopal, Modern Control Systems Theory, Third Edition, New Age International Publishers, 2015.

COURSE OUTCOMES:

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

1) Ability to understand the optimal control problem formulation and its selection of performance measures.(Unit I)
2) Ability to recognize and recall the fundamentals of calculus of variation.(Unit II)
3) Ability to implement optimal control concept for minimum time and minimum control effort problems. (Unit III)
4) Ability to apply Matrix Ricatti Equation for real world problem. (Unit–IV)
5) Ability to understand the concepts of dynamic programming. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓	✓						
CO3	✓	✓	✓						
CO4	✓	✓	✓		✓				
CO5	✓	✓	✓		✓				

06PEXXX	MODEL PREDICTIVE CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the fundamentals of model predictive control.
- To study the methods of predictive control.
- To analyse the implementation issues of MPC.
- To design and implement MPC algorithm for the given process.

Unit–I : Model Predictive Control

Introduction to Model Predictive Control strategy – Model predictive control elements – Prediction model, process model – Objective function – Control law – State space formulation.

Unit–II : Model Predictive Control Schemes

Dynamic matrix control – Model algorithmic control - Predictive functional control -Formulation of generalized model predictive control – Closed loops relationships.

Unit–III : Constrained model predictive control scheme

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

Unit–IV : Methods for implementing Model Predictive Control

Model predictive control and multi-parametric programming - Implementation of model predictive control for uncertain systems - Implementing Nonlinear Model Predictive Control Scheme-Closed loop min-max model predictive control implementation and dead time consideration.

Unit–V : Case studies

Self tuning GPC strategy and gain scheduling GPC for solar power plant – Design of MPC for a petrochemical industries.

TEXT BOOKS

1) E.F.Camacho and C.Bordons, Model Predictive Control, Springer, Second corrected Edition 2007.
2) B.W. Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall, 2003.

REFERENCE BOOK

1) Seborg Edgar, Mellichamp.Doyle, Process Dynamics and Control John Wiley & Sons Pvt. Ltd., Third Edition 2013.

REFERENCE JOURNAL

1) Carlos E.Garcia et.al, Model Predictive Control: Theory and Practice A Survey, Automatica, vol. 25, issue 3, pp. 335-348, May 1989.

COURSE OUTCOMES

After completion of this paper the student will understand

1) The basics of MPC including tuning parameters such as prediction horizon, control horizon and control weight. (Unit I)

2) The basics of Dynamic matrix control and model algorithmic control.(Unit II)
3) Effect of tuning parameters on control performance, stability and ability to handle constraints. (Unit III)
4) Development of various methods of MPC algorithm. (Unit–IV)
5) Implementation issues and applications of MPC in industry.(Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓					
CO2	✓	✓		✓					
CO3	✓	✓		✓					
CO4	✓		✓	✓					
CO5			✓	✓	✓	✓		✓	

06PEXXX	FAULT DETECTION AND DIAGNOSIS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand different faults that occurs in sensors and actuators.
- To identify kind, size and magnitude of the fault by model based and model free methods.
- To understand the structured residuals and directional structured residuals.
- To understand the methods to estimates the faults.

Unit–I : Introduction to Fault Detection and Diagnosis (FDD)

Scope of FDD: Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances - Different issues involved in FDD Typical applications.

Unit–II : Analytical Redundancy Concepts

Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

Unit–III : Design of Structured Residuals

Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

Unit–IV : Design of Directional Structured Residuals

Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation- Introduction of Residual generation of parametric fault – Robustness Issues- Statistical Testing of Residual generators

Unit–V : Data Driven Methods

Principal Component Analysis – Partial Least Squares - Canonical Variate Analysis – Knowledge Based Methods.

TEXT BOOKS

1) Janos J. Gertler, Fault Detection and Diagnosis in Engineering systems, Second Edition, Marcel Dekker, 1998.
2) R. Isermann, Fault-Diagnosis Systems An Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2006.

REFERENCE BOOKS

1) L.H. Chiang, E.L. Russell and R.D. Braatz, Fault Detection and Diagnosis in Industrial Systems – Springer-Verlag-London, 2001.
2) Rami S. Mangoubi, Robust Estimation and Failure detection, Springer-Verlag, London 1998.

COURSE OUTCOMES

1) Ability to understand different approaches to Fault Detection and Diagnosis. (Unit I)
2) Ability to estimate the kind, size, type and time of occurrence of faults by analytical methods.(Unit II)
3) Ability to design and detect single and multiple faults using structured residual approach. (Unit III)
4) Ability to design and detect single and multiple faults using directional structured residual approach. (Unit–IV)
5) Ability to Understand the data driven methods like principle, partial least square methods etc., (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2		✓	✓	✓					
CO3			✓	✓					
CO4			✓	✓					
CO5				✓					

06PEXXX	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To study architecture of ARM processor.
- To introduce the concept assembly programming for ARM using THUMB instruction set.
- To understand the concept of interfacing of memory and peripherals to ARM PROCESSOR.
- To design operating system for ARM.

Unit–I : ARM Architecture

ARM architecture - RISC processor - ARM programming model - ARM development tools – Arm organization and implementation - 3 stage and 5 stage pipeline ARM organization – ARM instruction execution - ARM implementation – ARM co processor interface.

Unit–II : ARM Assembly Programming

ARM assembly programming - data processing and transfer instructions – control flow instructions – conditional execution –branch instructions - Co processor instructions – data operations – register transfer –break point instruction – memory faults –Arm architecture variants - writing simple assembly language programs .

Unit–III : THUMB Instruction Set

The THUMB Instruction set - Thumb programmer's model – Thumb branch instruction – Thumb software interrupt and data processing instructions – Thumb single and multiple register data transfer instructions – Thumb implementation – Thumb applications.

Unit IV System Development

Architectural support for system development – ARM memory interface – advanced microcontroller bus architecture - ARM reference peripheral specification – hardware system prototyping tools – ARMualtor – JTAG boundary scan test architecture – embedded trace – signal point support –ARM processor cores – ARM7TDMI – ARM 8.

Unit V Operating System

Architectural support for operating system – ARM system control coprocessor – CP15 protection unit registers – ARM protection unit – CP15 MMU registers – ARM MMU architecture - synchronization – context switching – Embedded ARM applications – VLSI ruby II advanced communication processor – VLSI ISDN subscriber processor.

TEXT BOOK

1) Furber,S., ARM System on Chip Architecture Addison Wesley trade Computer Publication, 2000.

REFERENCE BOOKS

1) David seal,ARM architecture reference model, Addison Wesley, 2003.
2) Andrew sloss,Dominicsymes and chris wright, ARM system developers guide Morgan Kaufmann.

COURSE OUTCOMES

1) Understand the basis of RSIC processor. (Unit I)
2) Programming the ARM processors.(Unit II)
3) Design of operating system for advanced microcontrollers.(Unit III)
4) By the end of this course, the students will be able to know about the functions and operations of the ARM processor and develop assembly code for various applications.(Unit–IV and V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓								
CO3	✓		✓						
CO4	✓			✓					

06PEXXX	EMBEDDED SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the basis of embedded system components
- To learn concept of embedded networking and various buses
- To study embedded programming using embedded C
- To study basis RTOs
- To design embedded system for real time applications

Unit–I : Introduction to Embedded Systems

Definition and Classification – Overview of Processors and hardware units in an emedded system – Embedded Systems on a Chip (SoC) –memory organization-structural units in a processor-processor selection for an embedded system-memory selection -interfacing processor ,memories and I/O devices-Development and debugging-Embedded network-Distributed embedded architectures – networks for embedded systems – I^2C bus – CAN bus.

Unit–II : PIC Microcontroller

Overview of PIC 18 family- PIC 18 architecture – Pin configuration – RSIC architecture - Instruction set – Addressing modes - I/O port programming – Timer – serial port – Interrupt programming.

Unit–III : Embedded Programming

Embedded programming – modular and C code construction – creating and accessing data in C – C programming structures – programming elements – queues – stacks - list and order lists - C Cross compilers – introduction RAID and KEIL – writing simple programs in embedded C.

Unit–IV : Real Time Operating System

Real Time operating system- operating system services – network operating system - multiple tasks and multiple processes – processes – context switching – scheduling polices – Interprocess communication mechanisms – evaluating operating system performance – power optimization strategies for process –use of Micro C/OS-II and Vx Works.

Unit–V : System Design Techniques

System design techniques – design methodologies – requirement analysis – specifications – quality assurance – design example – telephone PBX – Ink jet printer – set top boxes – smart card.

TEXT BOOKS

1) Rajkamal, Embedded Systems Architecture, Programming and Design, Tata McGraw Hill,2004.
2) Muhammad ali mazidi, Rolin Mckinlay and Danny Causey,PIC Microcontroller and Embedded system, Pearson eduction,2008.

REFERENCE BOOKS

1) Steve Heath, Embedded Systems Design, Newnes.
2) David E. Simon, An Embedded Software Primer, Pearson Education.
3) Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Harcourt India, Morgan Kaufman Publishers
4) Todd D.Morton,' Embedded microcontroller' pearson education - 2003
5) Frank Vahid and Tony Givargis,Embedded Systems Design- A Unified Hardware/ Software Introduction, John Wiley & Sons.

COURSE OUTCOMES

1) Understand the basis of embedded system and embedded networking. (Unit I)
2) Learn the architecture and programming of PIC18.(Unit II)
3) Design of embedded networking.(Unit III)
4) Design of embedded system using Embedded C and RTOS.(Unit–IV)
5) By the end of this course, the students will be able to formulate design and analyze any embedded system for real time applications. (Unit V)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓								
CO3	✓		✓						
CO4	✓		✓	✓					
CO5	✓			✓				✓	

LIST OF PROFESSIONAL ELECTIVES LAB (EP-LAB)

06EPXXX	ELECTRICAL MEASUREMENTS LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To equip students with knowledge about B-H characteristics and determination of characteristics of ring specimen and transformer core.
- To familiarize the calibration methods for the calibration of various types of Energy meter, ammeter, voltmeter, wattmeter and DC potentiometer.
- To impart knowledge about various bridge circuit measurement methods for important electrical parameters such as resistance, inductance and capacitance.

LIST OF EXPERIMENTS

1) Determination of B-H curve of a given ring specimen using Ballistic Galvanometer.
2) Determination of B-H loop in a transformer core using C.R.O.
3) Calibration of single phase Energy meter.
4) Inductance measurements.
    a) Anderson's bridge
    b) Hay's bridge
5) Calibration of Ammeter, Voltmeter, Wattmeter using DC Potentiometer.
6) Calibration of Three Phase three wire Energy meter.
7) Calibration of three phase four wire Energy meter.
8) Measurement of capacitance using
    a) Schering Bridge
    b) Desauty Bridge
9) a) Three ammeter three voltmeter methods.
    b) Measurement of ABCD constant of a short transmission line.
10) Measurement of resistance using.
    a) Kelvin's double bridge
    b) Wheat's stone bridge

COURSE OUTCOMES

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

1) Select and apply proper measuring bridge circuit for the measurement of various electrical parameters such as resistance, inductance and capacitance.
2) Incorporate the knowledge gained on B-H characteristics for the selection of materials and design of systems.
3) Apply the calibration methods for the calibration of various types of Energy meter, ammeter, voltmeter, wattmeter and DC potentiometer.
4) Design and develop measuring systems suited for any branch of engineering.

Mapping with Program Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓	✓	✓						
CO3	✓								
CO4					✓			✓	

06EPXXX	INSTRUMENTATION SYSTEM DESIGN LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

- To impart knowledge about the implementation of Auto/Manual switch in PID controller.
- To study and implement anti-reset windup scheme and various practical forms of PID controller
- To design and implement an electronic PID controller
- To design and implement signal conditioning circuits for various process.
- To learn the design and development procedure of cold junction compensation scheme using RTD

LIST OF EXPERIMENTS

1) A) Implementation of Auto/Manual switch in PID controller
2) B) Design of an Annunciator circuit using PLC
3) A) Implementation of anti-reset windup scheme
4) B) Implementation of practical forms of PID controller
5) Design and implementation of electronic PID controller
6) Realization of first order and second order systems with dead time using electronic circuits
7) Design and implementation of cold junction compensation scheme using RTD
8) A) Design and simulation of two position controller for a Thermal process using Electronic Work Bench (EWB) software
   B) Design of Alarm circuit using Logic gates.
9) Design of Signal conditioning circuit for the given process
10) A) Design of control valve sizing
    B) Design of an orifice

COURSE OUTCOMES

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

1) To implement the Auto/Manual switch in PID controller
2) To design practical forms of PID and anti reset windup scheme.
3) To design and implement electronic PID controller and to familiarize with cold junction compensation for Thermocouple using RTD.

Mapping with Program Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓				✓
CO2	✓	✓		✓	✓				✓
CO3	✓	✓		✓	✓				✓

06EPXXX	VIRTUAL INSTRUMENTATION LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the analog and digital measurement principles.
- Understanding Virtual Instrumentation concepts.
- To develop the basic skills in data acquisition operation.
- To motivate for creating virtual instruments for practical operations.

LIST OF EXPERIMENTS

1) Basic LabVIEW Programming - Part1.
2) Basic LabVIEW Programming - Part2.
3) Design of Virtual Digital Voltmeter using LabVIEW.
4) Design of Virtual Function Generator using LabVIEW.
5) Hardware & Firmware design for Programmable Digital Voltmeter.
6) Hardware & Firmware design for Programmable Function Generator.
7) DAQ Post processing and Report Generation.
8) Design of GUI using MATLAB.
9) Implementation of ECG signal processing algorithms using LabVIEW.
10) Realization of PID controllers using LabVIEW.

COURSE OUTCOMES

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

1) Develop ability for programming in LabVIEW using different data structures and program structures.
2) Apply the basic knowledge of interfacing for GUI development.
3) Learn to acquire, condition, analyze and present the data from field instruments.
4) Develop LabVIEW skills to engineer advanced computer based instrumentation.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓						
CO2				✓					
CO3	✓								
CO4		✓							

06EPXXX	INDUSTRIAL INSTRUMENTATION LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To study the characteristics of convertors, square root extractor and transmitters
- To design and implement ON/OFF control, single speed floating ontroland averaging control
- To study the P&I diagram
- To study pneumatics
- To design and implement pH measurement system
- To linearize thermocouple using LABVIEW software

LIST OF EXPERIMENTS

1) Study of characteristics of I/P and P/I convertors.
2) Study of characteristics of Square root extractor.
3) Design and implementation of ON/OFF temperature control system.
4) (a) Characteristics of Single speed floating control.
   (b) Study of P & I Diagram
5) Characteristics of strain measurement system using cantilever beam set up.
6) (a) Design & simulation of Averaging Control.
   (b) Study of Pneumatics.
7) Determination of characteristics of capacitive level transmitter.
8) Design and Determination of characteristics of temperature transmitter.
9) Design and implementation of pH measurement system.
10) Study of Linearization of Thermocouple using Lab View.

COURSE OUTCOMES

1) Ability to design components of control system like transmitters, convertors and controllers
2) Ability to analyze and design the characteristics of ON/OFF, single speed floating and averaging control.
3) Ability to design signal conditioning circuits.
4) Ability to use both software and hardware tools.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2	✓	✓	✓						
CO3	✓	✓	✓						
CO4				✓					

06EPXXX	INDUSTRIAL AUTOMATION LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To introduce students, the broad knowledge of essential component of present industrial Automation Industry such as Programmable Logic Controller (PLC), Distributed Control System (DCS), Supervisory Control and Data Acquisition (SCADA)
- To Design and implement advanced control techniques
- To enable the students to connect and make use of Data Acquisition cards and connect them with the processes.

LIST OF EXPERIMENTS

1) Study of Closed loop Air flow control system.
2) Study of Programmable Logic Controller.
3) Design and implementation of P and PI controller for an Air temperature control system.
4) Design and simulation of Cascade Control System using MATLAB software.
5) Programmable Logic Controller Applications using KV – 16 Ladder builder software.
6) Study of SCADA software
7) PC based control of Air flow/pressure process using V-MAT data acquisition card.
8) Study of DCS.
9) Design and implementation of Feed forward – Feedback controller using SIMULINK.
10) Simulation and closed loop control of temperature process using LabView.

COURSE OUTCOMES

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

1) Describe working of various blocks of basic industrial automation system.
2) Connect the peripherals with the PLC
3) Use various PLC functions and develop small PLC programs
4) Summarize Distributed control system and SCADA system
5) Use Data Acquisition cards and control real time processes.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2				✓	✓				
CO3	✓	✓	✓	✓					✓
CO4			✓	✓					✓
CO5	✓	✓	✓		✓				✓

06EPXXX	PROGRAMMING LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To develop skills to design and analyse object oriented program.
- To strengthen the ability to identify and apply the suitable object oriented concept for the
- given real world problem
- To gain knowledge in practical applications of object oriented concept.
- Developing the logic to find solution to a given problem from semantic point of view.
- Importance of space and time complexity to enable writing a program which meets
- requirements of memory constraints and time constraints.

LIST OF EXPERIMENTS

1) Simple Exercise using C++
   i) Check for ODD or EVEN
   ii) Sum of the Digits
   iii) Print in words of the given number
   iv) Generate the Fibonacci series
   v) Conversion Algorithm
2) Find the Area of two Objects (Circle & Rectangle) using Function Overloading
3) Add 'N' Complex numbers using Operator Overloading
4) To add two Numbers using Single Inheritance
5) To Read and Write the information of Books using File in C++
6) To draw the Bar Chart for Student Result
7) To check where the given string is palindrome or not using pointers
8) To study different MATLAB Commands for Matrix Operations and Logical Operations

COURSE OUTCOMES

1) Competences to design, write, compile, test and execute straightforward programs using a high level language.
2) An awareness of the need for a professional approach to design and the importance of good documentation to the finished programs.
3) The students will learn to write, compile & execute basic c++ program.
4) The student will learn the use of data types & variables, decision control structures: if, nested if etc.
5) The student will learn the use loop control structures: do, while, for etc.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓	✓					✓
CO2			✓		✓	✓		✓	✓
CO3	✓	✓		✓			✓		
CO4		✓	✓			✓		✓	✓
CO5			✓	✓		✓	✓		

06EPXXX	DIGITAL SYSTEM DESIGN LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

This course prepares students to work professionally in the area of designing digital systems.

- To develop skills in digital systems design using HDL.
- To understand the concepts of HDL, structural, data flow and behavioral models.
- To understand fundamentals of digital circuit simulation.
- FPGA implementation

LIST OF EXPERIMENTS

1) Introduction to FPGA design tool Xilinx ISE 14.
2) Implementation of simple combinational logic, a three-bit binary adder.
3) Implementation of multiplexer, decoder and demultiplexer.
4) Implementation of RAM and ROM.
5) Implementation of flip-flops.
6) Implementation of shift register and sequence counter.
7) Implementation of an arithmetic unit.
8) Implementation of a control unit and data paths.
9) Implementation of a finite state machine.
10) Memory BIST.

COURSE OUTCOMES

This course makes significant emphasis on practical design techniques required for digital logic design, hardware engineering and implementation:

1) An ability to design a component, or a system to meet desired needs.
2) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
3) Use industry standard tools to analyze, design, develop and test computer-based systems containing both hardware and software components.
4) Continue to develop their knowledge and skills after graduation in order to succeed personally and contribute to employer success.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					
CO2		✓		✓					
CO3		✓		✓					
CO4				✓					

06EPXXX	MEMS SIMULATION LABORATORY	L	T	P
		0	0	3

COURSE OBJECTIVES

- To study the IntelliSuite and CoventorWare MEMS CAD tools.
- To study the fabrication procedure of MEMS devices.
- To fabricate various MEMS devices using MEMS design tools and test their performance characteristics by FEM analysis.

LIST OF EXPERIMENTS

Fabrication and Simulation of MEMS Devices using MEMS CAD Tools

1) Pressure sensor.
2) Electrostatic switch.
3) Capacitive pressure sensor.
4) Electrostatic cantilever actuator.
5) Piezoresistive pressure sensor.
6) Capacitive accelerometer.

COURSE OUTCOMES

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

1) Expertise knowledge of using IntelliSuite and CoventorWare MEMS CAD tools.
2) Understand the fabrication procedure of MEMS devices.
3) Fabricate various MEMS devices using MEMS design tools and improve their performance characteristics by FEM analysis.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					
CO2		✓	✓		✓				
CO3		✓						✓	✓

06EPXXX	BIOMEDICAL INSTRUMENTATION LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To train students in the practice of design, and analysis of biomedical systems, devices, diagnostics, and therapeutics.
- To learn the sources of bio-potentials in the human body, understand the techniques used for obtaining measurement of several electrical potentials.

- To introduce a wireless, multi-channel physiological recording platform of a bioelectric signal.
- To quickly analyze gait without the restraints of a gait laboratory, such as limited walking space with a portable and easy to use wireless wearable system.
- To determine a subject's hearing levels and also to measure the ability to discriminate between different sound intensities with the aim to diagnose hearing loss.
- To perform a treadmill test to determine how well the heart responds during times when it is stressed.

LIST OF EXPERIMENTS

1) Analysis of Standard ECG, Respiratory and Pulse Signals using Bio Simulator
2) Measurement of Cardiac Electrical Activity using single lead system
3) Measuring the volumes and capacity of lung using Spirometer.
4) Testing of ultrasound and interferential therapy.
5) Measuring the pulse of a person using pulse plethysmograph.
6) Quantitative Gait analysis using Biosensics.
7) Measurement of Auditory Signals using Audiometer.
8) Measurement of Cardiac Electrical Activity by TMT.
9) Testing and Analysis of Physiology of Brain using BIOPAC – EEG module and finding the power spectrum of the obtained EEG using Matlab.
10) Experimental analysis of the working principle of diathermy therapeutic equipment.

COURSE OUTCOMES

1) To introduce student to basic biomedical engineering technology.
2) To familiarize the students to understand, design and evaluate systems and devices that can measure, test and/or acquire biological information from the human body.
3) To make students familiar with the design/usage of sophisticated medical devices.
4) To provide an exposure and hands on training to the wired/wireless recording platform of medical equipments/instruments used in hospital laboratories.
5) To provide students with opportunities for an experiential learning approach based on biomedical applications.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓	✓	✓				✓
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓				
CO4	✓		✓	✓					
CO5	✓		✓	✓					✓

OE - OPEN ELECTIVES

06OEXXX	ROBOTICS AND AUTOMATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the basic anatomy of robots and trajectory planning
- list of objectives about the course
- To enable students to understand about the work envelopes of robots and
- its role in automation
- To give an overview of the various methods of control of robots
- To know about Factory automation
- To select robots based on their applications and their related issues in industrial automation

Unit–I : Fundamentals of Robots

Definition –Historical background- Robot Anatomy : Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration–Work volume– Robot Drive System : Hydraulic, Electric, Pneumatic – Control System: Limited sequence, Play back with point to point and Continuous path control Intelligent Robots- Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance – Introduction to End effectors, Robotic Sensors, Robot Programming and work cell control.

Unit–II : Robot End Effectors, Sensors

End Effectors: Types-Mechanical grippers-Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops- Tools as end effectors - Robot/ End-effectors interface- Consideration in Gripper selection and Design.

Sensors: Transducers and Sensors – Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems- Machine Vision System.

Unit–III : Programming and Control of Robots

Robot Programming: Methods of Programming-: Leadthrough Methods, Robot program as a path in space- Motion interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and limitations of Leadthrough Methods- Textual Robot Programming- structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands

Robot Control: Open and Closed loop control- control Problem- Linear control Schemes- Design of Partitioned PD, PID and Adaptive Controllers for Linear Second order SISO Model of robot and their Block schematic representation- Control of Industrial Robots Using PLCs.

Unit–IV : Automation

Factory Automation: Fixed Automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards

Automatic Feeders, Automatic Storage and Retrieval Systems (AS/RS), Transfer Lines, Automatic Inspection Systems

Unit–V : Applications of Robots

Factors influencing the selection of Robots – Robots for Welding, Painting, Assembly, Nuclear, Thermal and Chemical Plants.

Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots – Control and Safety Issues.

TEXT BOOKS

1) Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., Industrial Robots: Technology, Programming and Applications, McGraw-Hill Book Company, 2012.
2) Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.

REFERENCE BOOKS

1) Groover, M.P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice-Hall of India Private Limited, New Delhi, 2007
2) S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994
3) Yoran Koren, Robotics for Engineers, McGraw Hill, 1980.
4) Saeed B. Niku, An Introduction to Robotics- Analysis, Systems, Applications, Second Edition, John Wiley & Sons Inc., 2010.
5) Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.

COURSE OUTCOMES

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

1) Expertise in fundamentals of Robotics (Unit I)
2) Understand the issues related to end effectors and sensors (Unit II)
3) Acquire knowledge in Programming and control of Robots (Unit III)
4) Understand the issues related to implementation of Industrial Automation with Robot Application (Unit–IV :)
5) Gain an in depth understanding of the selection of robots for various application and their safety issues (Unit V)

	Mapping with Programme Outcomes								
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2	✓								
CO3				✓					
CO4		✓							
CO5					✓				

06OEXXX	NANO MATERIALS AND NANO ELECTRONICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To expose the students about the basics of Nanotechnology and its applications.
- To provide adequate knowledge on Nanomaterial properties, Quantum Mechanics and
- Nano electronics.
- To expose the knowledge on Nano electronics devices and its applications.

Unit–I

Introduction to nanomaterials - Preparation/Synthesis: History of nanomaterials - Influence on properties by "nano - structure induced effects" - Some present and future applications of Nanomaterials, Approaches for synthesis of nanostructures - Processes for producing ultrafine powders - Chemical Synthesis - Physical Synthesis – Bio mimetic processes.

Unit–II

Characterization and Properties of Nanomaterials: Structural Characterization - X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy - Mechanical - Introduction - Property changes due to nanostructuring - Strengthening and Toughening Mechanisms – Chemical – Sensors – catalysis – Magnetic- Magnetic Properties of small atomic clusters – Why interest in nano-scale magnetic materials- Classifications of magnetic nanomaterial – Optical-Absorption of light in semiconductor materials - Optical properties of a translucid object.

Unit III

Quantum Mechanics: Schrodinger – Time Dependent / Independent Equation-Electron to Electron Interactions-Differential to Matrix Equation-Choosing Matrix Parameters-Non-Equilibrium Green's Functions (NEGF)-Conductance Functions for Coherent Transport-Elastic Dephasing-Quantum of Conductance-2D Conductor as ID Conductors in Parallel.

Unit–IV

Fundamentals of Nano Electronics: The New Ohm's Law-The Bottom-Up Approach-Electrons Flow-Ballistic and Diffusive Transport-Diffusion Equation for Ballistic Transport-Conductivity, Drift-electrostatics- smart contacts. Nano transistors-current equation, physics of Ballistic MOSFET – characteristics.

Unit–V

Carbon Nanotubes :Graphene band structure, properties. Synthesis of Carbon Nanotubes – The Structure of Carbon Nanotubes, Carrier Concentration – Electronic properties of Nanotubes – Electron Transport in ballistic conductor – Carbon Nanotube Electronics: Theory of CNT P-N junction - Carbon Nanotube Transistors – density of states - Schottky Barrier – Ohmic Contacts– Schottky Contacts –Subthreshold Short- Channel Effects.

TEXT BOOKS

1) Nanostructures &Nanomaterial: Synthesis, Properties and Applications, Guozhong Cao, Imperial College Press - World Scientific Publishing Co. Ltd, London - 2004.
2) Lessons from Nano electronics. A New Perspective on Transport-SupriyoDatta, Purdue University, USA, 2012.

REFERENCE BOOKS

1) Janos H. Fendler, Nanoparticles and Nanostructured films: Preparation, Characterization and Applications, ISBN: 3527294430, Wiley VCH, 1998.
2) Kenneth J. Klabunde, Nanoscale materials in chemistry, ISBN: 0471383953, John Wiley &Sons, 2001.
3) Zhon Ling Wang, Characterization of Nano phase materials, ISBN: 3527298371, Wiley-VCH Verlag GmbH, 2000.
4) The physics of Carbon Nanotube Devices, ISBN: 978-0-8155-1573-9 François Léonard, 2009 by William Andrew.

COURSE OUTCOMES

1) Will get to know the future of electronics and its applications. (Unit I, II & IV)
2) Updates the students with the recent advancements in the nanotechnology. (Unit I, II & IV)
3) To introduce the students the concepts of quantum mechanics for analysis of nanoelectronic devices. (Unit III)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2		✓							
CO3			✓						

06OEXXX	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To expose the students to the fundamentals Micro electromechanical systems.
- To teach the fundamental concepts MEMS Fabrication process.
- To study the design concepts of MEMS devices.
- To compare types and Functionalities of various methods of micromachining.

Unit–I : Miniaturization of Systems

Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling in mechanical domain, Scaling in Electrostatic domain, Scaling in thermal domain.

Unit–II : Micromachining Technology

Silicon as a material for micromachining-Crystal Structure , Silicon Wafer Preparation- Thin Film Deposition –Evaporation, Sputtering, CVD, Epitaxial

Growth, Thermal Oxidation-Lithography – Photolithography , Lift-Off Techniques-Etching – Isotropic Etching, Anisotropic Etching, Etch Stops, Dry Etching - Silicon Micromachining – Bulk , Surface Micromachining – Specialized Materials for Microsystems-Polymers, Ceramic Materials- Advanced Process Of Micro fabrication-Wafer Bonding Techniques, Special Micro fabrication Techniques.

Unit–III : Silicon Capacitive Accelerometer

Overview, advantages of silicon capacitive accelerometer , typical applications, an example of a prototype, material used, fabrication process, principle of operation.

Piezoresistive pressure sensor**:** overview, advantages of piezoresistive pressure sensor, typical applications, material used, fabrication process, principle of operation, An example commercial Products.

Unit–IV : Modelling of Solids in Microsystems

The simplest Deformable Element: a bar- Transversely deformable Element: a beam- energy methods for elastic bodies- Bimorph effects.

Unit–V : MEMS Actuators and their Applications

Actuation mechanisms – Electrostatic actuation – Electrostatic cantilever actuators – Electrostatic comb drives – Feedback stabilization of electrostatic actuators - lectrostatic micro grippers – Electrostatic relays and switches - Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation.

TEXT BOOKS

1) G.K.Ananthasuresh, K.J.Vinoy,S.Gopalakrishnan, K.N.Bhat,V.K.Aatre, Micro and smart systems.
2) Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, Tata McGrawHill, New Delhi, 2002.

REFERENCE BOOKS

1) Stephen D. Senturia, Microsystem Design, Springer International Edition, 2001.
2) Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International,2006.
3) S.M. Sze, Semiconductor Sensors, John Wiley and Sons, 1994.
4) Gregory T.A. Kovacs, Micro machined Transducers, WCB McGraw Hill, 1998.

COURSE OUTCOMES

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

1) The fundamentals of Micro electromechanical systems and their applications will be studied. (Unit I)
2) The fundamental concepts of MEMS Fabrication process will be gained. (Unit II)
3) The design concepts of MEMS devices will be developed. (Unit II, III & IV)
4) The Functionalities of various methods of micromachining involved in different MEMS devices will be studied. (Unit V)

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓						
CO2					✓				
CO3					✓				
CO4			✓						

06OEXXX	CLOUD COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES

- Gives the Idea Of Evolution Of Cloud Computing
- Provides knowledge about Its Services Available Today
- Helps to the Design And Development Of Simple Cloud Service.
- Focused On Some Key Challenges And Issues Around Cloud Computing.

Unit–I : Introduction

Cloud-definition, benefits, usage scenarios, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing - issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.

Unit–II : Cloud Services

Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

Unit–III : Collaborating Using Cloud Services

Email Communication over the Cloud - CRM Management - Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.

Unit–IV : Virtualization for Cloud

Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.

Unit–V : Security, Standards and Applications

Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

TEXT BOOKS

1) John Rittinghouse & James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.
2) Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Que Publishing, August 2008.

REFERENCE BOOKS

1) David E.Y. Sarna Implementing and Developing Cloud Application, CRC press 2011.
2) Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3) Anthony T Velte, Toby J Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw-Hill 2010.
4) Haley Beard, Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.
5) G.J.Popek, R.P. Goldberg, Formal requirements for virtualizable third generation Architectures, Communications of the ACM, No.7 Vol.17, July 1974.

07OEXXX	BIOLOGY FOR ENGINEERS	L	T	P
		4	-	-

COURSE OBJECTIVES

- The course acts as a bridge between engineering and biology to provide basic understanding of biological mechanisms of living systems from engineering perspective.
- It will illustrate the many possible means to utilize living things' relevance to engineering principles.
- With substantial knowledge and continuing interest will make a student into a specialist in the technical diversity.

Unit–I : Requirements of Biological Systems

Biological Units Need Water; Biological Units Need the Right Amount of Oxygen; Biological Units Need Food and Nutrients; Biological Units Become Ill in the Presence of Wastes; Biological Units Need Heat Sources and Sinks.

Unit–II : Behavior of Biological Systems

Biological Units Adapt to Their Environments; Biological Units Modify Their Environments; Adaptations Require Extra Energy and Resources; Biological Units, If Possible, Move to Friendlier Environments; Biological Units Evolve under Environmental Pressures.

Unit–III : Response to Stress by Biological Systems

Crowding of Biological Units Produces Stress; Biological Units Are Affected by Chemical Stresses; Biological Units Respond to Mechanical Stresses; Optimization Is Used to Save Energy and Nutrient Resources; Biological Units Alter Themselves to Protect against Harsh Environments.

Unit–IV : Existence of Biological Systems

Biological Units Cooperate with Other Biological Units; Biological Units Compete with Other Biological Units; Biological Units Reproduce; Biological Units Coordinate Activities through Communication; Biological Units Maintain Stability

with Exquisite Control; Biological Units Go through Natural Cycles; Biological Units Need Emotional Satisfaction and Intellectual Stimulation; Biological Units Die.

Unit–V : Scaling Factors and Biological Engineering Solutions

Allometric Relationships from Evolutionary Pressure; Dimensional Analysis; Golden Ratio; Fractal Scaling within an Organism; Self-Similarity for Tissues and Organs; Self-Similarity in Populations; Systems Approach; Relationships between Engineering and Biology; The Completed Design.

TEXT BOOKS

Arthur T. Johnson, " Biology for Engineers", CRC Press, 2010

REFERENCE BOOKS

1) Aydin Tözeren, Stephen W. Byers, New Biology for Engineers and Computer Scientists, Pearson/Prentice Hall, 2004
2) S. Thyaga Rajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "Biology for Engineers," Tata McGraw-Hill, New Delhi, 2012.

COURSE OUTCOMES

1) The ability to understand the information known about familiar living systems.
2) The ability to anticipate the properties of an unfamiliar group of living things from knowledge about a familiar group.
3) The ability to demonstrate the relevance of engineering to biological systems.
4) The knowledge about the biological responses and it is scaling with respect to scientific principles that cannot be related back.
5) The knowledge of biological principles and generalizations that can lead to useful products and processes.
6) The ability to avoid or mitigate unintended consequences of dealing with any and all living system.

02OEXXX	DISASTER MANAGEMENT	L	T	P
		4	0	0

COURSE OBJECTIVES

This course helps in providing the basic concepts of disasters and also gives a thorough knowledge and experience to reduce disaster risks.

Unit–I

Introduction – Disaster- Characteristics and types of Disasters- Causes and effects of Disaster -Risk- Vulnerability – Preparedness- Disaster mitigation and disaster management- Classification of mitigation measures-Vulnerability Analysis-Observation and Perception of Vulnerability- Socio-Economic Factors of Vulnerability- Vulnerability in India- Disaster related policy goals of UNDP UNDRO and Govt. of India- Appraising disaster needs- Needs for technical expertise- Role of various Agencies in Disaster Management and Development -Disaster risk reduction planning- Role of Developmental Planning for disaster Management

Unit–II

Earthquake - Cause of Earthquake- General characteristics- Measuring Earthquakes- Distribution pattern of Earthquakes in India- Earthquake prone areas- case studies of important Indian earthquakes - Forecasting techniques and

risk analysis- Possible risk reduction measures- earthquake resistance buildings and re-engineering techniques in India.

Unit–III

Tsunamis- Causes of a Tsunami- General Characteristics- Tsunami warning system-Distribution pattern of Tsunami in India- Possible risk reduction measures-Integrated coastal zone management.

Landslides- Rock falls- Avalanches- Mud flows and glaciers- Landslides and rock falls- landslide hazard zonation- Instrumentation and monitoring- Techniques for reducing landslide hazards.

Unit–IV

Tropical cyclones- Structure of tropical cyclones- Nature of tropical cyclones-Cyclone experience in India and Tamilnadu- Preparedness- Tropical cyclones and their warning systems- Tropical cyclone warning strategy in India special nature of the problem in the region- Classification- Protection of buildings from cyclones of India- Precautions during and before cyclones.

Unit–V

Coastal floods- Intensification of hazards due to human interference-Management-River and coastal floods- Temperature extremes and wild fires-Physiological hazards- Flood forecasting-mitigation- planning- management- flood prone areas the Indian scenario- Flood experience in India and Tamilnadu.

Environmental hazards- Typology- Assessment and response- Strategies -The scale of disaster-Vulnerability- Disaster trends- Paradigms towards a balanced view- Chemical hazards and toxicology-Biological hazards- Risk analysis- Other technological disasters.

TEXT BOOKS

1) David R. Godschalk (Editor), Timothy Beatiey, Philip Berke,.David J. Browt:r, Edward J. Kaiser Charles C. Boh, R. Matthew Goebel, *Natural Hazard Mitigation: Recasting Disaster Policy and Planning* Island Press; (January 1999), ISBN) 559636025

2) Sinha, P.C. *Wind & Water Driven Disasters*, 1998, 250pp, Anmol Publications

REFERENCE BOOKS

1) Davide Wikersheimer *Windstorm Mitigation Manual for Light Frame Construction*, DIANE Publishing Co: (Paperback-May 1997)

2) Brown D *Redevelopment After the Storm: Hazard Mitigation Opportunities in the Post Disater Setting.* (Paperback – June 1985) Publisher: John Wiley & Sons ISBN:047191505X

3) Sinha, P.C. *Technological Disasters* , 1997, 516 pp Anmol Publications Trivedi,

COURSE OUTCOMES

1) Develop an understanding of the key concepts, definitions key perspectives of all Hazards Emergency Management.

2) Develop a basic under understanding of Prevention, Mitigation, Preparedness, Response and Recovery.

00OEXXX	ENTREPRENEURSHIP	L	T	P
		4	0	0

COURSE OBJECTIVES

- Develop an entrepreneurship sprit
- Help to identify business opportunities within an organization or independently
- Initiate action on the business plan from the prospective business through EDC.

Unit–I

Meaning – Characteristics of management – Nature of management – Process of management – Functional areas of management – Management and administration – Role of management – Level of management – Evolution of management.

Unit–II

Meaning - Nature of planning – Importance of planning – Types of planning – Steps in planning – Decision making – Meaning and definition of organizing – Steps in organizing – Nature of organization – Organization structure – Purpose of organization – Principles of organization – Delegation of authority – Nature and importance of staffing.

Unit–III

Meaning and nature of direction – Principles of directing – Leadership and leadership style – Motivation – Communication – Need and feedback in communication – Importance of communication – Channels of communication – Types of communication – Forms of communication.

Unit–IV

Evolution of concept of entrepreneur – Concept of entrepreneur – Characteristics of entrepreneur – Distinction between entrepreneur and manager – Technical entrepreneur – Charms of being an entrepreneur – Types of entrepreneur – Role of entrepreneurship in economic development – Barriers in entrepreneurship.

Unit–V

Meaning of project – Project classification – Project identification – Meaning and significance of project report – Contents of a project report – Formulation of project report – Planning commission guidelines – Identification of opportunity – Project feasibility study.

TEXT BOOKS

1) Veerabhadrappahavinal, *Management and entrepreneurship*, New age International, New Delhi, 2008.
2) Peter f. Drucker; I*nnovation and entrepreneurship, B*utterworth – Heinemann, London, 1985.

REFERENCE BOOKS

1) *"Creativity, innovation, entrepreneurship and enterprise in construction and development"*, University of Reading, Alan Barrell – Entrepreneur in Residence Entrepreneur in Residence, University of Xiamen, Xiamen 2012.

2) "*Entrepreneurship Studies*", National University Commission (Nigerian University System), 2010.

COURSE OUTCOMES

- At the end of this course the student should have an understanding about entrepreneurship. The students should have knowledge about the principles of business Plan.

00OEXXX	HUMAN RIGHTS	L	T	P
		4	0	0

COURSE OBJECTIVES

- At the end of this course the student is expected to understand what is human rights, how to obey the rights, what is the role of a human being in making a good society for the future generations.

Unit–I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human

Rights - Historical Development of Human Rights.

Unit–II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U .N .O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Convenant on Economic, Social and Cultural Rights and Optional Protocol.

Unit–III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

Unit–IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments -European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

Unit–V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment. Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

TEXT BOOKS

1) Desai, A.R. Violation of Democratic Rights in India, Sage Publishers, 1986.

2) S. Hick, E. Halpin and E. Hoskins, Human Rights and the Internet, Springer Publishers, 2000.

REFERENCE BOOKS

1) International Bill of Human Rights, Amnesty International Publication, London, 1988.
2) Human Rights, Questions and Answers, UNESCO, 1982
3) Mausice Cranston- What is Human Rights
4) Timm. R.W. - Working for Justice and Human Rights.
5) Human Rights, A Selected Bibliography, USIS.
6) Cheous K (Ed) - Social Justice and Human Rights (Vols 1-7).
7) Devasia, V.V. - Human Rights and Victimology.

00OEXXX	NATIONAL SERVICE SCHEME	L	T	P
		4	0	0

COURSE OBJECTIVES

- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving
- Develop capacity to meet emergencies and natural disasters
- Practice national integration and social harmony and
- Utilize their knowledge in finding practical solutions to individual and community problems.

Unit–I : National Service Scheme

A) History and its Objectives

B) Organizational structure of N.S.S. at National, State, University and College Levels

C) Advisory committee and their functions with special reference to college principal, Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

Unit–II : National Integration

A) Need of National integration

B) Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.

Unit–III : Special Programme

A) Legal awareness

B) Health awareness

C) First-aid

D) Career guidance

E) Leadership training - cum - Cultural Programme

F) Globalization and its Economic Social Political and Cultural impacts.

Unit–IV : Special Camping Programme

A) Nature and its objectives

B) Selection of camp site and physical arrangement

C) Organization of N.S.S. camp through various committees and discipline in the camp.

D) Activities to be undertaken during the N.S.S. camp.

E) Use of the mass media in the N.S.S. activities.

Unit–V : N.S.S. Regular Activities

A) Traffic regulation

B) Working with Police Commissioner's Office

C) Working with Corporation of Chennai

D) Working with Health Department

E) Blind assistance

F) Garments collection

G) Non-formal education

H) 'Environmental Education, Awareness and Training (EEAT)'

I) Blood donation

REFERENCE BOOKS

1) National Service Scheme Manual, Government of India, 2006.
2) Training Programme on National Programme scheme, TISS.
3) Orientation Courses for N.S.S. Programme officers, TISS.
4) Case material as Training Aid for field workers, Gurmeet Hans.
5) Social service opportunities in Hospitals, KapilK.Krishan,TISS.
6) Social Problems in India, Ram Ahuja.