REGULATIONS AND CURRICULUM

B. Tech. Degree Programme in Instrumentation Technology Offered by Department of Instrumentation Under Faculty of Technology.

(With effect from 2020 Admission)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN – 682 022

Regulations for the B. Tech. degree programme in Instrumentation Technology offered by Department of Instrumentation under Faculty of Technology

The following regulations are made applicable to the B Tech. programme in Instrumentation Technology offered by The Department of Instrumentation, Cochin University of Science and Technology, under Faculty of Technology with effect from the academic year 2020 - 21.

1. Admission requirements

Candidates seeking admission to the B. Tech Degree program in Instrumentation technology shall be required to posses the following qualification.

1.1 The candidate shall have passed the plus two (12th) examination of any state/national board with Mathematics, Physics and Chemistry as optional subjects or any other examination accepted as equivalent by the Cochin University of Science and Technology.

1.2 The candidate shall have secured a minimum of 50% marks in Mathematics and 50% marks in Mathematics, Physics and Chemistry put together.

1.3 Relaxations in marks shall be followed for candidates belonging to SC/ST and socially and educationally backward classes as prescribed by the University.

1.4 The candidates shall also satisfy the conditions regarding physical fitness as may be prescribed by the University.

1.5 Admission to the course shall be through Common Admission Test (CAT) conducted by the University every year and admission will be based on the rank in the admission test. If a candidate, after getting admission based on his/her CAT rank, fails to meet the admission requirements as specified in clause 1.1, 1.2 and 1.3 above before commencement of the first semester examination, he/she shall be terminated from continuing the course.

1.6 10% additional seats may be created in a batch in the third semester for lateral entry. Candidates seeking admission through lateral entry shall have 3 years diploma in Instrumentation or Electronics awarded by a board recognized by the department of technical education, Govt. of Kerala, with not less than 60% marks. Maximum age limit will be 25 years as on 1st July of the academic year.

2. Duration of the course

The duration of the B Tech. programme shall be eight semesters spanning over four academic years as prescribed in the curriculum. Each semester shall consist of a minimum of 16 weeks.

3. Course Registration

It is mandatory for the students to register for the courses in each semester.

3.1 Before registration, the students should Clear all dues including any fees to be paid and should not have any disciplinary issues pending

3.2 The Department will announce the dates for registration in its academic calendar. Late registration will be allowed up to 7 working days from the commencement of the semester with late registration fee.

4. Mode of Evaluation

4.1 The performance of the students in theory courses will be evaluated based on continuous assessment and semester end examination. In the case of laboratory courses, the evaluation will be based on continuous assessment and semester end assessment, which will be carried out internally.

4.2 For theory courses, there will be 50% weightage for internal assessment and 50% weightage for semester end examination. For practical courses, continuous assessment and semester end assessment will carry 50% weightage each.

3. For theory courses, the assessment pattern will be as follows:

Continuous assessment:

a) First periodical test - Maximum marks: 15
b) Second periodical test - Maximum marks: 15
c) Assignments - Maximum marks: 15
d) Attendance - Maximum marks: 5

Semester End Examination

a) Examinations shall be of 3 hours duration.
b) Maximum marks: 50

4. For laboratory courses, the assessment pattern will be as follows:

Continuous Assessment:

The marks may be awarded on the basis of the performance of the student in the laboratory sessions. The break-up of marks for continuous assessment of laboratory courses shall be:

a) Practical records/Outputs - Maximum weightage: 20%
b) Lab work - Maximum weightage: 30%

Semester end assessment:

The semester end assessment will consist of an examination and a viva voce. Maximum weightage for semester end examination: 50%

5. At the end of the semester, semester examination will be conducted in all the theory courses offered in that semester and they will be of three hours duration unless otherwise specified. The Controller of Examinations will make necessary arrangements for setting the question papers and valuation of answer books for the semester end examination of theory

courses.

6. The department shall conduct the semester end assessment for the laboratory courses internally with at least two faculty members as examiners.
7. In the case of project work, the project guide concerned shall make the continuous assessment. A committee consisting of the Project Coordinator (nominated by the Head of the Department), project guide, and at least one senior faculty member at the level of Associate Professor or above will carry out the assessment of the project report and final review.
   The weightage for the assessment of project work shall be as follows:

Continuous assessment	: 40 percent
Project report	: 20 percent
Final review	: 40 percent

8. The Viva-voce examination at the end of VIII semester will be conducted by a panel of minimum three examiners consisting of the Head of the Department or his/her nominee and two or more faculty members with one senior faculty at the level of Associate Professor or above of the Department.
9. A candidate shall not be allowed to improve the continuous assessment marks in theory/ laboratory courses. A candidate who desires to improve his/her marks in the semester end examination in theory courses shall be permitted to do so in the next available chance. This facility will be available only once for a theory course.
10. For industry elective courses, the evaluation will be done jointly by the resource persons from the industry who handles the course and the faculty in charge of the course.

5. Course Completion and Earning of Credits.

Students registered for a course have to attend the course regularly and meet the attendance rules of the University and appear for all the internal evaluation procedures for the completion of the course. However, credits can be earned only on completion of the semester end examination and on getting a pass grade. Students, who have completed a course, but could not write the semester end examination for valid reasons, are permitted to write the examination at the next available chance and earn the credits without undergoing the course again.

6. Eligibility to Appear for the Semester End Examination

A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for the completion of a semester.

6.1 A student shall secure not less than 75% of overall attendance in a semester taking into account the total number of periods in all courses attended by the candidate as against the total number of periods in all courses offered during that particular semester.

2. The Head of the Department shall have the power to condone shortage of attendance up to 5% (between 75% and 70%) in a particular semester due to medical reasons (hospitalization/accident/specific illness) on production of medical certificate from a registered med-

ical practitioner endorsed by the University Medical Officer and on payment of the required fee. However, such condonation for shortage of attendance shall be given only twice during the entire duration of the B Tech. programme.

6.3 The Vice Chancellor shall have the power to condone shortage of attendance up to additional 5% (between 70% and 65%) in a particular semester due to medical reasons (hospitalization/accident/specific illness) duly verified and recommended by the Head of the Department and on production of Medical certificate from a registered medical practitioner endorsed by the University Medical Officer and on payment of the required fee. However, such condonation for shortage of attendance shall be given only twice during the entire duration of the B Tech. programme.

6.4 Candidates who secure overall attendance of less than 65% (subject to clauses 6.2 and 6.3 above) will not be permitted to write the semester end examinations and will not be permitted to go to next/subsequent semester. They are required to repeat the incomplete semester in the next academic year.

7. Eligibility to Write the Suppelementary Examination

Failed candidates and those who could not write the semester end examination due to health reasons or other contingencies that are approved by the Head of the Department can register for the supplementary examination. Those who wish to improve their performance in the semester end examinations can also register for the same, subject to the provisions of clause 4.9. Grades awarded in the supplementary examination will be taken as semester grades in these subjects and will be based on the semester examination-grading pattern in that subject. In the case of candidates appearing for improvement of marks, the higher mark obtained will be considered for the purpose of grading.

A candidate who fails to obtain a pass in courses having only continuous assessment will be permitted to repeat the course along with the junior batches.

8. Revaluation

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

9. Pass Requirements

A candidate has to obtain a minimum of 50% marks for continuous assessment and semester end examination put together with a minimum of 40% marks in the semester end examination for a pass in theory and laboratory courses.
In the case of theory/laboratory courses having only continuous assessment, a candidate has to obtain a minimum of 50% marks in continuous assessment for a pass.

10. Promotion to Higher Semesters

10.1 A candidate shall be eligible for promotion from one semester to the next semester only if he/she has

a) A valid registration for the university examination
b) Secured the minimum attendance as per Clause 6

10.2 Supplementary university examinations for all semesters shall be held along with the regular examinations.

10.3 Special supplementary examination may be conducted for the seventh and eighth semesters.

10.4 Total number of chances to appear for the examination in any subject is limited to five only.

11. Eligibility for the Degree

11.1 No candidate shall be eligible for the degree, unless he/she has undergone the prescribed course of study for a period of eight semesters in the university and has passed the prescribed examinations in all the semesters.

11.2 All the requirements for the degree shall be completed by the candidate within a period of eight academic years from the date of admission to the first semester.

12. Grading

1. Grades shall be awarded to the students in each course based on the total marks obtained in continuous assessment and at the end semester examination and as per the provisions of clause 4.

The grading pattern shall be as follows:

Marks obtained (Percentage)	Grade	Grade points
90 to 100	S (Outstanding)	10
80 – 90	A (Excellent)	9
70 – 80	B (Very good)	8
60 – 70	C (Good)	7
50 - 60	D (Fair)	6
< 50	F (Fail)	0

Note: Where X – Y range denotes 'X' inclusive and 'Y' exclusive

2. A student is considered to have credited a course or earned credits in respect of a course if he/she secures a grade other than F for that course.

3. Grade Point Average.

The Grade Point Average (GPA) indicates the academic performance of a student in a semester.

$$\text{GPA} = \frac{G_1C_1 + G_2C_2 + \ldots + G_nC_n}{C_1 + C_2 + \ldots + C_n},$$

where 'G' refers to the grade point and 'C' refers to the credit value of the corresponding course undergone by the student.

The Grade Point Average (GPA) for each semester will be calculated only for those students who have passed all the registered courses of that semester. Similarly, Cumulative Grade Point Average (CGPA) up to any semester will be calculated only for those students who have passed all the courses up to that semester.

4. Classification:
On successful completion of the program Cumulated GPA (CGPA) will be calculated as follows

$$\text{CGPA} = \frac{GP_1C_1 + GP_2C_2 + \ldots + GP_8C_8}{C_1 + C_2 + \ldots + C_8},$$

where GP_n refers to the GPA and C_n refers to the total number of credits obtained by a student in Semester n.

The classification based on CGPA is as follows

CGPA 8 and above	: First Class with distinction
CGPA 6.5 and above, but less than 8	: First Class
CGPA 6 and above, but less than 6.5	: Second Class.

5. Conversion of CGPA to Percentage marks

The following formula shall be used to convert the CGPA obtained by a student to percentage marks.

$$\text{Percentagemarks} = \left(\text{CGPA} - 0.5\right) \times 10$$

13. **Electives and Open courses**

The curriculum for the programme consists of Professional Elective Courses, and open courses. In addition, industry based elective courses shall be offered for students as part of the curriculum. A student shall have the choice of taking upto 20% of credit allotted to electives from such industry

base elective courses. Three open elective courses are offered in the final semester. The students shall select these courses from the list of courses available from approved national agencies such as SWAYAM, subjected to the approval of the department faculty council. The students are responsible to pay the course fee, if any, attend these online courses, pass the exam and produce the certificate. The percentage of marks/credit will be given according to the marks obtained in the above examination.

14. Faculty Advisor

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a teacher of the Department to each batch of students, this teacher will be the Faculty Advisor for that batch of students throughout their period of study. These Faculty Advisors shall advise the students and monitor the courses taken by the students, check the attendance and progress of the students and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress/performance of the students concerned.

15. **Class Committee**

A class committee consists of teachers of the class concerned, student representatives and a chairperson who does not handle any subject for the class. It is like the 'Quality Circle' (more commonly used in industries), with the overall goal of improving the teaching- learning process. The functions of the class committee include:

a. Solving problems experienced by students in the classroom and in the laboratories in consultation with Head of the Department.
b. Clarifying the regulations of the degree programme and the details of rules therein.
c. Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
d. Informing the student representatives, the details of regulations regarding weightage used for each assessment.
e. Analyzing the performance of the students of the class after each test and finding ways and means of improving the performance of the students.
f. Identifying the students who are low achievers or weak in their subjects if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such students.

The Head of the Department will constitutes the class committee. The class committee shall be constituted within a week from the date of commencement of a semester. At least 4 student representatives from the respective class (usually 2 boys and 2 girls) shall be included in the class committee. The student representatives shall be nominated on the basis of their academic performance since the first semester of the B Tech. programme. In the case of first and second semesters, the rank obtained in the Common Admission Test (CAT) shall be the criterion for nominating the student representatives. The Chairperson of the class committee may invite the Faculty Advisor(s) and the Head of the Department to the meeting of the class committee. The Chairperson of the class committee is required to prepare the minutes of every meeting, submit the same to the Head of the Department within two days of the meeting and arrange to circulate the same among students concerned and teachers. If there are some points in the minutes requiring action by the University, the same shall be brought to the attention of the Head of the De-

partment and the Registrar.

The first meeting of the class committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of internal assessments shall be decided in the first meeting, within the framework of the regulations and the same shall be communicated to the students. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the class to improve the effectiveness of the teaching-learning process.

16. **Discipline**

Every student is required to observe discipline and decorous behaviour both inside and outside the campus and refrain from any activity, which may tarnish the image of the University as per the provisions of the Cochin University Students' (Conduct and Disciplinary) Code - 2005. Any act of indiscipline, misbehaviour including unfair practice in examinations will be referred to the authorities of the University that will make a detailed enquiry on the matter and decide on the course of action to be taken.

17. **Amendment to Regulations**

Notwithstanding all that has been stated above, the University has the right to modify any of the above regulations from time to time.

18. Course Structure and Scheme of Evaluation.

The programme of instruction will consist of the following:

a) Basic Science Courses (BSC) comprising Mathematics, Physics, Chemistry etc;
b) Engineering Science Courses (ESC) introducing the student to the foundations of engineering.
c) Professional Core Courses (PCC) introducing the students to the foundations of Instrumentation and Control engineering.
d) Elective Courses (EC) enabling the student to opt and undergo a set of courses of interest to him/her;
e) Professional practice including project, seminar, and industrial training;
f) Humanities courses (HC) on soft skills; and
g) Mandatory Courses (MC) on Indian Constitution and Environmental Science, in addition to Induction training.

The B Tech. programme will have a curriculum and syllabus for the courses approved by the Academic Council.

The B Tech. programme will follow the credit system.
The curriculum of the B Tech. programme has a total of 160 credits.

SEMESTER I

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
BSC	20-211-0101 Calculus	3	1	0	3	50	50	100
BSC	20-211-0102 Engineering Physics	3	1	0	3	50	50	100
ESC	20-211-0103 Basic Electronics	3	1	0	3	50	50	100
ESC	20-211-0104 Electrical Engineering - I	3	1	0	3	50	50	100
ESC	20-211-0105 Mechanical Engineering	3	1	0	3	50	50	100
HSC	20-211-0106 Soft Skill Development	1	1	0	1	100		100
HSC-L	20-211-0107 Language Lab	0	0	1	1	50		50
ESC-L	20-211-0108Engineering Graphics	1	0	3	2	100		100
ESC-L	20-211-0109Electrical and Mechanical Workshop	0	0	3	1	50		50
MC	Induction Training				0			
MC	Indian Constitution				0			

Total Credits: 20.

Total marks: 800

SEMESTER II

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
BSC	20-211-0201 Linear Algebra and Transforms	3	1	0	3	50	50	100
ESC	20-211-0202 Engineering Chemistry	3	1	0	3	50	50	100
ESC	20-211-0203 Analog Electronics	3	1	0	3	50	50	100
ESC	20-211-0204 Electrical Engineering II	3	1	0	3	50	50	100
ESC	20-211-0205 Engineering Mechanics	3	1	0	3	50	50	100
BSC	20-211-0206 Materials Science	3	1	0	3	50	50	100
ESC-L	20-211-0207 Computer Programming	1	1	1	2	100		100
ESC-L	20-211-0208 Basic Electronics Lab	0	0	3	1	100		100
MC	Environmental Science				0			

Total Credits: 21.

Total marks: 800

SEMESTER III

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
BSC	20-211-0301Complex Analysis and Partial differential Equations	3	1	0	3	50	50	100
ESC	20-211-0302Electrical measurements and Instrumentation	3	1	0	3	50	50	100
ESC	20-211-0303 Digital electronics	3	1	0	3	50	50	100
PCC	20-211-0304 Linear Integrated Circuits	3	1	0	3	50	50	100
PCC	20-211-0305 Transducers - I	3	1	0	3	50	50	100
PCC	20-211-0306Principles of measurements and Instrumentation	3	1	0	3	50	50	100
ESC-L	20-211-0307 Analog Electronics Lab	0	0	3	1	100		100
ESC-L	20-211-0308 Electrical Machines Lab	0	0	3	1	100		100

Total Credits: 20

Total Marks: 800

SEMESTER IV

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext	Total
BSC	20-211-0401 Numerical and Statistical Methods	3	1	0	3	50	50	100
PCC	20-211-0402 Transducers - II	3	1	0	3	50	50	100
PCC	20-211-0403 Control Engineering -I	3	1	0	3	50	50	100
PCC	20-211-0404 Power Electronics	3	1	0	3	50	50	100
PCC	20-211-0405 Pneumatics and Hydraulics	3	1	0	3	50	50	100
ESC	20-211-0406 Signals and Systems	3	1	0	3	50	50	100
PCC-L	20-211-0407 Digital Electronics Lab	0	0	3	1	100		100
PCC-L	20-211-0408 Material science Lab	0	0	3	1	100		100

Total Credits: 20

Total Marks: 800

SEMESTER V

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
PCC	20-211-0501 Control Engineering II	3	1	0	3	50	50	100
PCC	20-211-0502 Digital Signal Processing	3	1	0	3	50	50	100
PCC	20-211-0503.Microprocessors & micro controllers	3	1	0	3	50	50	100
PCC	20-211-0504 Analytical Instruments	3	1	0	3	50	50	100
HSC	20-211-0505 Engineering Management	3	1	0	3	50	50	100
PCL-L	20-211-0506 Control Systems Lab	3	1	0	3	100		100
PCC-L	20-211-0507 Transducers and Industrial Instrumentation Lab	0	0	3	1	100		100
PEC	20-211-05** Elective - I	0	0	3	1	50	50	100

Total Credits: 20

Total Marks: 800

SEMESTER VI

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext	Total
PCC	20-211-0601 Vacuum and cryogenic Instrumentation	3	1	0	3	50	50	100
PCC	20-211-0602. Embedded Systems	3	1	0	3	50	50	100
PCC	20-211-0603 Process Control	3	1	0	3	50	50	100
PCC	20-211-0604 Optoelectronic Instrumentation	3	1	0	3	50	50	100
PCL-L	20-211-0605 Microprocessor and microcontroller Lab	0	0	3	1	50	50	100
PCL-L	20-211-0606 Virtual Instrumentation Lab.	0	0	3	1	50	50	100
	20-211-0607 Seminar	1	0	0	1	50		50
PEC	20-211-06** Elective - II	3	1	0	3	100		100
PEC	20-211-06** Industry Elective	2	1	0	2	100		100

Total Credits: 20

Total marks: 850

SEMESTER VII

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
PCC	20-211-0701 Biomedical Instrumentation	3	1	0	3	50	50	100
PCC	20-211-0702 Advanced Process control	3	1	0	3	50	50	100
PCC	20-211-0703 Power plant & Industrial Instrumentation	3	1	0	3	50	50	100
PCC	20-211-0704 Communication Systems and Telemetry	3	1	0	3	50	50	100
PCC	20-211-0705 Robotics and automation	3	1	0	3	50	50	100
PCC-L	20-211-0706 Process Control Lab	0	0	3	1	100	0	100
PCC-L	20-211-0707 Digital Signal Processing Lab	0	0	3	1	100	0	100
	20-211-0708 Mini project	0	0	0	1	50	0	50
PEC	20-211-07** Elective - III	3	1	0	3	50	50	100

Total Credits: 21

Total marks: 850

SEMESTER VIII

Course category	Course Code and Title of the Course	Hours per week			Credit	Evaluation		
		L	T	P		Int.	Ext.	Total
	20-211-0801Project Work	-	-	-	10	300	-	300
	20-211-0802 Viva-voce	-	-	-	2	100	-	100
OEC	20-211-08** Open Course 1	-	-	-	2	-	-	100
OEC	20-211-08** Open Course 2	-	-	-	2	-	-	100
OEC	20-211-08** Open Course 3	-	-	-	2	-	-	100

Total Credits: 18

Total Marks: 700

Program total:

Credits: 160

Marks: 6400

Syllabus for I and II Semester BTech Degree Programme in Instrumentation Technology offered by Department of Instrumentation under Faculty of Technology, Cochin University of Science and Technology.

(With effect from 2020-21 onwards)

20-211-0101 CALCULUS

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:
After completion of this course the student will be able to:

CO1: Recall the methods of differentiation and integration.
CO2: Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineering problems
CO3: Estimate the maxima and minima of multi variable functions.
CO4: Evaluate area as double integrals and volume as triple integrals in engineering applications.
CO5: Illustrate the application and physical meaning of gradient, divergence and curl.

Module I (16 hours, End semester marks 25%)

Ordinary differential equations:

First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.

Linear differential equations of higher orders with constant co-efficient-Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems – Electrical Circuits, Mechanical Systems.

Module II (16 hours, End semester marks 25%)

Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule-Total derivative- Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables (Proof of the result not required)-Simple applications.

Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space-Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module III (16 hours, End semester marks 25%)

Integral calculus:

Application of definite integrals: Area, Volume, Arc length, Surface area.

Multiple integral: Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals-Change of Variables in integrals.

Applications of multiple integrals. Plane Area, Surface area &Volumes of solids

Module IV (16 hours, End semester marks 25%)

Vector calculus:

Scalar and vector point functions, gradient and directional derivative of a scalar point function, divergence and curl of vector point functions, their physical meaning. Evaluation of line integral, surface integral, and volume integrals, Gauss's divergence theorem, Stoke's theorem (No proofs), conservative force fields, scalar potential.

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2. Erwin Kreyzig. Advanced engineering mathematics (Tenth edition). John Wiley& Sons, Hoboken, NJ. (2011)
3. Veerarajan, T. Engineering mathematics. (third edition). Tata McGraw Hill Publishers, New delhi. (2011)
4. Grewal,B.S. Higher Engineering Mathematics. (Forty Third Edition). Khanna Publishers, New Delhi. (2013).
5. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0102 ENGINEERING PHYSICS

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

After completion of the course, students will be able to CO1: Explain wave phenomena
CO2: interpret optical phenomena involving interference and diffraction.
CO3: Explain the basic principles of optical instruments.
CO3: Summarise polarisation of light and its applications.
CO4: Understand atomic phenomena and the solid state based on the principles of quantum and statistical theories.
CO5: Explain the fundamentals of sound and the factors that. affect the acoustics of buildings CO6:Explain the production and applications of ultrasound.

Module I (16 hours, End semester marks 25%)

Waves: One dimensional wave - differential equation and solution. Three dimensional waves - differential equation and solution (no derivation) - transverse vibrations of a stretched string.

Interference of light: Analytical treatment of interference- coherent sources -derivation of expression for fringe width in in double slit experiment - white light fringes - fringe shift with thin transparent plate - interference on thin films - Newton's rings - air wedge - planeness of surfaces - anti reflection coatings.

Module II (16 hours, End semester marks 25%)

Diffraction of light: - Fresnel and Fraunhofer diffraction - zone plates - plane diffraction grating - measurement of wave length - dispersive power of grating - resolving power – Raleigh's criterion - resolving power of telescope and grating.

Polarization of light: polarization by reflection - refraction - Brenster's law - double refraction - negative and positive crystals - Nicol prism - quarter and half wave plates - production and detection of circularly and elliptically polarized lights - -rotatory polarization - half shade polarimeter - applications of polarized light.

Module III (16 hours, End semester marks 25%)

Quantum Mechanics: wave particle duality - de Broglie's concept of matter waves - Davison & Germer experiment - uncertainty principle - postulates of quantum mechanics- formulation of time independent and time dependent Schrodinger equation - energy and momentum operators - Eigen values and functions - one dimensional infinite square well potential - tunnelling(qualitative ideas).

Statistical mechanics: macrostates and microstates - phase space - basic postulates of Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics and their distribution functions (no derivation) -Fermi level and its significance.

Module IV (16 hours, End semester marks 25%)

Acoustics: Intensity of sound - loudness - absorption coefficient - reverberation - significance of reverberation time - Sabine's formula (no derivation) - acoustics of buildings.

Ultrasonics: production of ultrasonic waves - magnetostriction and piezoelectric oscillators - detection of ultrasonics - thermal and piezoelectric methods - applications of ultrasonics - NDT and medical applications.

References

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2. Beiser, A., Cocepts of ModernPhysics, McGraw Hill India Ltd.
3. Bhattacharya and Tandon, Engineering Physics, Oxford India.
4. Raghuvanshi, G. S., Prentice Hall of India.
5. Brijlal and Subramanyam, A Text Book of Optics, S. Chand & Co.
6. Philip J., A Text Book of Engineering Physics, Educational Publishers.
7. Vasudeva A. S., A Text Book of Engineering Physics, S. Chand& Co.
8. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0103 BASIC ELECTRONICS

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

After completion of the course, students will be able to

CO1: understand the basic principle of operation of semiconductor junctions
CO2: understand the working of diodes and bipolar junction transistor
CO3: analyze a bipolar junction transistor using its mathematical model
CO3: understand the principles of transistor biasing
CO4: understand different types of field effect transistors, its basic working principles and some basic field effect transistors circuits.

Module I (16 hours, End semester marks 25%)

P-N junction diode: Semiconductors – band structure of semiconductors – intrinsic and extrinsic semiconductors – doping. Law of mass action – P-N junction – V-I characteristics – Zener diode, LEDs, photodiodes and solar cells.

Bipolar Junction Transistor: Construction and principle of operation – current components, BJT as an amplifier, CE, CB and CC configurations, BJT characteristics.

Module II (16 hours, End semester marks 25%)

Two port networks – transistor hybrid model – conversion formulas – transistor amplifier analysis using *h* parameters – emitter follower – comparison of configurations – Millers theorem and its dual
– cascading – simplified CE, CC configurations – CE amplifier with emitter resistance – high input resistance transistor circuits.

Module III (16 hours, End semester marks 25%)

Transistor Biasing: Operating point – fixed-bias and self-bias – bias stabilization – bias compensation – thermal runaway – thermal stability.

Module IV (16 hours, End semester marks 25%)

Field effect transistors: The junction field effect transistor, pinch-off voltage, JFET V-I characteristics, FET small signal model, MOSFET, depletion MOSFET, MOSFET gate protection and CMOS. Low frequency common source and common drain amplifiers. Biasing the FET, FET as an voltage variable resister (VVR), the common-source amplifier at high frequencies and the common drain amplifier at high frequencies.

References

1. Jacob Millman and Arvin Grabel – Microelectronics – McGraw Hill.
2. Jacob Millman and Christos C. Halkias – Integrated Electronics – Tata McGraw Hill.

3. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0104 ELECTRICAL ENGINEERING I

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

After completion of the course, students will be able to

CO1: Explain varies laws in electric and magnetic fields CO2: Solve problem in electrostatics and magnetic circuits CO3: Explain varies laws in electromagnetic induction

CO3: Understand fundamentals of ac voltage generation and definition of varies terms

CO4: Define and apply various theorems for solving voltage and currents in DC circuits

CO5: Analyze AC series and parallel circuits

CO6: Analyze DC transients in *R-L* and *R-C* circuits.

CO7: Acquire basic knowledge about three-phase power system

Module I (16 hours, End semester marks 25%)

Electrostatics: Electric charge, Coulomb's law of electrostatics, Electric field, Electric potential, capacitor and capacitance.

Electromagnetism: Magnetic field, Biot-Savart law, Magnetic field of an infinite linear conductor, field strength due to circular loop, field strength inside a solenoid, force on current carrying conductor in a magnetic field, hysteresis.

Magnetic Circuits: Magnetomotive force, magnetic field strength, reluctance, laws of magnetic circuits, ampere-turns of magnetic circuit.

Module II (16 hours, End semester marks 25%)

Electromagnetic induction: Relation between magnetism and electricity, Faraday's laws of electromagnetic induction, direction and induced emf, magnitude of induced emf in a coil, dynamically induced emf, statically induced emf.

Fundamentals of AC: generation of alternating current and Voltage, emf equation, phase and phase difference, rms value, average value form factor, peak factor and vector diagram.

Module III (16 hours, End semester marks 25%)

DC circuit theory: Kirchoff's laws, source transformation, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem, substitution theorem and maximum power transfer theorems

Single-phase series ac circuits: Purely resistive, capacitive and inductive ac circuits. *R-L*, *R-C* and *R-L-C* series ac circuits. Resonance, Q-actor, power and power factor in ac series circuits.

Single-phase parallel ac circuits: *R-L, R-C, L-C, L-R-C* parallel ac circuits, parallel resonance, Q factor and power factor improvement.

DC transients in R-L and R-C circuits: rise and fall of current, time constant and energy stored in *R-L* and *R-C* circuits.

Module IV (16 hours, End semester marks 25%)

Three phase system: generation of three phase voltage, star connection and delta connection, star to delta and delta to star conversion, power in 3 phase system, and measurement of 3 phase power in balanced and unbalanced systems.

Symmetrical components: Positive sequence components, negative sequence components and zero sequence components.

References

1. V.N. Mittle, “Basic Electrical Engineering”, Tata McGraw-Hill.
2. B.L. Thevaja, “A textbook of Electrical Technology Vol. I”, S. Chand & Company Ltd.
3. D. Roy Choudhury, “Networks and systems”, New age International Publishers.
4. John Bird, “Electrical Circuit Theory and Technology”, Routledge
5. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0105 MECHANICAL ENGINEERING

L	T	P	C
3	1	0	3

Prerequisites: Nil

Total Hours: 64

Course Outcomes:

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

CO1. Understand basics of thermodynamics and working of steam turbines.

CO2. Understand basics of internal combustion engines, refrigeration and air conditioning.

CO3. Gain knowledge on the working of hydraulic turbines and centrifugal pumps.

CO4. Identify manufacturing methods encountered in engineering practice and understand mechanism of power transmission.

Module I (16 hours, End semester marks 25%)

Thermodynamics: Thermodynamics systems – open, closed and isolated systems, equilibrium state of a system, property and state, process, cycle, Zeroth law of thermodynamics – concept of temperature, temperature scales. First law – internal energy, enthalpy, work and heat, different processes (isobaric, isochoric, isothermal, adiabatic and polytropic processes). Second law – Kelvin-plank and Claussius statements and their equivalennce, Carnot Cycle (Elementary problems only). Thermodynamic properties of Steam, Stea generator. Different types of boilers, boiler mountings and accessories. Formation of steam at constant pressure, working of steam turbines, compounding of turbines.

Module II (16 hours, End semester marks 25%)

Internal Combustion Engines: Air standard cycles – Otto and Diesel cycles, working of two stroke and four stroke Petrol and Diesel engines, carburetted and MPFI engines, fuel pump, fuel injector, ignition system, coolig system, lubricating system.

Refrigeration & Air-conditioning: Introduction to refrigeration and air-conditioning, rating of refrigeration machines, coefficient of performace, simple refrigeration vapour compression cycle (Elementary problems only), summer and winter air conditioning.

Module III (16 hours, End semester marks 25%)

Air compressors: Reciprocating air compressors – Mechanical details – Shaft work – Multi-stage air compressors with intercooling – Introduction to condenssors and cooling towers.

Power plants: Hydro-electric power plants, thermal power plants, nuclear power plants, diesel power plants, wind mills, solar energy (working principles using schematic representations only)

Module IV (16 hours, End semester marks 25%)

Introduction to Manufacturing Systems: Welding - different types of welding, resistance welding, arc welding, gas welding, brazing and soldering, different welding defects. Casting - different casting processes, sand casting, casting defects, rolling - hot rolling and cold rolling, two high, three high, cluster rolling mills, wire drawing, forging, extrusion, heat treatment of steel, elementary ideas of annealing, hardening, normalizing, surface hardening.

Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, Chain and Gear Drive. Length of belt open and crossed. Ratio of belt tensions (Elementary problems only). Different types of gears (Elementary ideas only). Types and functioning of clutches.

References:

1. Nag, P.K. Engineering thermodynamics. (Fifth edition). McGraw Hill Education (India) Pvt. Ltd., New Delhi. (2003)
2. Gill, J.H. Smith Jr. annd Ziurys, E.J. Fundamentals of internal combustion engines, Oxford & IBH, New Delhi. (1959)
3. Stoecker, W.F. Refrigeratin and air conditioning. Tata McGraw Hill, New Delhi. (1980)
4. JagadishLal. Hydraulic machines. Metropolitan Book Co., New Delhi. (1994)
5. Raghavan, V. Material Science and Engineering, Prentice Hall of India, New Delhi. (2004)
6. Rajendar Singh. Introduction to basic manufacturing processes and workshop technology, New Age International, New Delhi. (2006)
7. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0106 SOFT SKILLS DEVELOPMENT

L	T	P	C
1	1	0	2

Pre-requisites: Nil
Total hours: 32

Course Outcomes:

On completion of this course the student will be able to:

CO1: Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.

CO2: Read, comprehend and answer questions based on literary, scientific and technological texts

CO3: Develop self-motivation, raised aspiration, belief in one's own abilities and commitment to achieving one's goal

CO4: Demonstrate emotional maturity and emotional health.

Module I

Role and importance of verbal communication, Everyday active vocabulary, Common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension- skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Two types of meaning- literal and contextual. Constructive criticism of speeches and explanations.

Module II

Fundamental grammar, Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open –ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learning authoritative writing skills, polite writing and good netiquette. Writing for internships and scholarships.

Module III

Kinesics, Proxemics, Haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same.

Different types of interviews, and presentation - oral, poster, ppt. Organizing ideas for group discussions, the difference between GD and debates.

Effective listening and seeking to understand others' perspectives. Non-violent negotiation and persuasion, communicating across age groups, cultures or identity groups.

Higher order thinking and evaluation, information-seeking, research, and independent learning, synthesis, creativity, problem analysis and problem solving. Decision making, Self-reflection and learning from experience.

Module IV

Developing positive self: Understanding oneself, a realistic awareness of oneself and one's abilities, strengths and potential, Self-esteem, Self-efficacy, steps for improvement.

Intra-personal skills – Self-control, emotional regulation and self-discipline, conscientiousness, dutifulness, reliability, truthfulness, honesty and trustworthiness. Goal orientation and initiative. Time management – prioritising work.

Interpersonal skills – cross cultural competence and valuing diversity of perspectives, respecting and expressing concern for others. Empathy and ability to notice the effect of one's actions on others, tolerance for disagreement, conflict management and resolution.

Civic engagement and social responsibility – Global and local awareness (issues, challenges, priorities). Vision, ability to imagine something new or improved. Social responsibility and willingness to take constructive action.

References:

1. Duck, Steve and David T. Macmahan. Communication in Everyday Life. 3rd Ed. Sage, (2017).
2. Gamble, Kawl Teri and Michael W. Gamble. The Public Speaking Playbook. Sage, (2015).
3. Raman, Meenakshi and Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, (2015).
4. Coleman, D. Emotional intelligence: Why it can matter more than IQ, Bantam Books, New York (2006).
5. Devadas Menon. Stop sleep walking through life, Yogi Impressions Books Pvt. Ltd, Mumbai (2012).
6. Barun K Mitra. Personality Development and Softskills, Oxford University Press (2012).

ASSESSMENT

1. 'Soft Skills Development' is a practical and activity oriented course which has continuous assessment for 50 marks based on class room interaction, activities, and assignments. The activities may include 'Just a Minute' (JAM) sessions, group discussion, role play, debate, and extempore speech.

The Marks for the different components shall be as follows:

Class room interaction – 10 marks
Activities – 30 marks
Assignments (mainly from Modules I and II) – 10 marks

2. Semester End Examination is not envisaged.

3. A student should secure a minimum of 50% marks in continuous assessment for a pass in the course.

20-211-0107 LANGUAGE LAB

L	T	P	C
0	0	1	1

Pre-requisites: Nil
Total hours: 32

Course Outcomes:
On completion of this course the student will be able to:

CO1: Test pronunciation skills through stress on word accent, intonation, and rhythm.
CO2: Use English language effectively for writing business letters, resume, minutes of meeting and reports.
CO3: Use English language effectively to face interviews, group discussions, and public speaking.

Following course content is prescribed for the **Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. 'Just A Minute' Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

20-211-0108 ENGINEERING GRAPHICS

L	T	P	C
1	0	3	2

Prerequisites: Nil
Total Hours: 64

Course Outcomes: On completion of this course, a student will be able to:

CO1. Prepare drawings as per BIS code, draw orthographic projection of straight lines.
CO2. Draw orthographic projections of solids, section of solids and understand development of surface of different geometric shapes.
CO3. Understand and draw, curves of intersection of solids and perspective drawings of objects. Construct isometric scale and isometric projections.
CO4.To understand and draw, multi-view projections of solids, produce machine drawings of machine components.

Module I (16 hours, End semester marks 25%)

Introduction to Engineering Graphics: Need for engineering drawing. Drawing instruments BIS code of practice for general engineering drawing.

Orthographic projection of points and lines: Projection of points in different quadrants, projection of straight lines inclined to one of the reference planes, straight lines inclined to both the planes; true length and inclination of lines with reference planes; traces of lines.

Module II (16 hours, End semester marks 25%)

Projection of solids: Solids in simple position. Sections of simple solids in simple vertical positions with section plane inclined to one of the reference planes - true shapes of section - developments of surfaces of these solids.

Module III (16 hours, End semester marks 25%)

Intersection of surfaces: Intersection of prism in prism and cylinder in cylinder - axis bisecting at right angles only.

Perspective projections: Perspective projections of simple solids.

Isometric projections: Isometric projections and views of plane figures simple and truncated simple solids in simple position including sphere and hemisphere and their combinations.

Module IV (16 hours, End semester marks 25%)

Multi-view projection: Conversion of isometric view of objects to orthographic views.

Introduction to machine drawing: BIS conventions - screw threads - nuts and bolts - locknuts - riveted joints.

Bearings: Simple, bush and thrust bearings. Shaft couplings muff, flanged and flexible couplings.

References:

1. N.D. Bhatt - Engineering Drawing - Charotar Publishing House
2. P.I. Varghese and K.C. John - Engineering Graphics - Jovast Publishers
3. N.D. Bhat and V.M. Panchal - Machine Drawing Charotar Publishing House
4. P.I. Varghese and K.C. John - Machine Drawing - VIP Publishers
5. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0109 ELECTRICAL AND MECHANICAL WORKSHOP

L	T	P	C
0	0	3	1

Pre-requisites: Nil
Total hours: 48

Course Outcomes:

After completion of the course, students will be able to

CO1: understand the the safety precaution to be taken in a mechanical workshop
CO2: understand different tools and equipment used in a mechanical workshop
CO3: acquire skills for the preparation of different fitting and welding models
CO3: understand different operatin of different maching tools used in a mechanical workshops
CO4: understand the the safety precaution to be taken while dealing with electric circuits
CO5: understand and analyse different types of wiring circuits, both domestic and industrial.

List of Exercises/ Experiments for Mechanical Engineering Workshop
(24 hours, End semester marks 50%)

Safety rules: Understand the safety rules in mechanical engineering workshops
General: Study of mechanical tools such as screwdrivers, spanners, Allen keys, cutting pliers etc.
Sheet metal works: Make cylindrical, conical and prismatic shaped jobs from sheet metals
Welding: Make joints using electric arc welding – butt joint, corner joint, T-joint and lap joint.
Fitting: Exercise on one simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc.
Machines: Demonstartion and application of drilling machine, grinding machine, shaping machine, milling machine and lathe.

List of Exercises/ Experiments for Electrical Workshop
(24 hours, End semester marks 50%)

Safety rules: Understand the safety rules in electrical engineering labs
Component identification: Identify different electric wiring components such as different types of wires/cables, fuses and fuse carriers, MCB, ELCB, MCCB and their uses.

Wiring exercises:

1. Simple light controlling circuit, PVC conduit wiring
2. Light control circuit using two-way switch
3. Godown wiring, PVC conduit wiring
4. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and energy meter

5. Measurement of voltage, current and power in single-phase circuit using voltmeter, ammeter and Wattmeter. Calculation of power factor of the circuit.

Reference

1. Lab manual provided by the concerned faculty in charge.
2. Virtual labs (http://www.vlab.co.in/)

20-211-0201 LINEAR ALGEBRA AND TRANSFORM TECHNIQUES

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

On completion of this course the student will be able to:

CO1: Solve linear system of equations and to determine Eigen values and vectors of a matrix.
CO2: Understand the concept of vector space and sub space.
CO3: Determine Fourier series expansion of functions and transform.
CO4: Solve linear differential equation and integral equation using Laplace transform.

Module I (16 hours, End semester marks 25%)

Linear Algebra 1: Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix- Cayley Hamilton theorem (without proof) Verification- Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II (16 hours, End semester marks 25%)

Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III (16 hours, End semester marks 25%)

Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV (16 hours, End semester marks 25%)

Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2011.
2. Grewal, B. S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2013.
3. Hsiung, C.Y. and Mao, G.Y.- Linear Algebra, World Scientfic.
4. Hoffman, K. and Kunze, R., Linear Algebra, Prentice Hall of India, New Delhi 1971
5. Venkataraman, M. K., Linear Algebra, The National Co., 1999.

6. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0202 ENGINEERING CHEMISTRY

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

On completion of this course the student will be able to:

CO1: Bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.

CO2: Acquire knowledge of engineering materials and about fuels and batteries.

CO3: Understand the importance of organic and inorganic materials in industrial usage and significance of corrosion control to protect the structures

CO4: Understand the use of fundamental principles to make predictions about the general properties of materials.

CO5: Impart a scientific approach and to familiarise the applications of chemistry in the field of technology

CO6: Develop abilities and skills that are relevant to the study and practice of chemistry and to choose appropriate materials for various engineering purposes.

CO7: develop an ability to design and construct engineering products like cells, batteries, composites and antistatic materials.

Module I (13 hours, End semester marks 25%)

Atomic orbitals – Radial probability distribution function of Hydrogen atom – Quantum numbers, aufban principle for many electron atoms – LCACO method for diatomic like N2, CO etc. – Basic ideas – Hybridisation and molecular shape. Conjugated systems.

Module II (17 hours, End semester marks 25%)

Electrochemistry – Galvanic cells – EMF measurement, classification of electrodes – Nernst" equation – Electrode potential cell reaction relation between cell potential and thermodynamic quantities, Ni Cd cell, Hydrogen – Oxygen fuel cell, electro-chemical corrosion.

Corrosion – Theories of corrosion – Factors influencing corrosion – Corrosion Control – Cathode protection – Protective coatings – Metallic coatings – Hot dipping – electroplating, metal spraying, cladding, Non-metallic coatings – properties and functions of ingredients used in paints, varnishes, Enamels and Lacquers – special paints.

Module III (15 hours, End semester marks 25%)

Organic chemistry – Nucleophilic aliphatic substitution – Elimination reactions of alkyl halides, nuclephiles – leaving groups: SN2 reaction mechanism, kinetics and stereochemistry, reactivity and steric hindrance, SN, reactions, Mechanism and Kinetics, concept of aromaticity. Hackel's (4n + 2) rule.

Module IV (15 hours, End semester marks 25%)

Fuels – classification – Calorific value determination of solids, liquids and Gaseous fuels – solid fuels, wood, peut, lignite, coal and coke proximate analysis of coal – liquid fuels – petroleum and its refining – fractions and their uses – cracking and reforming – petrol knock and octane number – Diesel knock and octane number – Synthetic petrol – Gaseous fuels – Natural cases – Acetylene Combustion calculation – Lubrication – Classification and properties of lubricants – Production of lubricating oils – Synthetic lubricants.

References

1. Castallan – Physical chemistry – Addison Wesley.
2. Galsitone and Leivis – Elementary Physical Chemistry.
3. Cotton and G. Wilkinson – Advanced inorganic chemistry.
4. G.S. Munku – Theoretical principles of inorganic chemistry.
5. Hendrickson, Cram and Hammond – Organic Chemistry – McGraw Hill.
6. Morrison and Boyd – Organic chemistry – Prentice Hall India.
7. J.C. Kuriakose and Rajaram – Chemistry in Engineering & Technology, Vol.II
8. P.C. Jain and Monika – Engineering Chemistry
9. L. Munree – Chemsistry of Engineering Materials.
10. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0203 ANALOG ELECTRONICS

L	T	P	C
3	1	0	3

Pre-requisites: 20-211-0103 Basic Electronics
Total hours: 64

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

CO1: Understand the working of diodes in circuits and rectifiers
CO2: Analyse the working of transistor amplifier at high frequencies.
CO3: Explain the concept of feedback and working of oscillators.
CO3:Understand the operation of power amplifier circuits and its classification.
CO4:Familiarise various aspects of amplifier design like noise, shielding, grounding etc
CO5:Understand linear wave shaping , switching and related circuits.

Module I (16 hours, End semester marks 25%)

Diode circuits: Diode as a circuit element - piece wise linear model - clipping and clamping circuits - voltage multiplier - rectifiers - voltage equations - simple zener regulator - regulated power supplies - series voltage regulator.

Module II (16 hours, End semester marks 25%)

Transistor at high frequencies: Hybrid-pi CE transistor model - CE short circuit current gain - single stage CE transistor amplifier response - gain-bandwidth product - emitter follower at high frequencies.

Feedback amplifiers: concept of feedback - positive and negative feedback - effect of feedback on amplifier - expressions and derivations - voltage, current, series and shunt feedback - typical circuits.

Oscillators: Barkhausen criteria - RC phase shift oscillator - principle analysis and design - principle of operation of Hartley, Colpitt's and crystal oscillator.

Module III (16 hours, End semester marks 25%)

Power amplifiers:- Classification of power amplifiers - Class A, Class B, Class AB and Class C - push-pull power amplifier. - transformer less class AB - complimentary symmetry power amplifier- harmonic distortion.

Amplifer noise: Thermal noise - shot noise - interference - shielding and grounding.

Module IV (16 hours, End semester marks 25%)

Linear wave shaping: High pass and low pass circuits - analysis - output for step, pulse, square wave and ramp inputs - transistor as a switch - application - logic inverter - MOSFET analog switch - sweep circuits using BJT -Miller and bootstrap sweep circuit - UJT- characteristics - relaxation oscillator - multivibrators - bistable multivibrators - triggering circuit - commutating capacitors - monostable and astable multivibrators

References

1. Jacob Milman and Christos C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill Publishing Co. Ltd.
2. Pulse and DigitalSwitching Circuits, J. B. Gupta, S. K. Kataria&Sons.
3. Microelectronic Circuits and Devices, Mark A. Horenstein, PHI Learning
4. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0204 ELECTRICAL ENGINEERING II

L	T	P	C
3	1	0	3

Pre-requisites: 20-211-0104 Electrical Engineering – I
Total hours: 64

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

- **CO1:** understand the detailed working principle of transformers, its testing methods and applications
- **CO2:** understand the detailed working principle of rotating DC machines, its basic characteristics and applications
- **CO3:** understand the detailed working principle of alternators, including the starting methods
- **CO3:** understand the detailed working principle of different types of induction motors and its performance analysis
- **CO4:** Understand the basic working principle of stepper motor and hysteresis motor
- **CO5:** Understand the basic methods of electric power generation, its distribution and protection circuits.

Module I (16 hours, End semester marks 25%)

Transformer: Working principles of ideal transformer – constructional features – emf equation – vector diagram – equivalent circuit – impedance transformation – transformer losses – flux leakage – efficiency – open circuit and short circuit tests – auto transformer – working principle and saving of copper – Basic idea of current transformer and potential transformer.

Module II (16 hours, End semester marks 25%)

Rotating DC Machines: Types of rotating D.C. machines, emf generated in the armature, Torque in DC machine, method of excitation, mmf and flux density wave forms in D.C. machines, commutation process, compensating windings, magnetisation curve. Effect of armature mmf on DC machine calculations. Operating characteristics of DC generators and motors. DC motor starting, speed control of DC machines and DC machine applications.

Module III (16 hours, End semester marks 25%)

Alternator: rotating field, speed and frequency – effect of distribution of winding – emf equation – losses and efficiency regulation – emf and mmf methods. Synchronous motor – torque equation – starting methods – effect of over/under excitation.
Induction motor: Three phase induction motor – constructional features – principle of operation – Vector Diagram and equivalent circuits – performance calculation using circle diagram – starting and speed control of squirrel cage and wound rotor induction motor.

Principle of operation of single-phase induction motor, stepper motor, universal motor and Hysteresis motor

Module IV (16 hours, End semester marks 25%)

Generation and distribution of electric power: Introduction to hydroelectric, thermal, nuclear, diesel and gas power stations. Elements of transmission and distribution of electric power – Practical working voltages – underground systems and overhead systems – Typical power scheme – Different systems of transmission and circuits – Different types of line insulators used. **Switchgear and protection:** Requirement of circuit breaker, basic principle of operation of circuit breakers and types of circuit breakers.

References

1. P.S. Bimbhara – Electrical Machinery – Khanna Publishers
2. S.L. Uppal – Electrical Power – Khanna Publishers.
3. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0205 ENGINEERING MECHANICS

L	T	P	C
3	1	0	3

Prerequisites: Nil

Total Hours:64

Course Outcomes:

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

CO1. Understand the principles of mechanics (statics and dynamics), the concept of free body diagrams and resolution of forces.

CO2. Stress and strain concept on bodies and its physical applications.

CO3. Analyse given engineering or physical applications and calculate the required parameters like forces, moments, various motion parameters like, displacement, velocity, acceleration etc.

CO4. Ascertain the physical and mathematical meaning of quantities, like centroid, moment of inertia and their applications in engineering and locate centroid and calcutate the moment of inertia or second moment of area of typical sections used in engineering.

Module I (16 hours, End semester marks 25%)

Introduction to Mechanics: Definition and classification of mechanics – rigid body (statics and dynamics)
and deformable body mechanics.

Forces and Force systems: Force and its characteristics, principles of statics – concept of resultant and equilibrant, composition and resolution of forces force systems.

Coplanar concurrent force system: Equilibrium of two, three and more than three forces, moment of a force, Varignon's theorem of moments, equations of equilibrium, friction and its effects on bodies, engineering applications.

Coplanar parallel force system: Two parallel forces, general case of parallel forces in a plane, centre of parallel forces, centre of gravity, centre of mass, centroids of curves, areas and volumes – regular and composite. Pappu's theorems, equilibrium of distributed forces in a plane applications of the concept of centroid in engineering practice.

Module II (16 hours, End semester marks 25%)

Moment of Inertia: Concept of moment of inertia and second moment of area, moment of inertia of regular and composite solids, second moment of area of regular and irregular surfaces,

Polar moment of inertia / second moment of area, product of inertia, principal moments of inertia and principal axes, applications of the concepts in engineering practice.

Stress and Strain: Concepts of stress – stresses in axially loaded members – concept of strain – Hooke's law – elastic constants – thermal strain – bending stresses in beams – shear force and bending moment diagrams – cantilever beams, simply supported beams and over hanging beam

Module III (16 hours, End semester marks 25%)

Principle of virtual work: Concept of virtual work and the principle of virtual work, applications in engineering, equilibrium of ideal systems, stable annd unstable equilibrium.

Inroduction to Dynamics: Definitions, units, divisions – kinematics, kinetics.

Rectilinear translation: Kinematics of rectilinear motion – displacement, velocity, acceleration, kinetics – differential equations of motion, D'Alembert's principle in rectilinear translation and its applications, motion of a particle due to a constant force, motion of a particle due to a force proportional to displacement – simple harmonic motion, momentum and impulse, work and energy, conservation of energy, collision of two bodies – direct central impact.

Module IV (16 hours, End semester marks 25%)

Curvilinear translation: Kinematics of curvilinear translation – components of displacement, velocity and acceleration, normal and tangential acceleration, kinetics – differential equations of motion, motion of projectile – projection on horizontal and inclined surfaces, D'Alembert's principle in curvilinear motion and its applications, moment of momentum, work and energy in curvilinear motion.

Rotation of a rigid body: Kinematics of rotation – angular displacement, velocity and acceleration, RPM, relations of kinematic parameters of linear and angular motions, kinetics – differential equations of motion of a rigid rotating about a fixed axis, rotation under the action of a constant moment, rotation proportional to angular displacement – compound pendulum, D'Alemberts principle in rotation, resultant inertia force in rotation, principle of angular momentum in rotation, energy equation for rotating bodies.

References:

1. Timoshenko and Young. Engineering mechanics. McGraw Hill Book Company, Singapore. (1956)
2. Beer F.P. and Johnston, E.r. Mechanics for engineers (Vol. 1: Statics and Vol. 2: Dynamics). Tata McGraw Hill, New Delhi. (2004)

3. Merriam H.L. and Kraige L.G. (2003). Engineering mechanics (Vol. 1: Statics and Vol. 2: Dynamics). John Wiley and Sons, Somerset N.J. (2003)
4. Hibbeller R.C. Engineering mechanics. Vol. 1: Statics, Vol. 2: Dynamics. (Twelfth edition). Pearson Education Asia Pvt. Ltd., New Delhi.
5. Rajasekharan S. and Sankarasubramanian G. Fundamentals of engineering mechanics. (Third edition). Vikas Publishing House Pvt. Ltd., New Delhi. (2010)
6. R.S. Khurmi, N. Khurmi. Strength of Materials (Mechanics of Solids) Publisher S. Chand (2017)
7. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0206 MATERIALS SCIENCE

L	T	P	C
3	1	0	3

Pre-requisites: Nil
Total hours: 64

Course Outcomes:

After completion of the course, students will be able to

CO1: Explain the crystal structure of solids and various types of bondings.
CO2: Interpret x-ray diffraction patterns.
CO3: Explain phase diagrams.
CO3:Summarise the basics of nanostructure and nanotechnology.
CO4:Explain the electrical and magnetic properties of solids.
CO5:Develop a comprehensive understanding of production and properties of a range o modern technologically important materials.

Module I (16 hours, End semester marks 25%)

Structure of materials: Crystal structure - space lattice - unit cell - crystal systems - lattice planes - Miller indices - spacing between lattice planes - x-ray diffraction - Bragg's law - powder diffraction method - defects and dislocation in solids - diffusion in solids - Fick's law.
Bonding in solids - ionic, covalent and metallic bonding - Van der Waal and Hydrogen bonding.

Module II (16 hours, End semester marks 25%)

Phase diagrams: Phase rule - single component systems - binary phase diagrams - applications of phase diagrams.
Introduction to nanoscale science and technology: nanostructure -classifications - nanoring - nanorod - nanoparticle - optical, electrical, magnetic and mechanical properties - applications of nanotechnology.

Module III (16 hours, End semester marks 25%)

Electrical properties of materials: Free electrons in solids - metallic conductivity - resistivity - elements of band theory - semiconductors - intrinsic and extrinsic - p-n junction - semiconductor materials.

Magnetic properties of materials: Diamagnetism, paramagnetism, and ferromagnetism - Langevin theory - magnetic materials.

Module IV (16 hours, End semester marks 25%)

Ceramics and composites - classification - modern ceramic materials - cements - glass ceramics - carbon fibre - whiskers - thermoplastics - thermoset materials.
Polymers: Polymerisation techniques - natural and synthetic rubbers - plastics -FRP and CFRP materials - engineering applications.

References:

6. V. Raghavan, Materials Science and Engineering, Prentice Hall of India
7. S. K. Hajra Choudhury, Materials Science and Processes, Indian Book distributers
8. A. G. Guy, Essentials of Material Science, McGraw Hill
9. Van Vleck, Elements of Materials Science, Addison Wesley
10. C. Kittel, Introduction to Solid State Physics, Wiley.
11. S.O. Pillai, Solid State Physics, New age International.
12. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).

20-211-0207 COMPUTER PROGRAMMING

L	T	P	C
1	1	1	2

Pre-requisites: Nil
Total hours: 48

Course Outcomes:
On completion of this course the student will be able to:

CO1: Solve problems efficiently by choosing loops and decision making statements programming.
CO2: Implement different operations on arrays.
CO3: Solve problems using functions and recursion
CO4: Design and implement C programs using the concepts of structure, pointers and files.

Cycle I

C Programming Basics:

1. To write a program to calculate and display areas of rectangle and triangle.

Decision Making:

2. To write a program for electricity bill preparation.
3. To write a program to find the roots of a quadratic equation.
4. To write a simple menu driven calculator program using switch statement.
5. To write a program to find the sum of digits of a given number.

Cycle II

Looping:

6. To write a program to print all the prime numbers of a given range.
7. To write a program to print the sine and cosine series.
8. To write a program to print Pascal's triangle.

Arrays:

9. To write a program to print the sum and average of elements in an array.
10. To write a program to sort the given numbers using bubble sort.
11. To write a program to perform Matrix addition and matrix multiplication.

String:

12. To write a program to perform string manipulation functions like string concatenations, comparison, find the length and string copy without using library functions.
13. To write a program to arrange names in alphabetical order.

Cycle III

Functions:

14. To write a C program to calculate the mean, variance and standard deviation using functions.
15. To write a C program to perform sequential and binary search using functions.

Recursion:

16. To write a program to print the Fibonacci series using recursive function.
17. To write a program to print the factorial of the given number using recursive function.

Structure:

18. To print the mark sheet of n students using structures.

Pointers:

19. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.

Files:

20. To write a program to count the number of characters, lines in a file.

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, (2013).
2. Smarajit Ghosh, All of C, PHI Learning Pvt. Ltd, (2009).
3. Byron Gottfried, Programming with C, 2 nd edition, Tata McGraw-Hill, (2006).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
5. Sukhendu Dey, Debobrata Dutta, Complete Knowledge in C, Narosa PublishingHouse, New Delhi, (2009).
6. Virtual labs (http://www.vlab.co.in/)

20-211-0208 BASIC ELECTRONICS LAB

L	T	P	C
0	0	3	1

Pre-requisites: 20-211-0103 Basic Electronics
Total hours: 48

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

CO1: remember how to identify different electronic components and read its specification
CO2: read electronic circuits drawn using IEEE standard symbols
CO3: understand testing of various electronic components
CO3: properly use electronic testing and measurement instruments in the laboratories.
CO4: Understand the characteristics of electronic components such as diodes, BJTs and FETs

List of exercises
(18 hours, End semester marks 40%)

1. Familiarization/ identification of electronic components with specification: functionality, type, size/ value, colour coding, package etc. of components such as resistors, capacitors, inductors, ICs, switches, relays, crystals, displays, heat sinks etc.
2. Understanding IEEE symbols for electronic components in drawings.
3. Familiarization of electronic test and measurement instruments such as multi-meter, function generator, power supply, oscilloscope etc.
4. Testing of electronic components such as resistor, capacitor, diode, transistor, UJT and FET
5. Soldering practice: assemble a full wave rectifier using transformer, diodes, capacitor and Zener diode on a general purpose PCB.

List of experiments
(30 hours, End semester marks 60%)

1. Characteristics of diode
2. Characteristics of Zener diode
3. Transistor characteristics in CB configuration
4. Transistor characteristics in CE configuration
5. Bias and bias stabilization
6. FET characteristics
7. Design of FET amplifiers – frequency response

References :

1. The faculty in charge will provide lab manual
2. Virtual labs (http://www.vlab.co.in/)

SYLLABUS FOR III-VIII SEMESTERS

OF

B. Tech. Degree Programme in Instrumentation Technology,
Department of Instrumentation,
(Faculty of Technology)

(With effect from 2020 Admission)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN – 682 022

20-211-0301 COMPLEX ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS.

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Transform a region to another region using conformal mapping. (Understand)

CO2: Evaluate real integrals using residue theorem.(Apply)

CO3: Formation and solution of partial differential equation.(Apply)

CO4: Determine solution of partial differential equation for vibrating string and heat conduction. (Apply)

Module I (16 hours, End semester marks 25%)

Analytic functions - Cauchy-Riemann equation (Cartesian and polar) -Harmonic function-construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II (16 hours, End semester marks 25%)

Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III (16 hours, End semester marks 25%)

Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagrange's equation—Linear homogeneous partial differential equation with constant coefficient.

Module IV (16 hours, End semester marks 25%)

One dimensional wave equation, D'Alembert's solution and one dimensional heat flow equation - solution by the method of separation of variables - application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th ed.,Wiley,2011.
2. Grewal, B. S.,Higher Engineering Mathematics, 43rd ed., Khanna Publishers,2013.
3. https://nptel.ac.in/courses/111/107/111107111/

20-211-0302 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Explain and identify types of errors during measurement of electrical quantities (Understand).
CO2: Describe the working of instruments used for measurement of voltage, current and power (Understand).
CO3: Identify and evaluate bridges for measurement of R, L and C (Apply).
CO4: Describe calibration and standardisation of measuring instruments (Understand).
CO5: Summarise the characteristics of instruments for magnetic measurements (Understand).

Module 1 (16 Hours. End semester marks: 25%)

Measurements and measuring systems: SI units- Significance of measurements – method of measurements – type of instruments – classification of instruments – functions of instruments and measurement system. Accuracy and precision – significant figures – types of errors - probability errors- limiting errors - statistical analysis.

Module II (16 Hours. End semester marks: 25%)

Electrical instruments: D' Arsonval galvanometer-constructional details – dynamic behavior of D' Arsonval galvanometer – galvanometer sensitivity – PMMC type -conversion of PMMC type instruments to voltmeter and ammeter - MI type - dynamometer type.

Cathode ray oscilloscopes: - Principles, block diagram, construction.

Module III (16 hours, End semester marks 25%)

Potentiometers: D.C. potentiometer-use of DC potentiometer in the measurement of voltage, current, resistance and power – calibration of ammeter, voltmeter, wattmeter – A.C. potentiometers – use of A.C. potentiometers in magnetic measurements

DC bridges: General equation for bridge at balance, Types of bridges –Wheatstone, Kelvin, Carry Foster slide wire bridge.

AC bridges: General equation for bridge at balance, Maxwell's inductance and Maxwell's inductance -Capacitance bridge.

Module IV (16 hours, End semester marks 25%)

Magnetic measurements : Classification of magnetic measurements – measurement of flux density and magnetizing force – magnetic potentiometers – determination of B.H. curve – hysteresis loop – testing of bar and ring specimens– measurement of air gap flux – testing of permanent magnets.

Experimental learning modules:

1. http://vlab.amrita.edu/index.php?sub=1&brch=192

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. A K Swahny, A Course in Electronic Measurements and Instrumentation, Dhanpath Rai & Co, 2015.
2. David A Bell, Electronic instrumentation and Measurements, 3rd Edition, Oxford, 2017.
3. Kalsi H S, Electronic Instrumentation and Measurements, Mc Graw hill, 4th ed., 2019.
4. https://nptel.ac.in/courses/108/105/108105153/

20-211-0303 DIGITAL ELECTRONICS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain digital system such as digital representation of information, digital logic, boolean algebra etc (Understand).
CO2: Compare different types logic families with respect to their performance and efficiency (Understand)
CO3: Design combinational logic circuits (Apply).
CO4: Design sequential logic circuits (Apply).
CO5: Demonstrate basic knowledge in Verilog (Understand).
CO6: Describe semiconductor memories and PLDs (Understand).

Module I (16 hours, End semester marks 25%)

Number systems and Codes: –Decimal, binary, octal, hexadecimal number systems and conversions – addition, subtraction multiplication and division arithmetic in various number systems –four bit BCD codes, excess – 3 code, gray code, error detecting and correcting codes – parity checking, hamming code.

Module II (16 hours, End semester marks 25%)

Logic gates: – AND, OR, NOT, NAND, NOR, EXOR, EXNOR.
Boolean postulates and laws: – De-Morgan's theorems, principle of duality, minimization of boolean expressions, Sum of Products (SOP), Product of Sums (POS), Canonical forms, Karnaugh map minimisation.
Introduction to Logic families: –RTL,DTL and TTL characteristics –TTL inverter - circuit description and operation, CMOS inverter - circuit description and operation, structure and operations of TTL and CMOS gates; NAND in TTL and CMOS, NAND and NOR in CMOS ,comparison of RTL, DTL, TTL, I^2L, CMOS and ECL logic families.

Module III (16 hours, End semester marks 25%)

Combinational Logic Circuits:- Comparators, multiplexers, de-multiplexers, encoder, decoder. half and full adders, subtractors, serial and parallel adders, BCD adder.
Sequential Logic Circuits: Building blocks like S-R, JK and master-slave JK FF, edge triggered FF, conversion of flip-flops, excitation table and characteristic equation. shift registers-SIPO, SISO,

PISO, PIPO. shift Registers with parallel Load/Shift, ring counter and Johnson's counter. asynchronous and synchronous counter design, mod N counter.

Module IV (16 hours, End semester marks 25%)

Basics of Verilog: -- basic language elements: identifiers, data objects, scalar data types, operators, modeling in Verilog, implementation of gates with simple Verilog codes. Modeling and simulation of combinatorial circuits with Verilog codes at the gate level. Modeling and simulation of flip-flops and counters in Verilog.
Semiconductor memories: –Classification-RAM, ROM, PROM, EEPROM.
Programmable Logic devices –Design of combinational logic using PAL and PLA.

Experimental learning modules:

1. http://cse11-iiith.vlabs.ac.in/
2. http://he-coep.vlabs.ac.in/
3. http://vlabs.iitkgp.ernet.in/dec/
4. http://cse15-iiith.vlabs.ac.in/
5. http://vlabs.iitb.ac.in/vlabs-dev/labs/digital_application/labs/index.php
6. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/labs/explist.php
7. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/cool_developers/labs/index.html
8. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/labs/index.php
9. http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/labs/index.html
10. http://vlabs.iitkgp.ernet.in/coa/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Mano M.M., Ciletti M.D., Digital Design, Pearson India, 4th Edition, 2006.
2. D.V. Hall, Digital Circuits and Systems, Tata McGraw Hill, 1989.
3. S. Brown, Z. Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw Hill
4. Samir Palnikar, Verilog HDL: A Guide to Digital Design and Syntheis, Sunsoft Press.
5. http://nptel.ac.in/courses/117105080/
6. https://nptel.ac.in/courses/117/106/117106114/

20-211-0304 LINEAR INTEGRATED CIRCUITS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the working of operational amplifiers (Understand)
CO2: Describe the characteristics of operational amplifiers and its effect on output (Analyse)
CO3: Explain and design the linear and non linear applications of op-amps (Apply)
CO4: Describe op-amp based comparators and waveform generators.(Understand)
CO5: Explain the working of multivibrators using general purpose opamp and 555 IC (Apply)
CO6: Illustrate the application of monolithic regulator ICs and PLL.(Understand)

Module I (16 hours, End semester marks 25%)

Differential amplifiers: – Differential amplifier configurations using BJT– Input and output impedance, Voltage gain, CMRR, Transfer characteristics.

Operational Amplifiers:-Block diagram –ideal characteristics- Op Amp parameters –open-loop op-amp configurations(inverting, non-inverting, differential)- voltage-transfer curve- frequency response of Op Amps –gain-Bandwidth product-slew rate.

Module II (16 hours, End semester marks 25%)

Op-amps with negative feedback: virtual ground concept-inverting amplifier-non-inverting amplifier
Applications of op-amps: : scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Solution of differential equations,voltage to current and current to voltage converters,Instrumentation amplifier

A**ctive filters:** Advantages, First and second order low pass, High pass, Band pass and band reject filters, Design of Low pass filters using Butterworth approximations.

Module III (16 hours, End semester marks 25%)

Non-linear applications: Precision rectifiers – Logarithmic and anti-logarithmic amplifiers-analog multipliers - Comparator-Schmitt Trigger-sample and hold circuits-multivibrators- Phase shift and Wien bridge oscillators

Module IV (16 hours, End semester marks 25%)

Timer IC 555: Astable and monostable operations, applications.

Monolithic regulators:– Switched mode power supplies – Principles and applications – switching regulators- Fixed voltage regulators, 78XX and 79XX series, Adjustable voltage regulators, IC 723

Phase locked loops and applications: Operating principles - Building blocks-Lock and capture – classification-phase sensitive detection using PLL.

Experimental learning modules:

1. http://vlabs.iitkgp.ernet.in/be/
2. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/index.html
3. http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/index.php

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Jacob Milman and Christos C. Halkias, Integrated Electronics, McGrow-Hill, 1972.
2. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010.
3. Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008.
4. Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
5. William D. Stanley, Operational Amplifiers and Linear Integrated Circuits, Pearson, 4th Ed., 2007.
6. http://nptel.ac.in/courses/117103063/
7. https://nptel.ac.in/courses/117/101/117101106/
8. https://nptel.ac.in/courses/117/107/117107094/

20-211-0305 TRANSDUCERS - I

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Describe working principles of various transducers/sensors (Understand).
CO2: Interpret the characteristics of the transducers/sensors (Understand).
CO3: List various standards used for selection of transducers/sensors (Remember)
CO4: Select transducers/sensors for specific applications (Apply).

Module I (16 hours, End semester marks 25%)

Temperature measurement: Temperature scales, classification of temperature sensors, standards - different types of filled system thermometers, installation maintenance, source of errors - Bimetallic thermometer - Thermocouples, basic principles, various types of thermocouples, materials, construction - RTD, materials, construction, characteristics, measuring circuits, three wire and four wire methods - Thermistor, materials, construction, characteristics, measuring circuits - Radiation methods of temperature measurement, radiation pyrometer, optical pyrometer - Semiconductor and IC sensors.

Module II (16 hours, End semester marks 25%)

Pressure measurement: Definition, pressure scale, standards - Elastic type pressure gauges, material, construction, calibration - Elastic pressure sensors - Pressure gauges using strain gauge, capacitive, inductive and piezoelectric materials - Measurement of low pressure, McLeod gauge, thermal conductivity gauge, thermocouple gauges, ionisation gauges - Pressure calibration using dead weight tester.

Module III (16 hours, End semester marks 25%)

Level measurement: Float type level indicator, displacer level indicator, air purge systems, diaphragm box type, manometer type - Electrical methods of level measurement, resistive, capacitive, ultrasonic, radiation type, laser level sensors - Solid level measurement, gamma ray absorption method, weighing method, capacitive type, diaphragm method, rotating paddle, stack detector - Level switches.

Module IV (16 hours, End semester marks 25%)

Measurement of speed: – Mechanical tachometers, revolution counter type, resonance type, centrifugal force type tachometers – Electrical tachometers, Eddy current, electric generator, contactless type, frequency type tachometers - Stroboscopic tachometers - magnetic pickups, encoders, photoelectric pickups.
Measurement of acceleration – potentiometric accelerometer, LVDT accelerometer, piezo-electric accelerometer, strain gauge accelerometer.

Experimental learning modules:

1. http://sl-coep.vlabs.ac.in/
2. http://eerc03-iiith.vlabs.ac.in/
3. http://fm-nitk.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
2. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
3. Rangan, C. S., Sarma, G. R., & Mani, V. S. “Instrumentation: Devices and Systems” by TATA MCGRAW-HILL 1983.
4. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
5. R. K. Jain, “Mechanical and industrial measurements” by Khanna Publishers 1996.
6. E.O. Doebelin, “Measurement Systems”, McGraw Hill, Fifth ed., 2003.
7. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
8. https://nptel.ac.in/courses/108/108/108108147/
9. https://nptel.ac.in/courses/108/105/108105064/

20-211-0306 PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the basic blocks of an Instrumentation system and its characteristics (Remember).
CO2: Describe generalised system mathematically (Understand).
CO3: Generalize different types of signals and noise (Understand).
CO4: Describe and explain data acquisition systems and converters (Understand).
CO5: Explain some of the common digital instruments (Understand).
CO6: Outline the basics of telemetry and presentation systems (Understand).

Module I (16 hours, End semester marks 25%)

Generalised Performance characteristics of Instruments: Functional elements of an Instrument, Performance characteristics : static characteristics, dynamic characteristics, mathematical model, zero order, first order, second order Instruments – impulse, step and ramp response, Loading effect of Instrument, types and sources of error.
Signals and noise: Deterministic and random signals – periodic and aperiodic signals, sources of noise, Introduction to signal conditioning.

Module II (16 hours, End semester marks 25%)

Errors in measurement and statistical Analysis: Limiting errors, Types of errors – Gross, systematic, Random and sources of errors, error reduction techniques, Graphical representation of data, curve fitting, statistical concepts, mean and median values, standard deviation, variance, frequency distribution, normal and Gaussian distribution, confidence level, Analysis of linear systems.

Module III (16 hours, End semester marks 25%)

Data acquisition systems: Objectives of DAS, elements of analog data acquisition system – elements of digital DAS –Elementary treatment of A/D and D/A conversion, D/A converters – Binary weighted and R-2R ladder type – D/A accuracy and resolution – A/D converters counter ramp, successive approximation, Simultaneous, dual – slope A/D converters – A/D accuracy and resolution – sample and hold circuit. – Data loggers – elements of microprocessor and PC based DAS.

Module IV (16 hours, End semester marks 25%)

Data presentation elements: – Review and choice of data presentation elements, pointer – scale indicators, Analog chart recorders –Oscillographic recorders, magnetic tape recorders, Alpha numeric displays: Seven segment display, LCD devices, and LED devices. Digital meters – resolution, sensitivity – Digital Voltmeter- Digital Frequency meter, Digital Multimeter, RMS meter, Q meter.
Digital storage oscilloscope – Principles and instrumentation – Spectrum analyzer.

Experimental learning modules:
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. A K Shawney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpath Rai&Co.
2. A J Bouvens, “Digital Instrumentation”, McGraw Hill.
3. A.D. Helfrick and W.D. Cooper, “Modern electronic instrumentation and measurement techniques”, Prentice Hall India.
4. Doeblin, “Measurement system Application and Design”, McGraw Hill
5. https://nptel.ac.in/courses/108/105/108105153/

20-211-0307 ANALOG ELECTRONICS LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Design and set up various linear and non-linear circuits using operational amplifiers(Apply)
CO2: Design and set up various active filter circuits and study its characteristics(Apply)
CO3: Design and set up various waveform generator circuits using op-amps and 555 ICs(Apply)
CO4: Design and set up ADC and DAC circuits(Apply)
CO5: Design and set up voltage regulator circuits(Apply)

List of Experiments

1. Design and implementation of inverting amplifier, non-inverting amplifier and voltage follower circuits using op-amps.
2. Measurement of operational amplifier parameters
3. Adder and subtractor circuits using op-amps
4. Design and implementation of instrumentation amplifier using op-amps
5. Design and implementation of differentiator and integrator circuits using op-amps
6. Design and implementation of comparator circuits using op-amps
7. Design and implementation of active low-pass, high-pass, narrow band-pass and notch filters
8. Design and implementation of waveform generator circuits using op-amps
9. Design and implementation of astable and monostable multivibrator using 555 timer IC
10. Design and implementation of analog to digital converter
11. Design and implementation of digital to analog converter
12. Design and implementation of DC voltage regulator circuits

Note: Students are required to design, simulate and analyze the circuit using available software before implementing in hardware. Before starting the design/experiments, students must refer the datasheet of the components.

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/index.php
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. David A Bell, "Laboratory manual for operational amplifiers and Linear ICs", 2nd Edition, Prentice Hall
2. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson Education Asia. 4th Edition.
3. 2. D. Roy Choudhury, “Linear Integrated Circuits”, New Age International Publishers, 5th Edition.
4. https://nptel.ac.in/courses/117/107/117107094/

20-211-0308 ELECTRICAL MACHINES LAB

L	T	P	C
0	0	3	1

Total hours : 48

Course Outcomes:

(The cognitive levels are given in bracket)
On completion of the course, students will be able to:

CO1: Analyse the performance of DC motors and DC generators by performing suitable tests (Analyse).

CO2: Evaluate the performance characteristics of AC generators & AC motors by conducting appropriate experiments (Apply).

CO3: Interpret the performance characteristics of transformers by conducting OC, SC & load test (Apply).

CO4: Implement the concept of calibration and understand the limitations of the measuring instruments (Understand).

CO5: Demonstrate methods of measurement of self-inductance, capacitance and resistance using AC and DC bridges (Understand).

List of experiments:

1. Load Test on D.C. shunt motor
2. Load test on D.C. shunt generator
3. Open circuit and load test on separately excited D.C. generator
4. Load test on D.C. series motor
5. Load test on D.C. shunt generator
6. Load test on single phase induction motor
7. No load & Blocked rotor test on three phase induction motor
8. No load characteristic of single-phase generator
9. O.C.C. and S.C.C. of three phase synchronous generator
10. Open circuit and short circuit test on single phase transformer
11. Load Test on single phase transformer
12. Calibration of ammeter and voltmeter using precision potentiometer
13. Measurement of 3-phase power & Power factor using two-watt meter method
14. Kelvin’s double bridge

Experimental learning modules:
1. http://vem-iitg.vlabs.ac.in/
2. http://em-coep.vlabs.ac.in/

3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.

2. Theraja B. L., A Textbook of Electrical Technology, S. Chand & Company, New Delhi, 2008.

3. http://nptel.ac.in/courses/108105017/17

4. https://nptel.ac.in/courses/108/105/108105155/

20-211-0401 NUMERICAL AND STATISTICAL METHODS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Solve algebraic and transcendental equations by numerical methods (Apply).

CO2: Perform numerical differentiation and integration (Understand).

CO3: Find the mean and variance of a probability distribution including the binomial distribution (Understand).

CO4: Use statistical tests in testing hypotheses on data (Apply).

Module I (16 hours, End semester marks 25%)

Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences.

Module II (16 hours, End semester marks 25%)

Numerical differentiation at the tabulated points with forward, backward and central diffrences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation

Module III (16 hours, End semester marks 25%)

Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting- fitting of straight line, parabola, exponential.

Module IV (16 hours, End semester marks 25%)

Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test .

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/labs/explist.php

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be

included as and when it is made available by Ministry of Education.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th ed., Wiley, 2011.
2. Grewal, B. S., Higher Engineering Mathematics, 43rd ed., Khanna Publishers, 2013
3. Kandaswamy, p., Thilagavathy, K., Gunavathy, K., Numerical methods, S Chand & Co.
4. Richard A. Johnson, Irvin Miller and John E. Freund, Probability and statistics for engineers, 8th ed.,Pearson,2010.
5. https://nptel.ac.in/courses/108/108/108108079/
6. https://nptel.ac.in/courses/111/105/111105077/
7. https://nptel.ac.in/courses/111/107/111107062/
8. https://nptel.ac.in/courses/111/107/111107105/
9. https://nptel.ac.in/courses/127/106/127106019/

20-211-0402 TRANSDUCERS - II

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to
CO1: Describe working principles of various transducers/sensors (Understand).
CO2: Interpret the characteristics of the transducers/sensors (Understand).
CO3: List various standards used for selection of transducers/sensors (Remember).
CO4: Select transducers/sensors for specific applications (Apply).
CO5: Describe latest technologies used for development of advanced transducers/sensors (Understand).

Module I (16 hours, End semester marks 25%)

Flow Measurement: Bernoulli's theorem: velocity and pressure profile of closed channel flow, Classification of fluid flow - Reynolds number, laminar and turbulent flow – Variable head flowmeters, orifice, venturi tube, flow nozzle, pitot tube, square root extractor – Variable area flowmeter, rotameter - Quantity flow meters, positive displacement, nutating disc, reciprocating pistons, oscillating pistons, rotating vane, lobed impeller type – Electromagnetic flowmeter – Ultrasonic flowmeter – Turbine flowmeter - Mass flow meter – Anemometer.

Module II (16 hours, End semester marks 25%)

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, piezoelectric force transducers, vibrating wire force transducers, strain gauge torque meter, inductive torque meter, magneto-strictive transducers, torsion bar dynamometer, etc.

Module III (16 hours, End semester marks 25%)

Measurement of viscosity, consistency and density: units, coefficient of viscosity, basic principles of capillary viscometers, Saybolt's viscometers, rotameter type viscometers, rotating cylinder viscometer, electrical type viscometers – rotating vane consistency meter, oscillating type consistency meter - different types of density measurement: effect of temperature and pressure on density.
Measurement of humidity and moisture – basic principles – hygrometers – psychrometers - humidity charts –dew point hygrometers-electrical transducers and measurement systems for humidity, Electrical conductivity – Dielectric constant – Automatic electric psychrometer.

Module IV (16 hours, End semester marks 25%)

pH and conductivity meters – pH measurement – various types of electrodes – installation and maintenance of pH meters – conductivity meter – electrical conductivity of solution – cell

construction operating principles.

Advances in sensors technology: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, optical fiber sensors.

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
2. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
3. Rangan, C. S., Sarma, G. R., & Mani, V. S. “INSTRUMENTATION : DIVICES AND SYSTEMS” by TATA MCGRAW-HILL 1983.
4. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
5. R. K. Jain, “Mechanical and industrial measurements” by Khanna Publishers 1996.
6. E.O. Doebelin, “Measurement Systems”, McGraw Hill, Fifth ed., 2003.
7. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https:// online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
8. https://nptel.ac.in/courses/108/108/108108147/

20-211-0403 CONTROL ENGINEERING - I

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Describe the basic features and configurations of control systems (Understand).

CO2: Find the transfer function of mechanical, electrical and electromechanical systems (Understand).

CO3: Find the transfer function of multiple subsystems using block diagram reduction technique and Mason's gain formula (Apply).

CO4: Specify the transient and steady state performance of control systems (Understand).

CO5: Make and interpret a basic Routh table for stability analysis (Apply)

CO6: Sketch a root locus (Apply)

CO7: Define and plot the frequency response of a system (Understand).

CO8: Use the root locus to design cascade compensators in time domain (Apply)

CO9: Use the Bode plot to design cascade compensators in frequency domain (Apply).

Module I (16 hours, End semester marks 25%)

Introduction: Basic ideas of control systems and their classification - review of Laplace transforms - modelling of mechanical, electrical and electromechanical systems - transfer function -block diagrams reduction techniques - signal flow graphs - Mason's gain formula

Feedback characteristics of control systems:- Reduction of parameter variation- – control over system dynamics - effects of disturbances signal – regenerative feed back.

Module II (16 hours, End semester marks 25%)

Time domain analysis: Types of test inputs -time response of first and second order systems - design specifications - – effect of addition of poles and zeros -consideration for higher order systems - steady state error and error constants for feedback systems.

Concept of stability: conditions for stability – Routh Hurwitz Criterion.

Module III (16 hours, End semester marks 25%)

Root locus technique: root locus construction rules - sketching of root locus, root sensitivity.

Frequency domain analysis: Bode plot- asymptotic approximations -gain margin and phase margin - polar plot - Nyquist plot - stability analysis in frequency domain.

Module IV (16 hours, End semester marks 25%)

Introduction to design considerations in classical design: – Realisation of basic compensators. cascade compensation in time domain - cascade compensation in frequency domain -illustrative examples.

Experimental learning modules:
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. Nagarath Gopal, Control Systems Engineering, New Age International Publication, 5th ed..
2. Norman S. Nise, Control Systems Engineering, Wiley, seventh edition.
3. K. Ogata,Modern Control Engineering, Prentice Hall Publications, 5th edition.
4. G. Goodwin, S. Graebe, Mario Saglado, Control System Design, Pearson education.
5. G. Franklin, J. Powel, A Naeini, Feedback Control of Dynamic Systems, Pearson Education.
6. https://nptel.ac.in/courses/108/106/108106098/

20-211-0404 POWER ELECTRONICS

L	T	P	C
3	1	0	4

Total Hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)
On completion of the course, students will be able to:

CO1: Describe operation and characteristics of different power devices (Understand)

CO2: Choose appropriate power semiconductor device in converter circuits and develop their triggering circuits (Apply).

CO3: Draw output voltage and current waveforms for different power electronic converters (Apply)

CO4: Describe the operation of different types of power electronic converters (Understand).

CO5: Select appropriate power converter for specific applications (Apply)

Module I (16 hours, End semester marks 25%)

Introduction to power electronic devices: Power diode, Power MOSFET, IGBT (basic structure and characteristics)

Thyristors: Terminal characteristics of thyristor. Thyristor ratings, thyristor protection, series and parallel connection (analysis not required). Gate triggering circuits – R, RC, UJT triggering circuits.

Other members of thyristor family: Diac, triac, PUT, LASCR.

Module II (16 hours, End semester marks 25%)

Phase controlled rectifiers: Half wave circuit with RL load, Half wave circuit with RL load and freewheeling diode, Half wave circuit with RLE load. Full wave controlled converters- Single phase full wave converters with continuous and discontinuous load current. Three phase thyristor converters. Dual converters.

Module III (16 hours, End semester marks 25%)

Choppers: Principle of chopper operation- step down and step up choppers- control strategies, Types of chopper circuits, Commutation in chopper circuits.

Inverters: Single phase voltage source inverters, three phase bridge inverter, Voltage control in single phase inverters, Pulse width modulated inverters. Current source inverters.

Module IV (16 hours, End semester marks 25%)

AC voltage controllers: Principle of AC voltage controllers, Single phase voltage controllers, Sequence control of AC voltage controllers- Two stage and multistage sequence control of voltage controllers.

Cycloconverters: Principle of cycloconverter operation, Single phase to single phase circuit- Step-up cycloconverter and Step-down cycloconverter. Three phase Half wave cycloconveter.

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/power_electronics/index.php

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. P. S. Bimbhra- Power Electronics- Khanna Publishers.
2. Muhammad H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education.
3. M. Ramamoorthy- An Introduction to Thyristors and Their Applications- East West Press
4. Chute and R D Chute Electronics in Industry- McGraw Hill.
5. https://nptel.ac.in/courses/108/101/108101126/
6. https://nptel.ac.in/courses/108/107/108107128/

20-211-0405 PNEUMATICS AND HYDRAULICS.

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the importance of Pneumatics & hydraulics and compare them (Remember)
CO2: Classify and describe the working of air compressors (Understand).
CO3: Describe different types of pneumatic valves (Understand).
CO4: Identify the symbols of different kinds of pneumatic valves (Remember).
CO5: Design pneumatic circuits for specific applications (Apply)
CO6: Sketch, describe and analyse the working of pneumatic circuits (Analyse).
CO7: Write the basic and advanced equations of fluid dynamics (Understand).
CO8: Describe the importance of hydraulics and list their application areas (Understand).
CO9: Explain different kinds of hydraulic pumps and actuators (Analyse).

Module I (16 Hours. End semester examination 25% marks)

Introduction: Comparison of pneumatics, hydraulics and electrical systems. Pneumatic power supply: Compressor schemes of air production: Important parts, Classification, Selection criteria, Piston reciprocating type, Rotary vane type, Twin lobe (or Roots) type, Screw type compressors. Air Receiver Tank, Distribution Filters – Regulators -Lubricators (FRL unit). Valves: Speed control valves – Directional control valves –Time delay valves– Slide valves – Solenoid valves – Quick exhaust valve – Impulse valve- Servo and Proportional valves, Electro-mechanical I/P and E/P controlled valves – Applications. Pneumatic cylinders: Parts of Air Cylinders, Single acting - Double acting and Duplex types of cylinders, Cushion assembly.

Module II (16 Hours. End semester examination 25% marks)

Pneumatic control circuits and systems: Valve symbols. Manual control of Single acting and Double acting Pneumatic cylinders – Pilot operated circuits, Speed control circuits for single and double acting cylinders, Reciprocating cylinder circuit, Sequence operation of two cylinders – three cylinders and more cylinders.

Module III (16 Hours. End semester examination 25% marks)

Fluid flow: Types of fluid flow. Steady state flow of ideal gases: Compressible flow: Basic equations of Compressible flow -Continuity equation, Bernoulli's equation for compressible flow undergoing Isothermal process and Adiabatic process, Momentum equation and Equation of state. Mach number, Weight flow equation of a compressible fluid– Flow of compressible fluid through Orifices and Nozzles, Discharge coefficient, Flow of viscous incompressible fluid through circular pipe (Derivation of Hagen-Poiseuille's formula), Equations for viscus fluid flow between two parallel plates.

Module IV (16 Hours. End semester examination 25% marks)

Introduction to Hydraulics:- Applications - Elements of hydraulic systems – Advantages and disadvantages –Pascal's law, Service properties of hydraulic fluids– additives – filters and strainers – Fluid seals – Hydraulic symbols – Hydraulic accumulators: Bladder type, Free piston type, Gravity type, Spring loaded type. – Fluid power pumps: External gear pumps: Design, Pump characteristics, Internal power losses and advantages – Internal gear pump, Vane pump. Hydraulic actuators: Linear and Rotary actuators. Hydraulic Jack – Hydraulic lift. New trends in Hydraulic systems.

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/pneumatic-system-coep/labs/explist.php

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. W.A. Blaine – Analysis and design of pneumatic system – John Wiley and sons.
2. S.C. Rangwala – Fluid Mechanics – Charotan Publishing House.
3. F.K. Kay – Pneumatic Circuit Design – Machinery Publishing Company.
4. Pneumatic Circuits and Low weight Automation – Trade and Technical Press, England.
5. Principles and Theory of Pneumatics – Trade and Technical Press Ltd., England.
6. W. Deppert and K. Stoll, Pneumatic Control-An introduction to the principles, Vogel-Verlag,
7. B. W. Anderson, The analysis and Design of Pneumatic Systems, Krieger Pub. Co., 2001.
8. https://nptel.ac.in/courses/112/106/112106300/

20-211-0406 SIGNALS AND SYSTEMS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Explain the concept of signals and systems, their classifications and analysis using differential/ difference equations (Understand)

CO2: Explain the concept of impulse response and perform convolution (Understand)

CO3: Analyse LTI systems using Laplace transforms /Z transform (Apply).

CO4: Outline and evaluate the frequency response of LTI systems (Understanding)

CO5: Analyse systems in complex frequency domain (Apply).

CO6: Explain the need for sampling and reconstruction and Sampling theorem (Understand).

Module I (16 hours, End semester marks 25%)

Introduction to Signals: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties - Classification of signals - Continuous time (CT) and Discrete time (DT) Signals -Transformations of the independent variable - Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential.

Introduction to Systems: CT and DT Systems - Properties of systems - Linear time-invariant (LTI) systems - The representation of signals in terms of impulses - convolution - Properties of LTI systems - Singularity functions - LTI Systems described by differential and difference equations and calculation of impulse responses.

Module II (16 hours, End semester marks 25%)

The Laplace transform: The region of convergence for Laplace transforms - The inverse Laplace transform - Properties of the Laplace transform - Analysis and characterization of First-order and second-order LTI systems using the Laplace transform.

The z-transform: The region of convergence -Pole zero plot - Properties of the z-transform - Inverse z-transform (Partial fraction method, Long division method and Convolution method) - Analysis and characterization of LTI systems using z-transforms - System function.

Module III (16 hours, End semester marks 25%)

Continuous Time Fourier Series and Continuous Time Fourier Transform: The response of continuous-time LTI systems to complex exponentials - Fourier series representation of Continuous time periodic signals - Convergence of Fourier series - Properties - Continuous- time Fourier transform representation of Aperiodic signals - Fourier transform of periodic signals - Properties - Fourier transform and Fourier series pairs

Module IV (16 hours, End semester marks 25%)

Discrete Time Fourier Series and Discrete Time Fourier Transform: The discrete-time Fourier series - Properties - Discrete-time Fourier transform - Properties of Discrete-time Fourier transform – Frequency Response of Discrete -time systems- Transfer function.

Sampling: Introduction - Representation of a continuous-time signal by its samples - the sampling theorem -The effect of under sampling: aliasing - Sampling with a zero-order hold - Reconstruction of a signal from its samples using interpolation - Sampling of discrete-time signals

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/signals/labs/index.php
2. http://ssl-iitg.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Alan V Oppenheim, Alan S Willsky, Signals and Systems. Prentice Hall India ,2/e, (2010)
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.
8. S.S. Soliman, M.D. Srinath, Continuous and Discrete signals and systems, Prentice Hall India, 2/ e, 2004.
9. C.L. Phillips, J.M. Parr, E.A. Riskin, Signals Systems and Transforms. Pearson Education, 4/e, 2008.
10. http://ssl-iitg.vlabs.ac.in/

20-211-0407 DIGITAL ELECTRONICS LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Formulate digital functions using Boolean Algebra and verify experimentally (Apply).
CO2: Utilise datasheets for designing logic circuits (Apply).
CO3: Design and implement combinational logic circuits (Apply).
CO4: Design and implement sequential logic circuits (Apply).

List of exercises
(6 hours, End semester marks 10%)

1. Familiarization of Logic Gates (AND, NAND, OR, NOR, XOR)
2. Identification of typical logic ICs
3. Interpreting IC datasheets
4. Familiarization of Verilog and SPICE

List of experiments
(42 hours, End semester marks 90%)

1. Verification & Realization of De Morgan's theorem.
2. Realization of SOP & POS functions after K-map reduction.
3. Half adder & Full adder using gates.
4. 4-bit adder/subtractor & BCD adder using IC 7483.
5. Realization of 2-bit comparator using gates and study of four-bit comparator IC 7485.
6. BCD to decimal decoder and BCD to 7-segment decoder & display.
7. Study of multiplexer IC and realization of combinational circuits using multiplexers.
8. Realization of RS, T, D & JK flip flops using gates.
9. Study of flip flop ICs (7474 & 7476).
10. Realization of ripple up and down counters and modulo-N counter using flip-flops.
11. Study of counter ICs (7490, 7493).
12. Measure and plot TTL inverter (IC 7404) transfer characteristic. Also, measure the propagation delay of a TTL gate by a ring oscillator arrangement.
13. Design of synchronous up, down & modulo-N counters.
14. Realization of 4-bit serial IN serial OUT registers using flip flops.
15. Study of shift register IC 7495, ring counter and Johnson's counter.
16. Verilog implementation of full adder, 4-bit magnitude comparator

Experimental learning modules:

1. http://cse11-iiith.vlabs.ac.in/
2. http://he-coep.vlabs.ac.in/
3. http://vlabs.iitkgp.ernet.in/dec/
4. http://cse15-iiith.vlabs.ac.in/
5. http://vlabs.iitb.ac.in/vlabs-dev/labs/digital_application/labs/index.php
6. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/labs/explist.php
7. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/cool_developers/labs/index.html
8. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/labs/index.php
9. http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/labs/index.html
10. http://vlabs.iitkgp.ernet.in/coa/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References :

1. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011.
2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning,
3. 2013
4. Bhasker, Jayaram. A verilog HDL primer, Star Galaxy Publishing, 1999.
5. http://nptel.ac.in/courses/117105080/
6. https://nptel.ac.in/courses/117/106/117106114/

20-211-0408 MATERIAL SCIENCE LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Explain the behaviour of engineering materials under various forms and stages of loading (Understand).

CO2: Evaluate the strength and stiffness properties of engineering materials under various loading conditions (Analyse).

CO3: Characterise the elastic properties of various materials (Apply).

CO4: Conduct hardness test with different hardness testing machine (Apply).

CO5: Elucidate the universal testing machine and the tests conducted in it (Apply).

List of Experiments

1. Study the Brinell hardness testing machine & perform the Brinell hardness test.
2. Study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. Study the Vickers hardness testing machine & perform the Vickers hardness test.
4. Determine the impact strength of a given specimen by Izod test.
5. Determine the impact strength of a given specimen by charpy test.
6. Study the Universal Testing Machine & perform the Tensile Test.
7. Perform Compression test & find out the compressive strength of a test piece.
8. Perform the shear test on UTM.
9. Study the Torsion Testing Machine & perform torsion test.

Experimental learning modules:

1. http://sm-nitk.vlabs.ac.in/
2. http://eerc01-iiith.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. S.P. Timoshenko, History of Strength of Materials, Dover publications, 1953
2. IS 1608 (2005): Metallic Materials – Tensile testing at Ambient temperature, 3rd Revision, July 2008
3. IS 1598 (1977): Method for Izod Impact test of Metals, 2nd reprint, September 1986.
4. IS 1499 (1977) : Method for Charpy Impact test (U-Notch) for metals, 3rd reprint, March 1992.
5. https://nptel.ac.in/courses/105/105/105105108/

20-211-0501 CONTROL ENGINEERING II

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the basics of sampled data systems and digital control (Understand).
CO2: Find sampled data transfer functions (Understand).
CO3: Design digital controllers using time domain and analytical methods (Apply).
CO4: Model electrical and mechanical systems in state space (Understand).
CO5: Design a state feedback controller using pole placement to meet transient response specifications (Apply).
CO6: Design a state feedback observer using pole placement to meet transient response specifications (Apply).
CO7: Describe the phase plane method of analysis of nonlinear systems (Understand).
CO8: Determine and characterise limit cycles in non liner systems using describing function method (Apply).
CO9: Explain the characteristics of stochastic systems (Understand).

Module I (16 hours. End semester marks 25%)

Sampled data control systems - spectrum analysis of sampling process - signal reconstruction - difference equation - z-transform – z and pulse transfer function - response of linear discrete time systems – Z transform analysis of sampled data control systems – z and s domain relationships - stability analysis - compensation techniques by root locus method - analytical design - dead beat control - selection of sampling frequency.

Module II (16 hours. End semester marks 25%)

State variable analysis and design – concept of state, state variables and state model – state variable representation of SISO and MIMO systems – phase variable and canonical models – transfer function to state model-state model to transfer function- solution of state equation-state transition matrix - controllability and observability - Pole placement by state feedback- observer design.

Module III (16 hours. End semester marks 25%)

Nonlinear systems - Common physical nonlinearities - phase plane method - Singular points - construction of phase trajectories - system analysis by phase plane method - describing function method - describing function of common nonlinearities - limit cycles - stability of nonlinear systems - Lyapunov stability criteria.

Module IV (16 hours. End semester marks 25%)

Stochastic optimal linear estimation and control - stochastic process and linear systems - stochastic process characterisation - response of linear continuous time systems to white noise- response of linear discrete time systems to white noise - optimal estimation for linear continuous time and discrete time systems. - stochastic optimal linear regulator.

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. K. Ogata, Discrete Time ControlSystems, 2nd Edition, PHI Inc.,1995.
2. Gopal – Digital Control and State variable Methods, 2nd Edition, Tata McGraw-Hill, 2003.
3. Normen S. Nise, Control System Engineering, Seventh edition, Wiley.
4. Nagarath and Gopal – Control System Engineering , 5th edition, New Age International,
5. M. Gopal, Modern control System Theory, New Age international, 1993.
6. https://nptel.ac.in/courses/108/103/108103007/

20-211-0502 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Carry out time, frequency, and Z -transform analysis on signals and systems (Understand).
CO2: Explain the significance of various filter structures (Understand).
CO3: Explain DFT and its fast computation (Understand).
CO4: Design a digital filter for a given specification (Apply).
CO5: Explain the basic concepts in power spectrum estimation (Understand).
CO6: Explain the basic concepts of multirate signal processing (Understand).
CO7: Explain the features of DSP processors compared to general-purpose microcontrollers (Understand).

Module I (16 hours, End semester marks 25%)
Fourier transforms: Frequency domain representation of discrete time signals, discrete Fourier transform, properties of DFT, circular convolution, linear convolution of sequences using DFT, computation of DFT and IDFT, radix-2 FFT algorithm. filtering of long sequences: over-lap add method, and over-lap save method. Relation between DTFT, DFS, DFT and Z-transform.

Module II (16 hours, End semester marks 25%)
Structures for FIR Systems: Direct-form structure, cascade-form structure, frequency-sampling structure and lattice structure.
FIR digital filters: Characteristics of FIR digital filters, design of FIR filters: Fourier method, window techniques, and frequency sampling technique.

Module III (16 hours, End semester marks 25%)
Structures for IIR Systems: Direct-form structure, signal flow graphs and transposed structure, cascade-form structure, parallel-form structure, and lattice and lattice-ladder structure.
IIR digital filters: Characteristics of IIR digital filters, design of IIR digital filters from analog filters (Butterworth), step and impulse invariant techniques, and bilinear transformation method. Comparison of IIR & FIR filters.

Module IV (16 hours, End semester marks 25%)
Power spectrum estimation: Nonparametric methods for power spectrum estimation – Bartlett method, Welch method, and Blackman and Turkey method.

Introduction to multirate signal processing: Decimation, interpolation, and sampling rate conversion by a non-integer factor.
Representation of numbers: Fixed-point and floating-point numbers, errors due to rounding and truncation.
Introduction to DSP processors: General architecture of DSP processors, comparison between DSP processors and general-purpose micro-controllers.

Experimental learning modules:

1. http://vlabs.iitkgp.ernet.in/dsp/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. John G. Proakis and Dimitris G. Manolakis – Digital signal processing principles, algorithms and applications, 4th Edition, Prentice Hall India, 2014
2. Alan V. Openheim and Ronald W. Schafer – Discrete time signal processing, 3rd Edition, Pearson Education India, 2014
3. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https:// online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
4. http://nptel.ac.in/courses/117102060/
5. https://nptel.ac.in/courses/117/105/117105134/

20-211-0503 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Explain the architecture of 8085 and 8086 microprocessors (Understand).

CO2: Develop assembly language programs for 8085 microprocessor (Apply).

CO3: Explain the concept of microprocessor and microcontroller based system design (Understand).

CO4: Design a standalone system based on 8085 microprocessor (Apply).

CO5: Explain the architecture of 8051 microcontroller (Understand).

CO6: Design systems based on 8051 microcontroller (Apply).

Module I (16 hours, End semester marks 25%)

8085 Microprocessor: Architecture – functional block diagram, registers, ALU, bus systems, timing and control signals, machine cycles and timing diagrams, instruction set and assembly language programming.

Module II (16 hours, End semester marks 25%)

Hardware interfacing with 8085: Memory interfacing and concept of I/O device interfacing. 8255 PPI - architecture, various modes of operation & control words, interfacing of 8255 with 8085. Interrupt structure of 8085 microprocessor, 8259 programmable interrupt controller. Interfacing I/O devices with 8085 - Keyboard, LED display, D/A & A/D converters.

Module III (16 hours, End semester marks 25%)

Intel 8086 microprocessor: Internal architecture - bus interface unit, execution unit, pipelining, and register organization. Bus system, memory addressing, physical memory organization, memory banking, memory segmentation and interrupts.

Module IV (16 hours, End semester marks 25%)

8051 microcontroller: Internal architecture, signals, I/O ports, memory organization & interfacing, timing and control, port operations. 8051 timers and counters, and interrupts in 8051. Instruction set of 8051 and simple programs.

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/index.php
2. http://vlabs.iitkgp.ernet.in/coa/
3. http://cse11-iiith.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References :

1. Ramesh S Goankar, Microprocessor Architecture, Programming and Applications, 6th Edition, Penram International Publishing India Pvt Ltd.
2. Ayala, Kenneth J. 8051 Microcontroller. Cengage Learning, 2005.
3. Mathur S, Microprocessor 8086: Architecture, Programming and Interfacing, Prentice Hall India Learning Private Limited.
4. Avtar Singh & Walter A. Triebel “8088 & 8086 Microprocessor” Pearson Education.
5. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https://online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
6. https://nptel.ac.in/courses/117/104/117104072/
7. https://nptel.ac.in/courses/108/105/108105102/
8. https://nptel.ac.in/courses/117/105/117105078/
9.

20-211-0504 ANALYTICAL INSTRUMENTS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the fundamentals of analytical instruments.(Understand).
CO2: Describe the principle and instrumentation of various Spectroscopical methods (Understand).
CO3: Outline the principle and instrumentation of chromatography (Understand).
CO4: Explain the principle and instrumentation of electron microscopy (Understand).
CO5: Explain the principle and instrumentation of atomic force microscopy (Understand).

Module I (16 hours, End semester marks 25%)

Fundamentals of analytical instruments: Elements of an analytical instrument – performance requirements of analytical instruments – instrument calibration techniques: calibration curve method, standard addition method, method of internal standard.
Spectroscopical methods of analysis: Basics of Spectral methods of analysis, various ranges of electromagnetic radiation. Interaction of E.M. radiation with matter. absorbance transmittance-relationship,
UV-Visible Spectroscopy- Beer-Lambert's Law-its limitations. Concept of emission, absorption and scattering techniques. Instrumentation for UV-Visible Spectroscopy.

Module II (16 hours, End semester marks 25%)

Infrared Spectrophotometers: wave number - basic principle (using diatomic harmonic structure), radiation sources, monochromators, entrance and exit slits, detectors- quantum type detector, thermal detectors.
Fourier Transform Infrared Spectroscopy (FTIR) –Instrumentation and principle.
Attenuated Total Reflectance (ATR) Technique- Instrumentation and principle.

Raman spectrometer: Raman Effect – basic principle, resonance enhanced Raman scattering, surface enhanced Raman scattering, Raman spectrometer – rule of mutual exclusion – comparison of Raman and IR spectroscopy.
Atomic absorption spectrometry – sources, components and instrumentation.
Thermo analytical instruments: Thermo gravimetric analysis(TGA) – differential thermal analysis (DTA)– differential scanning calorimetric(DSC)-Principle and Instrumentation.

Module III (16 hours, End semester marks 25%)

Nuclear Magnetic Resonance Spectrometer: Principles of NMR- types of NMR spectrometers-cw-NMR spectroscopy, FTNMR spectroscopy – constructional details of NMR

Electron Spin Resonance Spectrometers: Principle and Instrumentation
x-ray Spectrometers: different types of x-ray spectroscopy: x-ray emission spectroscopy, x-ray fluorescence spectroscopy, x-ray absorption spectroscopy, x-ray diffraction spectroscopy – principle and instrumentation.

Module IV (16 hours, End semester marks 25%)

Mass Spectrometer: basic mass spectrometer – principle of operation – magnetic deflection mass spectrometer – the time-of-flight mass spectrometer – radiofrequency mass spectrometer.
Chromatography – General principles – Classification – Gas and liquid chromatography – Chromatography – Chromatographic detectors – GLC and HPLC – Principles and Instrumentation
Electron Microscopy – TEM, SEM- principle, Instrumentation, analysis
Scanning tunneling microscopy- Principles, Instrumentation, analysis, applications.
Atomic force microscopy –Principles, Instrumentation, analysis, applications.

Experimental learning modules:

1. http://ccnsb06-iiith.vlabs.ac.in/
2. http://mas-iiith.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. R.S. Khandpur, Handbook of Analytical Instruments, 2nd ed., Tata McGraw-Hill
2. Willard, Merritt Dean and Settle, Instrument Methods of analysis, East-west Press, 1997
3. Skoog. D.A and West.D.M, Principles of Instrumental Analysis, Holt Saunders Publications
4. Ewing.G.W, Instrumental Methods of Analysis, McGraw-Hill, 1992
5. Mann.CK., Vickers.T.J, and Gullick.W.H, Instrumental Analysis, Harper and Row Publications
6. Robert.D. Braun, Introduction to Instrumental Analysis, McGraw-Hill
7. Frank.A.Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall,
8. 1997
9. Skoog.D.A, Holler.F.J and Niemann.T.A., Principles of Instrumental Analysis, Saunders, 1998
10. Wiston.C, X-ray Method, John Wiley, 1991
11. https://nptel.ac.in/courses/104/106/104106122/

20-211-0505 ENGINEERING MANAGEMENT

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain the existing practices of management and organisational theories (Understand).
CO2: Discuss the tools and techniques used in managerial jobs (Analyse).
CO3: Apply different management theories in decision making (Apply).
CO4: Analyse and understand an organisation and its complexities (Analyse).

Module I (16 hours, End semester marks 25%)

Principles of management: Introduction-Evolution of management – Management functions-organizational structure.

Economics: Sources of finance – Elements of Economics – Supply, demand, price, savings, consumption -time value of money.

Module II (16 hours, End semester marks 25%)

Costing: Types – breakeven analysis

Accountancy: Jounal,Ledger,Trial Balance, profit and loss account and balance sheet – inferences(ratio analysis)

Module III (16 hours, End semester marks 25%)

Quantitative Techniques: LPP-Assignment problems-Transportation problems-Routing Problems-CPM and PERT

Module IV (16 hours, End semester marks 25%)

Operations Management: Plant location-layout-Inventory management-Quality management.
Human Resources Management: Human resource planning-job analysis-job description-recruitment and selection-appraisal-compensation-training-maintenance-separation.
Marketing concepts:Marketing mix-environment-market segmentation-physical distribution-promotion

Experimental learning modules:
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be

included as and when it is made available by Ministry of Education.

References:

1. O.P.Khanna – Industrial Engineering and Management-Dhanpath Rai and Sons, New Delhi
2. Paul Samuelson – Economics – McGraw Hill
3. S.G. Huneryager and I.L. Hechman – Human Relations in Management – D.B. Tarapurvala and sons
4. S.Elion – Elements of production planning and control – Macmillian Co.
5. I.M. Pandy – Financial Management – Vikas Publishing & Co.
6. E.S. Baffa – Modern production management – John Wiley and Sons.
7. I.W. Burr – Engineering Statistics and quality control – McGraw Hill.
8. A.J. Duncan – Quality Control and industrial statistics – Richard D. Irwing Inc.
9. https://nptel.ac.in/courses/110/105/110105067/

20-211-0506 CONTROL SYSTEMS LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:

(The cognitive levels are given in bracket)

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

CO1: Obtain time domain response of first and second order systems (Understand).

CO2: Analyse first and second order systems using time domain and frequency domain methods (Understand).

CO3: Apply basic control system tools for stability analysis (Apply).

CO4: Design basic compensators (Apply).

Description of experiments

1. Step, ramp and Impulse response of first order systems.
2. Step, ramp and Impulse response of second order systems.
3. Identification of damping in second order systems.
4. Time domain analysis for second order systems
5. Stability analysis of linear systems using Routh-Hurwitz method
6. Stability analysis of linear systems using Root Locus.
7. Frequency response analysis using Bode Plot.
8. Frequency response analysis using Nyquist Plot
9. Design of Lead, Lag, Lag - Lead Compensators in time domain
10. Design of Lead, Lag, Lag - Lead Compensators in frequency domain

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Lab manuals provided.
2. https://nptel.ac.in/courses/108/106/108106098/

20-211-0507 TRANSDUCERS AND INDUSTRIAL INSTRUMENTATION LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:

(The cognitive levels are given in bracket)

On completion of the course, students will be able to

CO1: Obtain the characteristics of various temperature sensors (Apply).

CO2: Obtain the characteristics of force sensors (Apply).

CO3: Find the characteristics of displacement sensors (Apply).

CO4: Elucidate working of industrial devices used to measure level and flow (Apply).

CO5: Demonstrate the working of industrial devices for measuring viscosity and conductivity (Understand).

CO6: Apply calibration and measurement on pressure gauge and PH meter (Apply).

List of Experiments

1. Strain guage characteristics
2. Load cell characteristics
3. Characteristics of Thermistor
4. Characteristics of RTD
5. Characteristics of Thermocouple
6. Characteristics of LVDT
7. Characteristics of Capacitive sensor
8. Measurement of flow using Orifice meter, Rotameter and Venturimeter
9. Level measurement using different techniques
10. Pressure gauge calibration
11. Measure flow using EM flow meter and ultrasonic flow meter
12. Conductivity meter calibration and measurements of conductivity of test solutions
13. Measurement of PH
14. Determination of viscosity coefficient

Experimental learning modules:

1. http://sl-coep.vlabs.ac.in/
2. http://eerc03-iiith.vlabs.ac.in/
3. http://fm-nitk.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, DhanpatRai& Company Private Limited, 2007.
2. Renganathan. S,“Transducer Engineering”, 4th edition Allied Publishers, Chennai, 2003.
3. R.K. Jain – Mechanical and Industrial Instruments – Khanna Publishers
4. https://nptel.ac.in/courses/108/108/108108147/
5. https://nptel.ac.in/courses/108/105/108105064/

20-211-0601 VACUUM AND CRYOGENIC INSTRUMENTATION

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Interpret the concepts of vacuum, classify different orders of vacuum and various units of pressure (Understand).
CO2: Illustrate the principles of kinetic theory of gases, pressure, particle collisions, velocity and free trajectory, viscous and molecular flow (Understand).
CO3: Describe various types of vacuum pumps, their operating principles, designs and their limitations in operating at various pressure ranges (Understand).
CO4: Explain the principles of vacuum measurement, some basic vacuum gauges, and their operating principles, designs and their limitations in operating at various pressure ranges (Understand).
CO5: Assess the effects of cryogenic temperature on different properties of materials (Understand).
CO6: Elaborate on the various methods for producing, measuring, and maintaining cryogenic temperature (Apply).

Module I (16 hours, End semester marks 25%)

Basic Theory: Gas kinetic theory, pressure, conductance, gas flow regimes, vapor pressure, pumping speed, throughput. Gas surface interactions: physisorption, chemisorption, condensation.
Vacuum Pumps: Mechanical, diffusion, molecular drag, turbo molecular, cryopumps, ion pumps - general working principles, operating regimes.

Module II (16 hours, End semester marks 25%)

Vacuum Instrumentation: Vacuum gauges (Mechanical phenomena gauges - Transport phenomena gauges – Ionization phenomena gauges), gas regulators, flow meters, residual gas analyzers.
Problem Solving: Leak detection and detectors, gas signatures.
Vacuum Applications: Freeze drying, packaging, vacuum coating, microelectronics, particle accelerators, distillation, metallurgical processes, television and X-ray tubes, cryogenic insulation, space simulation.

Module III (16 hours, End semester marks 25%)

Low temperature – Basic ideas: Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties- Electric and magnetic properties – Cryogenic fluids and their properties

Production of low temperature – Liquefaction systems ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Magnetic Cooling.

Module IV (16 hours, End semester marks 25%)

Cryogenic instrumentation: Pressure, flow-level, and temperature measurements.
Cryogenic fluid storage and transfer systems: Cryogenic Storage vessels
Applications of Cryogenics: Applications in space, Food Processing, superconductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry.

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Harris, Nigel S. Modern vacuum practice. 2007.
2. Roth, A. Vacuum Technology, North-Holland. 1990.
3. Rao, V. V., T. B. Gosh, and K. L. Chopra. Vacuum science and Technology. Vol. 1. Allied Publishers, 1998.
4. R. B. Scott, Cryogenic Engineering, Van Nostrand Co., 1959
5. Randal F. Barron, Cryogenic systems, McGraw Hill, 1986
6. https://nptel.ac.in/courses/112/101/112101004/

20-211-0602 EMBEDDED SYSTEMS

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Describe the role of individual components involved in a typical embedded system (Understand).
CO2: Analyse different computing elements and select the most appropriate one for an embedded system (Analyse).
CO3: Model the operation of a given embedded system (Apply).
CO4: Develop program for an embedded system (Apply).
CO5: Design, implement and test an embedded system (Analyse).

Module I (16 hours, End semester marks 25%)

Introduction to Embedded Systems: Overview of embedded systems, features, requirements and applications of embedded systems, recent trends in the embedded system design, introduction to RTOS, common architectures for the ES design, embedded software design issues, interfacing and communication Links, introduction to development and testing tools.

Module II (16 hours, End semester marks 25%)

Embedded system controllers: Microchip PIC16 family, PIC16F887 processor architecture-features, memory organization, on chip peripherals, Watchdog timer, ADC, Data EEPROM,.

Interfacing: Interfacing standards, USART-RS232, RS 485, SPI, basic concepts of I2C, USB, Interfacing a temperature sensor with PIC16F877.

Module III (16 hours, End semester marks 25%)

Embedded Software and Programming: Programming in embedded environment, embedded operating systems. – Features of Embedded C++. Software implementation(eg: temperature sensor with PIC16F877),Testing, Validation and debugging, system-on-chip.

Module IV (16 hours, End semester marks 25%)

Introduction to ARM Processors: Popular ARM architectures, Registers, Current Program Status Register (CPSR), Processor modes, Register organization, Instruction set overview, Interrupts, ARM Cortex M3-LPC1343 programmer’s model: Memory system, Data processing, processor and

memory organization, data operations, flow of control, pipelining in ARM, ARM bus (AMBA), Clock Control & Internal Oscillators, Reset & Power management, Inbuilt peripherals..

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. 1. A. Silberschatz, P. B.Galvin and G. Gagne, Operating System Concepts (6th ed.), John
2. Wiley & Sons, Inc., 2001 8. K.V.K.K. Prasad, Embedded/Real Time Systems: Concepts,
3. Design and Programming, Dreamtech Press, New Delhi, India, 2003.
4. 2. Douglas V. Hall, “Microprocessors and Interfacing Programming and Hardware”,
5. McGraw HillBook, Company, 1986
6. 3. Microchip - Microcontroller application notes / data sheets.
7. 4. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, Second Edition, Newnes, 2009,
8. ISBN: 978-0-12-382090-7
9. 5. LPC User Manual: www.nxp.com/documents/user_manual/UM10375.pdf
10. 6. LPC Datasheet: www.nxp.com/documents/data_sheet/LPC1311_13_42_43.pdf
11. 7. Daniel W. Lewis, Fundamentals of Embedded Software, where C and assembly meet,
12. Pearson Education 2001.
13. 8. John B. Peatman, Design with PIC Microcontrollers, Pearson Education, 1997.
14. 9. Wayne Wolf, Computers as Components: Principles of Embedded Computing System
15. Design, Elsevier Publication 2000.
16. 10. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer’s Guide –
17. Designing and Optimizing System Software, Elsevier Publications, 2007.
18. https://nptel.ac.in/courses/117/106/117106111/

20-211-0603 PROCESS CONTROL

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to
CO1: Explain the concepts and practices of input/output modelling and automatic process control (Understand)
CO2: Apply various control techniques to processes (Apply).
CO3: Design multivariable control scheme (Apply).
CO4: Design control systems and controller tuning for chemical processes (Apply)
CO5: Analyse various process loops and identify their characteristics (Analyse).

Module I (16 hours, End semester marks 25%)

Process characteristics: Process equation, degrees of freedom, modeling of simple systems – thermal, gas, liquid systems. Process lag, load disturbance and their effect on processes. Self-regulating processes, interacting and non- interacting processes, continuous and batch process.

Module II (16 hours, End semester marks 25%)

Controller modes: Basic control action, two position, multiposition, floating control modes. Continuous controller modes - proportional, integral, derivative. Composite controller modes - P-I, P-D, P-I-D, pneumatic and electronic controllers to realize various control actions. Digital algorithms for PID controllers.
Controller tuning Methods: Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Auto tuning.

Module III (16 hours, End semester marks 25%)

Final control elements: Pneumatic, hydraulic and electrical actuators, Valve positioners. Pneumatic and electrical dampers, Control valves types, construction details, various plug characteristics. Valve sizing. Selection of control valves. Inherent and installed valve characteristics. Fail-safe operation, Cavitation and flashing in control valves

Module IV (16 hours, End semester marks 25%)

Advanced control system: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, interaction of control loops.
Case Studies: Distillation column, boiler drum level control and chemical reactor control.

Experimental learning modules:

1. http://ial-coep.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. G.Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice Prentice Hall of India, New Delhi, 2nd Edition, 2005.
2. D.R. Coughanowr, Process Systems Analysis and Control, McGraw Hill, Singapore, 2nd Edition, 1991.
3. B.W. Bequette, Process Control Modeling, Design and Simulation, Prentice Hall of India, New Delhi, 2004.
4. Curtis D. Johnson. Process Control Instrumentation Technology. John Wiley & Sons, Inc., USA. 1977.
5. D.P. Eckman – Automatic Process Control – Wiley Eastern
6. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https:// online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
7. http://nptel.ac.in/courses/108105062/12

20-211-0604 OPTOELECTRONIC INSTRUMENTATION

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Illustrate the principles of interferometers and optical components (Understand).

CO2: Outline the theory and operation of display devices (Understand).

CO3: Analyse the principles and applications of various lasers (Analyse)

CO4: Outline the basics of fibre optics (Understand).

CO5: Explain the principle and operation of various fibre optic sensors (Understand).

Module I (16 hours, End semester marks 25%)

Interferometers: Fabry-Perot and Michelson interferometers – Interference filters – Interferometeric method of measurement of optical components – Optical spectrum analyser.

Module II (16 hours, End semester marks 25%)

Modulation of light: Birefringence – Optical activity – Electro-optic effect – Magneto-optic devices – Acousto-optic effect.

Display devices: Electroluminescence – Injection Luminescence – Light emitting diode – Plasma displays – Liquid crystal displays.

Module III (16 hours, End semester marks 25%)

Lasers: Principles of operation –Einstein relations – population inversion– Classes of lasers – Solid state: Nd-YAG laser, Ruby laser, gas: He-Ne laser, Argon ion laser, CO_2 laser and liquid dye lasers – Q-switching and mode locking –Properties of laser light

Applications of lasers: Distance measurement – Holography – Principles and applications – Pollution monitoring, industry and biomedical applications

Module IV (16 hours, End semester marks 25%)

Optical fibers: Introduction to optical fiber – Fiber characteristics, Light guidance through fibers – Different types of fibers– Losses in the optical fiber – Dispersion – optical time domain reflectometer-Advantages and disadvantages of optical fibers, Connectors and splices

Applications of optical fibres: optical fibre communication – fibre optic sensors – measurement of temperature, pressure, displacement, strain, acceleration and fluid level

Experimental learning modules:

1. http://vlab.amrita.edu/index.php?sub=1&brch=281
2. http://vlab.amrita.edu/index.php?sub=1&brch=189

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. J. Wilson and J.F.B. Hawkes – Optoelectronics: An Introduction – Prentice Hall of India.
2. K. Thygarajan and A.K. Ghatak – Lasers: Theory and Applications – Plenum Press.
3. John M. Senior, “Optical Fiber Communications-Principles and Practice”, Pearson Education Limited.
4. https://nptel.ac.in/courses/117/104/117104127/
5. https://nptel.ac.in/courses/117/101/117101054/

20-211-0605 MICROPROCESSOR AND MICROCONTROLLER LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Write and execute Assembly Language Programmes (ALP) for data manipulation in 8085 microprocessor (Apply).
CO2: Develop ALP to interface peripherals with 8085 microprocessor (Apply).
CO3: Write and execute ALP for data manipulation in 8051microcontroller (Apply).
CO4: Develop ALP to interface peripherals with 8051 microcontroller (Apply).

List of Experiments:

The following experiments to be done using 8085 trainer kit/8051 trainer kit.

1. Addition / subtraction / multiplication / division of 8bit data
2. Data transfer/exchange between specified memory locations
3. Checking parity
4. Checking odd or even
5. Sorting (Ascending/Descending) of data.
6. Largest/smallest from a series
7. Addition / subtraction / multiplication / division of 16 bit data

The following interfacing experiments to be done using 8085/8051

1. Blinking LED
2. DC motor interfacing
3. Stepper motor interfacing
4. ADC interfacing
5. DAC interfacing
6. 7 segment display interfacing
7. LCD interfacing

Experimental learning modules:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/index.php
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be

included as and when it is made available by Ministry of Education.

References:

1. Lab manuals provided.
2. https://nptel.ac.in/courses/117/104/117104072/
3. https://nptel.ac.in/courses/108/105/108105102/

20-211-0606 VIRTUAL INSTRUMENTATION LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:

(The cognitive levels are given in bracket)
On completion of the course, students will be able to:

CO1: Utilise LabVIEW software for graphical programming (Apply).

CO2: Utilise various hardware interface for virtual instrumentation (Apply).

List of Experiments:

1. Introduction to LabVIEW software
2. Programming exercises for loops and charts
3. Programming exercises for clusters, arrays, strings and graphs.
4. Programming exercises on case and sequence structures
5. Programming exercises on sub VI.
6. Programming exercises on file Input / Output.
7. Data acquisition through Virtual Instrumentation.
8. Develop a voltmeter using DAQ cards.
9. Develop a signal generator using DAQ cards.
10. Real time temperature and pressure acquisition using Virtual Instrumentation

Experimental learning modules:
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Jerome, PHI Virtual Instrumentation using Lab View, Jovitha,ISBN 978-81-203-40305,2010
2. Gary Johnson-Lab View Graphical Programming, Second edition, McGraw Hill.1997
3. https://www.ni.com/getting-started/labview-basics/

20-211-0607 SEMINAR

Course Outcomes:

(The cognitive levels are given in bracket)
On completion of the course the student will be able to:

CO1: Exhibit an ability to understand contemporary / emerging technology for various processes and systems (Understand).

CO2: Exhibit an ability to share knowledge effectively in oral and written form and formulate documents (Apply).

Course Contents:

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Instrumentation Engineering. The references shall include journals, conference proceedings, reputed magazines and books, technical reports and URLs. Each student shall present a seminar of about 30 minutes duration on the selected topic.

20-211-0701 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	**1**	**0**	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Describe the basic blocks of a biomedical instrument (Understand).
CO2: Explain various electrical activity of heart and brain (Understand).
CO3: Give an account of various recording instruments in biomedical field (Understand).
CO4: Outline different therapeutic instruments in the medical field (Understand).
CO5: Describe various respiratory and pulmonary measurements and equipments (Understand).
CO6: Give an account of various medical imaging methods (Understand).

Module I (16 hours, End semester marks 25%)
Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, electrode theory, bipolar and uni-polar electrodes, surface electrodes, needle electrode and microelectrode, physiological transducers-selection criteria and its application.
Bioelectric potential and cardiovascular measurements: ECG recording system, Heart sound measurement – phonocardiograph (PCG), Foetal monitor-ECG- phonocardiography, vector cardiograph, cardiac arrhythmia's monitoring system. EMG, EEG - Lead systems – ECG,EEG,EMG Evoked potential response, ERG and EOG recording system, Nerve conduction velocity
Blood Pressure measurement – Direct and indirect methods

Module II (16 hours, End semester marks 25%)
Clinical Laboratory Equipment: Chemical tests in clinical laboratory, Automated Biochemical Analysis System. Blood gas analyzer, Acid –base balance, Blood PH measurement, blood PCO2, blood PO2, Intra –arterial blood gas analyzers, Blood cell counters- types of blood cells, - methods of cell counting -coulter counter- Automatic recognition and differential blood cell counting. Medical diagnosis with chemical test, Spectrophotometer, colorimeter, automated chemical analyser.

Module III (16 hours, End semester marks 25%)
Respiratory and pulmonary measurements: Physiology of respiratory system, pulmonary function measurements, respiratory rate measurement- artificial respirator- oximeter, pulmonary function measurements–spirometer–photo plethysmography and body plethysmography, diathermy, nerve stimulator, Heart lung machine, Haemodialysis, ventilators, incubators.
Electrical safety: Sources of electrical hazards in medical environment and safety techniques for checking safety parameters of biomedical equipment.

Module IV (16 hours, End semester marks 25%)
Medical imaging systems: X ray machine, Computer tomography, ultrasonic imaging system, magnetic resonance imaging system, thermal imaging system, positron emission tomography, Ultra sonography
Biotelemetry – Principles – Types – Single channel and Multichannel, Introduction to telemedicine – Principles and applications.

Experimental learning modules:

1. https://bmi-iitr.vlabs.ac.in/
2. https://bmsp-coep.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill
2. L. Cromwell, F. J. Weibell and L. A. Pfeiffer, Biomedical Instrumentation Measurements, Pearson education, Delhi, 1990.
3. A. C. Kak and Malcolm Slaney, Principles of Computerized Tomographic Imaging, Society of Industrial and Applied Mathematics, 2001.
4. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons
5. https://nptel.ac.in/courses/108/108/108108167/

20-211-0702 ADVANCED PROCESS CONTROL

L		T	P	C
3		1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to
CO1: Explain the popular process automation technologies (Understand)
CO2: Design and development of PLC ladder programming for simple process applications (Apply).
CO3: Apply knowledge gained about PLCs to identified real-time industrial applications (Apply).
CO4: Describe the different architectures and blocks in DCS (Understand).
CO5: Define the latest communication technologies like HART and Field bus protocol (Remember).

Module I (16 hours, End semester marks 25%)

Review of PC based control design for process automation: Functional Block diagram of Computer control of process - Mathematical representation – Sampling Consideration- Data Acquisition system (DAS), SCADA, Direct Digital Control System, Distributed Control system architecture and Comparison with respect to different performance attributes
.

Module II (16 hours, End semester marks 25%)

Introduction to PLC: Definition and Evolution of PLC, PLC Architecture, PLC Input and Output modules, central processing unit, CPUs and Programmer/monitors, Solid state memory, the processor, Input modules (Interfaces), Power supplies, selection criteria for PLC.
Programming of PLC: Fundamentals of PLC ladder diagram, Basic components and their symbols in ladder diagram, Boolean logic and relay logic, Analog and discrete Input-output (I/O) devices, Programming instructions set, Timer and counter types along with wave form, shift registers, sequencer function, latch instruction.

Module III (16 hours, End semester marks 25%)

PLC Data manipulation instruction - Arithmetic and comparison instruction- Skip, MCR and ZCL instruction – PID and other important instruction set. PLC Installation, troubleshooting and maintenance. Design of alarm and interlocks, networking of PLC – Case studies using above instruction sets.

Module IV (16 hours, End semester marks 25%)

Distributed Control system: Local Control Unit (LCU) architecture - Comparison of different LCU architectures – LCU Process Interfacing Issues: - Block diagram, Overview of different LCU security design approaches, secure control output design, Manual and redundant backup designs. LCU communication Facilities - Communication system requirements – Architectural Issues – Operator Interfaces – Engineering Interfaces. Introduction to HART and Field bus protocol.

Experimental learning modules:

1. http://ial-coep.vlabs.ac.in/
2. http://plc-coep.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 4th Edition, Prentice Hall Inc., New Jersey, 1998.
2. Gary Dunning , “Introduction to Programmable Logic Controller”, Cengage Learning India Pvt. Ltd., Third Edition, 2006
3. Curtis D. Johnson, Process Control Instrumentation Technology, Pearson New International, 8th Edition, 2013.
4. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 2nd Edition, 2011.
5. Lukcas M.P Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
6. Frank D. Petruzella, Programmable Logic Controllers, 2nd Edition, McGraw Hill, New York, 1997.
7. Online courses from swayam (https://swayam.gov.in/), Stanfrd online (https:// online.stanford.edu/) and MIT OpenCourseware (https://ocw.mit.edu/).
8. http://nptel.ac.in/courses/108105062/12

20-211-0703 POWER PLANT AND INDUSTRIAL INSTRUMENTATION

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Describe the different methods of power generation with a particular stress on thermal power generation (Understand).
CO2: Explain the various measurements involved in power generation plants (Understand).
CO3: Describe the different types of devices used for analysis in power plants (Understand).
CO4: Elucidate the different types of controls and control loops (Analyse).
CO5: Explain the methods of monitoring different parameters like speed, vibration of turbines and their control (Understand).

Module I (16 hours, End semester marks 25%)

Overview of power generation: Brief survey of methods of power generation – Hydro, thermal, nuclear, solar and wind power - Thermal power plants – Block diagram – Details of boiler processes - Importance of instrumentation in power generation

Nuclear reactor control loops – Description – Function – Safety measures in nuclear reactor control.

Module II (16 hours, End semester marks 25%)

Reading and drawing of instrumentation diagrams: ANSI symbols for lines, valves, heat transfer, dryer, material handling equipment, storage vessels- flow sheet codes and lines. Graphical symbol for pipe fittings, valves and piping, instrumentation symbols, standards specifications Electrical measurements - Measurement of High Voltages and current , power, frequency and power factor – Non electrical parameters – Flow of feed water, fuel, air and steam with correction factor for temperature – Steam pressure and steam temperature – Drum level measurement.

Module III (16 hours, End semester marks 25%)

Flue gas oxygen analyser – Analysis of impurities in feed water and steam – Dissolved oxygen analyser – Chromatography – pH meter – Fuel analyser – Pollution monitoring instruments. Radiation detector – Smoke density measurement – Dust monitor.

Module IV (16 hours, End semester marks 25%)

Combustion control – Air/fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator control –Pulverizer control- Distributed control system in power plants – Interlocks in boiler operation.
Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system.

Experimental learning modules:
Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. E.L. Wakil MM – Power plant technology – McGraw Hill.
2. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2001.
3. R.K.Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1995.
4. K.Krishnaswamy and M.Ponni Bala,"Powerplant Instrumentation", PHI Learning Pvt. Ltd., 2013.
5. https://nptel.ac.in/courses/112/103/112103243/

20-211-0704 COMMUNICATION SYSTEMS AND TELEMETRY

L	T	P	C
3	1	0	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:
CO1: Explain types and concepts on analog and digital communication modulation schemes (Understand).

CO2: Explain effect of noise in analog communication (Understand).

CO3: Illustrate the concept of telemetry and standards in processes (Understand).

CO4: Analyse and design telecontrol system in industries (Apply).

CO5: Explain various case studies of telemetry and telecontrol systems (Analyse).

Module I((16 hours, End semester marks 25%)

Analog Communication: Introduction, elements of communication, modulation-amplitude modulation and demodulation, angle modulation and demodulation-frequency modulation, phase modulation (Frequency spectrum, modulation index and average power).

Noise in communication systems: Thermal noise (white noise), Shot noise, Partition noise, Flicker noise, Burst noise, Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise

Module II (16 hours, End semester marks 25%)

Digital Communication: Digital Communication system, Pulse Code Modulation (PCM): Pulse Modulation, Sampling process, Aliasing, Reconstruction, PAM, Quantization.Delta modulation, DPCM.

Digital modulation schemes: ASK, PSK, FSK, QAM

Multiplexing: Frequency division multiplexing, Time division multiplexing.

Module III (16 hours, End semester marks 25%)

Telemetry system: Functional blocks of telemetry– methods of telemetry –pneumatic and hydraulic telemetry, telemetry standards.

Landline telemetry: Electrical Telemetry – current, voltage, synchro and position.

Optical telemetry: Trends in fibre optic device development, Examples of optical telemetry system

Module IV (16 hours, End semester marks 25%)

Telecontrol system: Digital techniques in telecontrol, remote transmission, signaling, adjustment, guidance and regulation reliability of telecontrol installations.

Case Study: Telemetry system in process industries, Satellite telemetry and telecontrol system.

Experimental learning modules:

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. E.L. Gruenberg – Handbook of telemetry and remote control – McGraw Hill.
2. R.E. Young – Telemetry Engineering – Little Book Ltd., J.K.
3. G. Swoboda – Telecontrol methods and applications of telemetry and remote control – Reinhold publishing company U. K
4. Couch: Analog and Digital Communication. 8e, Pearson Education India, 2013
5. H.Taub and Schilling Principles of Communication Systems, , TMH, 2007
6. Blake, Electronic Communication system, Cengage, 2/e, 2012.
7. Simon Haykin, Communication Systems, Wiley 4/e, 2006.
8. https://nptel.ac.in/courses/117/102/117102059/
9. https://nptel.ac.in/courses/117/105/117105143/
10. https://nptel.ac.in/courses/117/101/117101051/

20-211-0705 ROBOTICS AND AUTOMATION

L	T	P	C
3	**1**	**0**	3

Total hours: 64

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to
CO1: Describe the anatomy, specifications and applications of Robots (Understand).
CO2: Summarise different sensors and actuators for robots (Understand).
CO3: Point out Robotic configuration and grippers for a particular application (Apply)
CO4: Obtain kinematic model of robotic manipulators (Analyse).
CO5: Explain the basics of Artificial intelligence (Understand).
CO6: Outline basic robot programming (Understand).
CO7: Explain the concept of Expert system (Understand).

Module I (16 hours, End semester marks 25%)
Introduction : Robots, brief history of robots, Asimov's laws of robotics, Types of Robots, Basic robotic system, Degree of freedom, Robot anatomy, robot motions, Robot joints, Work volume, Robot drive systems, coordinate systems- Cartesian, cylindrical, polar, joint arm. SCARA robot.
Robot Applications: medical, mining, space, defence, security, domestic, entertainment, Industrial Applications-Material handling, machine loading and unloading, welding, Spray painting, Machining.

Module II (16 hours, End semester marks 25%)
Sensor classification- Internal sensors- Position sensors, velocity sensors, acceleration sensors, Force sensors; External sensors- Range, proximity, touch, force-torque sensing;
Vision - Elements of vision sensor
Actuators for robots- classification-Electric, Hydraulic, Pneumatic actuators; their advantages and disadvantages;
End effectors – classification, mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot.

Module III (16 hours, End semester marks 25%)
Robot Coordinate Systems- Fundamental and composite rotations, homogeneous co-ordinates and transformations, Kinematic parameters, Geometric interpretations, Euler angle representation, D-H representation, Direct Kinematics problem, inverse kinematics problem

Module IV (16 hours, End semester marks 25%)
Artificial Intelligence: Goals of AI research, AI techniques, Search techniques in problem solving.

Robot Programming: Methods of robot programming**,** lead through programming methods, Program as a path in space, Methods of defining positions in space, Motion interpolation, branching.

Expert systems: Characteristics, rule based system architectures, Non production system architectures.

Experimental learning modules:

1. http://vlabs.iitkgp.ernet.in/mr/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References

1. S K Saha "Introduction to Robotics" , Mc Graw Hill Eduaction
2. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi,2003.
3. Mikell P. Groover, Mitchell weiss, Roger N. Nagel and Bnicholas G. Odery- industrial robotics Technology programming and Applications – McGraw Hill.
4. K.S Fu, R.C Gonzalez, C.S.G Lee "Robotics Control, Sensing, Vision and Intelligence" McGraw Hill.
5. https://nptel.ac.in/courses/112/101/112101099/
6. https://nptel.ac.in/courses/112/107/112107289/
7. https://nptel.ac.in/courses/112/105/112105249/
8. https://nptel.ac.in/courses/112/105/112105236/
9. https://nptel.ac.in/courses/112/101/112101098/

20-211-0706 PROCESS CONTROL LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:
(The cognitive levels are given in bracket)
On completion of the course, students will be able to:

CO1: Demonstrate and explain ON-OFF control action (Understand).
CO2: Demonstrate and explain continuous control actions (Understand)
CO3: Demonstrate and explain composite controller modes (Apply).
CO4: Demonstrate and explain the characteristics of typical industrial control loops (Apply)
CO5: Demonstrate Process loop tuning (Apply).

List of Experiments:

1. Response of controllers
2. ON-OFF Controlled process
3. Proportional Controlled Process
4. Integral and Derivative Controlled Process
5. Pressure Control Loop
6. Flow Control Loop
7. Temperature Control Loop
8. Level Control Loop
9. Reaction Curve method of Loop Tuning
10. Continuous Oscillation method of Loop Tuning

Experimental learning modules:

1. https://plcip-coep.vlabs.ac.in/
2. https://plchla-coep.vlabs.ac.in/
3. https://plctt-coep.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Lab manuals provided.
2. https://nptel.ac.in/courses/103/103/103103037/

20-211-0707 DIGITAL SIGNAL PROCESSING LAB

L	T	P	C
0	0	3	1

Total hours: 48

Course Outcomes:

(The cognitive levels are given in bracket)

CO1: Implement the basic signal processing algorithms, offline and in real time using software/ dedicated DSP hardware (Understand).

CO2: Design, implement and characterize various digital filers in offline and in real time using software/dedicated DSP hardware (Apply).

CO3: Apply DSP algorithms to real life problems (Apply).

The list of experiments is only indicative. A minimum subset of built-in functions in the software (e.g. MATLAB) are to be used so that the students develop data structures and algorithms from scratch. Experiments are to be implemented in a combination of software and hardware platforms.

1. Visualization of basic signals
2. Properties of LTI systems.
3. Working in the Z-plane, poles and zeros, graphical calculation of phase and magnitude responses.
4. Linear convolution - Response of a LTI system to an arbitrary input.
5. Discrete Fourier transform - Fast Fourier Transform algorithms - Decimation in time and Decimation in frequency FFT algorithms, Inverse discrete Fourier transform.
6. Circular convolution and Linear Convolution.
7. Filtering long signals using FFT algorithms - Overlap-save and overlap-add methods.
8. Frequency response of FIR filters - Minimum Phase filters, Linear phase filters.
9. FIR filter design - Window-based method - impulse response, step response, pulse response, response to sinusoids; FIR filters having arbitrary frequency response - Design using frequency sampling method.
10. IIR filter design - Butterworth and Chebyshev designs, Impulse invariant and Bi-linear transformation methods.
11. Realization of digital filters.
12. Processing of signals in STFT domain
13. Finite word length effects - coefficient quantization and rounding of adders/multipliers - in DSP system implementation.
14. Application of DSP algorithms to speech/music and Image processing.
15. A mini project applying DSP algorithms to a relevant problem of current importance.

Experimental learning modules:

1. http://vlabs.iitkgp.ernet.in/dsp/
2. http://ssl-iitg.vlabs.ac.in/

Any relevant Experiential learning module from Virtual Lab and courses from NPTEL may be included as and when it is made available by Ministry of Education.

References:

1. Mitra S. K., Digital Signal Processing: A Computer Based Approach, McGraw-Hill Publishing Company, 2013.
2. Emmanuel C. Ifeacher, Barry W. Jervis, Digital Signal Processing: A Practical Approach,2nd Edition, Pearson Education, 2004.
3. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Pearson India, 2007.
4. Oppenheim A. V., Schafer R. W, Digital Signal Processing, Pearson India, 2015.
5. Boaz Porat, A Course in Digital Signal Processing,Wiley India Pvt. Ltd., 2012.
6. The Manuals of the Digital Signal Processors manufactured by Texas Instruments or Analog Devices (Available online on the web pages of Texas Instruments or Analog Devices).
7. Vinay K. Ingle, John G. Proakis, Digital Signal Processing Using MATLAB, Cengage Learning, 2011
8. http://nptel.ac.in/courses/117102060/
9. https://nptel.ac.in/courses/117/105/117105134/

20-211-0708 MINI PROJECT

Course outcomes:

(The cognitive levels are given in bracket)
On completion of this course the student will be able to:

CO1: Work independently on a specific problem relevant to research or industry (Apply).

CO2: Develop team work skills toward in a group (Apply).

CO3: Design models based on the knowledge acquired in a specific area (Apply).

CO4: Explore the wider aspects of product development (Analyse).

Course Plan:

Each batch comprising of 3 to 5 students shall design, develop and realise an Instrumentation related product. Basic elements of product design must be considered. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documents including Bill of Materials and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability and aesthetic/ergonomic aspects shall be given due weightage.

20-211-0801 PROJECT WORK

Course Outcome:

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

CO1: Think innovatively on the development of components, products, processes, or technologies in the field of Instrumentation engineering (Apply).

CO2: Formulate a project proposal through extensive study of literature and/or discussion with learned resource persons in industry or around (Analyse).

CO2: Apply knowledge gained in solving engineering problems (Apply).

Course Plan:

In depth study of the topic assigned.

Review and finalisation of the approach to the problem relating to the assigned topic.

Preparing a detailed action plan for conducting the investigation, including team work.

Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.

Final development of product/process, testing, results, conclusions and future directions.

Preparing a paper for Conference presentation/Publication in Journals, if possible.

Preparing a report in the standard format for being evaluated by the assessment board.

Final project presentation and viva voce by the assessment board.

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