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.

References:

1. Sastry, S.S. Engineering mathematics: Vol1. (Fourth edition). PHI Learning, New Delhi. (2008).
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

1. Aruldas, G., Engineering Physics, PHI Ltd.
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
CO4: Understand fundamentals of ac voltage generation and definition of varies terms
CO5: Define and apply various theorems for solving voltage and currents in DC circuits
CO6: Analyze AC series and parallel circuits
CO7: Analyze DC transients in *R-L* and *R-C* circuits.
CO8: 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/)