Detailed syllabus for

B.Tech in Electronics and

Communication Engineering

(Eighth Semester)

2021

EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-4 (Any One)	PE EC 801	4)Satellite and RADAR Engineering 5)Nano Electronics 6)Fuzzy Logic and Its Applications	3	0	0	3	3	100
2.	Program Elective-5 (Any One)	PE EC 802	4)Antenna and Wave Propagation 5)Advanced VLSI 6)Introduction to Artificial Intelligence	2	0	0	2	2	100
3.	Open Elective-3	OE EC 803	**Refer to Annexure-III**	3	0	0	3	3	100
4.	Open Elective-4	OE EC 804	**Refer to Annexure-IV**	2	0	0	2	2	100
5.	*Project - 3*	*PR EC 805*	*Project Work Final*	0	0	12	12	6	200
6.	*Seminar - 2*	*SE EC 806*	*Seminar on Contemporary Engineering Topics - II*	0	0	2	2	1	100
7.	*Online Course*	*SW EC 807*	*SWAYAM Courses*[#]	0	0	0	0	1	100
			Total :	10	0	14	24	**18**	**800**

Program Elective-4.1:Satellite and Radar Engineering (PE EC 801/1)

Course Code	PE EC 801/1
Course Title	Satellite and RADAR Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basics of electromagnetics, signalprocessing, antennas and digital communications
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain Principles of satellite Communication systems	K2

CO-2	Explain the properties of various Satellite sub-systems, Modulation schemes and Multiple Access Techniques.	K2
CO-3	Explain the fundamentals of Radar system.	K2
CO-4	Analyze system performance of Tracking Radar.	K4

Course Content:-

Module-I: Introduction to Satellite Communication and Orbital Mechanics (09Hours)

Principles and architecture of satellite Communication,Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands usedforsatellitecommunication. Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit,evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day andSiderealday.

Module-II: Satellite sub-systems, Modulationschemes andMultipleAccessTechniques (09Hours)

Study of Architecture and Roles of various sub-systems of a satellite systemsuch as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system(AOCS),Communicationsub-system,powersub-systemsetc. Satellitelinkbudget. Variousmodulationschemes, Multiple access schemes based on time,frequency,andcodesharingnamelyTDMA,FDMAandCDMA.

Module-III:Fundamentals of Radar System(09Hours)

Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar, Prediction of range performance, minimum detectable signal, receiver noise, probability density function, SNR, Integration of radar pulses, radar cross-section of targets, PRF and range ambiguities, transmitter power, system losses, Related problems.

Module-IV: Tracking Radar (09Hours)

Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar, Low angle tracking, Pulse compression, Block Diagrams of Synthetic Aperture Radar (SAR), Phased array Radars.

***TEXT BOOKS* :**

1. Merril. I. Skolnik, Introduction to Radar Systems, 2/e, MGH, 1981.
2. Mark A. Richards, James A. Scheer and William A. Holm, Principles of Modern Radar: Basic Principles, Yes Dee Publishing Pvt. Ltd., India, 2012.
3. Byron Edde, Radar: Principles, Technology, Applications, Pearson, 2008.
4. Timothy Pratt and Charles Bostian, Satellite Communications, John Wiley, 1986.
5. Dennis Roddy, Satellite Communications, MGraw Hill, Millan, 4th edition, 2013.

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Program Elective-4.2:Nano Electronics (PE EC 801/2)

Course Code	PE EC 801/2
Course Title	Nano Electronics

Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Solid State Physics
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain various aspects of nano-technology and the processes involved in making nano components and material.	K2
CO-2	Explain advantages of the nano-materials and appropriate use in solving practical problems	K2
CO-3	Utilise various aspects of nano-technology and the processes involved in making nanocomponents and material.	K3
CO-4	Explain transport of charge in Nanostructures under Electric field and Magnetic field.	K2
CO-5	Utilise the concepts of silicon MOSFET and Quantum Transport Devices.	K2

Course Content:

Module 1: Introduction to Nanotechnology (10 hours)

Introduction: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics from microelectronics towards biomolecule electronics. Application of Nanotechnology
Molecular Nanotechnology: Electron Microscope, Scanning Electron Microscope, Atomic Force Microscope, Scanning Tunneling Microscope.
Nanomaterials Preparation: Chemical Vapor Deposition, Physical Vapor Deposition

Module 2: CMOS Scaling (08 hours)

Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig- Penny Model. Brillouin Zones.
CMOS Scaling, Nanoscale MOSFET, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot, DIBL.

Module 3: Transport Phenomena in Nano electronics (08 hours)

Transport of charge in Nanostructures under Electric field, parallel transport, hot electrons, perpendicular transport, Quantum transport in nanostructures, Transport of charge in magnetic field, Effect of magnetic field on a crystal, Aharonov-Bohm effect, the Shubnikov-de Hass effect, quantum Hall effect. 2D semiconductors.

Module 4: Silicon MOSFETS & Quantum Transport Devices (10 hours)

Nanoscale MOSFET, Transport in Nano MOSFET, FINFETs, Vertical MOSFETs, double gate transistors, Silicon on insulator (SOI), PDSOI (partially depleted SOI) and FDSOI (fully depleted SOI) Ultrathin body SOI,

Electron tunnelling, resonant tunneling diodes, resonant tunneling devices,Single electron devices for logic applications, Single electron devices, applications of single electron devices to logic circuits.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009.
2. W. Ranier, Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

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Program Elective-4.3:Fuzzy Logic and Its Applications (PE EC 801/3)

Course Code	PE EC 801/3
Course Title	Fuzzy Logic and Its Applications
Number of Credits	03 (L:3,T:0,P:0)
Prerequisites	Set Theory
Course Category	Program Elective (PE)
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain basic knowledge of the fuzzy sets, operations and their properties.	K-2
CO-2	Explain the fundamental concepts of Fuzzy functions and Fuzzy logic	K-2
CO-3	Apply the concepts of Fuzzy sets in Decision Making	K-3
CO-4	Apply the concepts of Fuzzy sets in image processing , Pattern reorganization and construct and examine various routing protocols	K-4

Course Content:

Module 1: Fuzzy sets: (12 hours)

Basic concepts of fuzzy set, t-norm, t-conorms, membership function, α-cut, Algebra of fuzzysets , distance between fuzzy sets, fuzzy relation.Fuzzy numbers , Arithmetic operations of fuzzy numbers , Extension principle, Interval arithmetic, Defuzzification.

Module 2 : Fuzzy function (12 hours)

Fuzzy valued functions , fuzzy equations, fuzzy inequalities , system of fuzzy . linearequations , maximum and minimum of fuzzy functions. Fuzzy Logic :Classical Logic – Multi-valued Logics – Fuzzy ropositions – Fuzzy Quantifiers – Linguistic hedges – Inference from conditional Fuzzy proposition**.**

Module 3 :Applications of Fuzzy set theory: (07 hours)

Fuzzy sets in Decision making , Optimization in Fuzzy environment, Fuzzy set application inimage processing , Fuzzy set application in Pattern reorganization.

Module 4 :Artificial Neural Networks: (07 hours)

Basic concepts - Architecture of ANN, Activation Functions,Training of ANN- Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.Application of ANN in Pattern Analysis.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Fuzzy sets and Fuzzy logic Theory and applications, George J.Klir and Bu Yuan, (PHI)
2. Fuzzy sets and systems, Didier Bubois and Henri Prade , Academic Press.
3. Introduction to Artificial Neural Networks, S.N. Sivanandam, M. Paul Raj ,VIKAS
4. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
5. Neural Networks and Learning Machines Simon Haykin (PHI)

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Program Elective-5.1:Antenna and Wave Propagation (PEEC 802/1)

Course Code	PE EC 802/1
Course Title	Antenna and Wave Propagation
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Communication
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Explain basic of an antenna	K2
CO-2	Explain properties about different Antenna Arrays	K2
CO-3	Identify and design the different types of antenna.	K3
CO-4	Develop different antenna parameter to design a system	K6
CO-5	Explain fundamental concepts of wave Propagation	K2

Course Content:

Module 1:Antenna Fundamentals (08 Hours)

Review of electromagnetic fields, Electromagnetic radiations, Review of Maxwell's Equation, Antenna Parameters: Introduction, Isotropic radiators, Radiation pattern, Gain, Directive gain, Directivity, Reciprocity theorem & its applications, effective aperture, radiation resistance, terminal impedance, noise temperature, elementary ideas about self & mutual impedance, front-to-back ratio, antenna beam width, antenna bandwidth, antenna beam efficiency, antenna beam area or beam solid angle, polarization, antenna temperature.

Module 2: Antenna Arrays (08 Hours)

Antenna Arrays: Introduction, various forms of antenna arrays, arrays of point sources, non-isotropic but similar point sources, multiplication of patterns, arrays of n-isotropic sources of equal amplitude and spacing (Broad-side & End-fire array cases), array factor, directivity and beam width, array of n-isotropic sources of equal amplitude and spacing end-fire array with increased directivity, scanning arrays, Dolph-Tchebysceff arrays, tapering of arrays, binomial arrays, continuous arrays, rectangular arrays, super directive arrays.

Module 3: Practical Antennas (05 Hours)

Aperture Antennas, loop antennas, slot radiators, scanning antennas, signal processing antennas, travelling wave antennas, Smart Antennas. long wire antenna, V-antenna, Rhombic antenna, Folded dipole antenna, Yagi-Uda antenna, and helical antenna,Horn antennas, slot antenna, microstrip or patch antennas, and turnstile antenna, frequency independent antennas, and microwave antennas, antenna measurement.

Module 4: Wave Propagation (05 Hours)

Propagation Mechanism- Reflection, refraction and Transmission, Scattering and diffraction, structure of atmosphere, basic idea of ground wave propagation, surface wave propagation, and space wave propagation, troposphere propagation and duct propagation.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Krauss J D, "Antennas", 4th edition, McGraw – Hill Inc., New York (1991).
2. Balanis A Constantine, "Antenna Theory, analysis and design", 2nd edition, Wiley, New York.(1997).
3. Prasad K D, "Antenna and Wave Propagation", 3rd edition, Satya Prakashan, New Delhi (1996).
4. Stutzman W L, Thieele G A, "Antenna Theory and Design", 2nd Ed., Wiley (1997).
5. C ABalanis, Antenna Theory: Analysis and Design, John Wiley & Sons publications, 2nd edition, 2014.

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Program Elective-5.2:Advanced VLSI (PE EC 802/2)

Course Code	PE EC 802/2
Course Title	Advanced VLSI
Number of Credits	2 (L: 2, T: 2, P: 0)
Prerequisites	VLSI Design
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

After completion of the course, the students will be able to-

CO Number	CO Description	K-level
CO-1	Explain basic device physics of MOS transistors.	K2
CO-2	Explain design issues, switching activity, power reduction techniquesof CMOS circuits.	K2
CO-3	Explain various CMOS combinational circuits and their working.	K2
CO-4	Apply various CMOS sequential circuits and their working.	K3

Course Content:

Module 1: MOS Transistor Basics (06 Hours)

Semiconductors, Junctions and MOSFET Overview: Introduction, Semiconductors, Conduction,Contact Potentials, P-N Junction.

Basic Device Physics:

Two Terminal MOS Structure: Flat -band voltage, Effect of Gate- substrate voltage on surfacecondition, Inversion,

Three Terminal MOS Structure: Contacting the inversion layer, Body effect, Regions ofinversion, Pinch-off voltage;

Four Terminal MOS Transistor: Transistor regions of operation, general charge sheet models,regions of inversion in terms of terminal voltage.

Module 2: VLSI circuit techniques (08 Hours)

Basic principles of low power design, transistor and gate sizing, pin ordering. Adjustable threshold voltages, logic-signalgating, clock gating. Power reduction in clocked networks, delay balancing. Switching activity reduction, parallelvoltage reduction, operator reduction, adiabatic computation.

Module 3: Combinational MOS Logic Circuits(06 Hours)

MOS logic circuits with depletion loads, CMOS logicgates, CMOS transmission gates, pseudo-NMOS domino logic gates, complex logic gates. Multilevelgate circuits and design, pass transistor logic.

Module 4: Sequential MOS Logic Circuits&CMOS OPAMP (06 Hours)

CMOS latch, clocked latch and flip-flop, Schmitt trigger circuit. Synchronous dynamic circuit techniques, high-performance dynamic CMOS circuits.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. CMOS Digital Integrated Circuit by Sung-Mo Kang and Yusuf Leblebici.
2. VLSI Design and EDA Tools by Angsuman Sarkar.
3. Low Power CMOS VLSI Circuit Design by Kaushik Roy.
4. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker.
5. VLSI Design by Debaprasad Das.

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Program Elective-5.3:Introduction to Artificial Intelligence (PE EC 802/3)

Course Code	PE EC 802/3
Course Title	Introduction to Artificial Intelligence
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Mathematics, Analytics and Programming skills.
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome:

After completion of the course, the students will be able to-

CO Number	CO Description	K-level
CO-1	Explain Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems	K2
CO-2	Apply Knowledge Representation, Problems in representing knowledge, Introduction to prolog.	K3
CO-3	Apply Network-based representation and reasoning	K3
CO-4	Analyze Adversarial search and Game theory, alpha-beta cut-offs, Introduction to natural language processing	K4
CO-5	Explain Reasoning in uncertain environments, Fuzzy logic, Probabilistic reasoning	K2

Course Content:

Module 1: Introduction: (6 hours)

Objective, scope and outcome, Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods.A* algorithm, and their analysis.Introduction to Genetic Algorithms.

Module 2: Knowledge Representation :(6 hours)

Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression, semantic Tableau.Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction, theorem proving, interference, monotonic and non-monotonic reasoning. Introduction to prolog.

Module 3: Language Processing (6 hours)

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames.Description logic (DL), concept language, reasoning using DL.Conceptual dependencies (CD), scripts, reasoning using CD.Introduction to natural language processing.

Module 4: Fuzzy logic (8 hours)

Adversarial search and Game theory, classification of games, game playingstrategies, prisoner's Dilemma. Game playing techniques, minimax procedure, alpha-beta cut-offs. Complexity of alpha-beta search.Automated planning, classical planning problem, forward planning, partial order planning, planning with proposal logic, hierarchical task planning, multiagent planning.Reasoning in uncertain environments, Fuzzy logic, fuzzy composition relation, operations on fuzzy sets. Probabilistic reasoning, Bayes theorem, construction of Bayesian networks, belief propagation. Markov processes and Hidden Markov models.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill.
2. Introduction to AI & Expert System: Dan W.Patterson, PHI.
3. Artificial Intelligence by Luger (Pearson Education)
4. Russel & Norvig, Artificial Intelligence: A Modern Approach, Pearson Education
5. N. P. Padhy – Artificial Intelligence and Intelligence Systems, OXFORD publication.
6. B. YagnaNarayana - Artificial Neural Networks, PHI
7. Simon Haykin -Neural Networks PHI.

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3. Open Elective-1: Refer to Annexure-III

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4. Open Elective-2: Refer to Annexure-IV

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5. Project Work Final (PR EC 805)

Course Code	PR EC 805
Course Title	Project Work Final
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3

CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a project work.

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6. Seminar on Contemporary Engineering Topics – II (SE EC 806)

Course Code	SE EC 806
Course Title	Seminar on Contemporary Engineering Topics – II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4

CO-3	Develop report writing and presentation making skill	K3
CO-4	Utilize suitable aid to present the topic among audience.	K3

Course Content:-

Each student shall

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

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7. SWAYAM Courses (SW EC 807)

Course Code	SW EC 807
Course Title	SWAYAM Courses
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Online Course (SW)
Number of classes	-

Courses Outcome:-

After completion of the courses, students will be able to:

CO Number	CO Description	K-level
CO-1	Make use of digital learning platform to enhance knowledge and skill beyond the prescribed curriculum structure	K3
CO-2	Take part in proctored examination system to prepare oneself for similar future challenges	K4
CO-3	Utilize the opportunity to learn from best faculty in the countryfor professional development	K3
CO-4	Develop the skill of lifelong self-learning and become future ready	K3

Courses Content:-

SWAYAM (Study Webs of Active-learning for Young Aspiring Minds); India Chapter of Massive Open Online Courses. SWAYAM is an indigenous developed IT platform, initiated by Government of India, which is instrumental for self-actualization providing opportunities for a life-long learning. Learner can choose from hundreds of courses, virtually every course that is taught at the university/college/school level and these shall be offered by best of the teachers in India and elsewhere. Student having registered a course, having submitting the Assignments as per requirements of the course, shall at the end of each course, be accessed through a proctored examination. A student having successfully completed the course shall get a Certificate.

Each student has to undergo and qualify at least two relevant SWAYAM or equivalent courses (to be certified by concerned HOD) with certification during the entire course of B. Tech. program. The Head of the departments will approve the relevancy of a SWAYAM or equivalent course for respective branch of engineering.

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PROGRAM OUTCOMES (POS) AS PER NATIONAL BOARD OF ACCREDITATION (NBA)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.