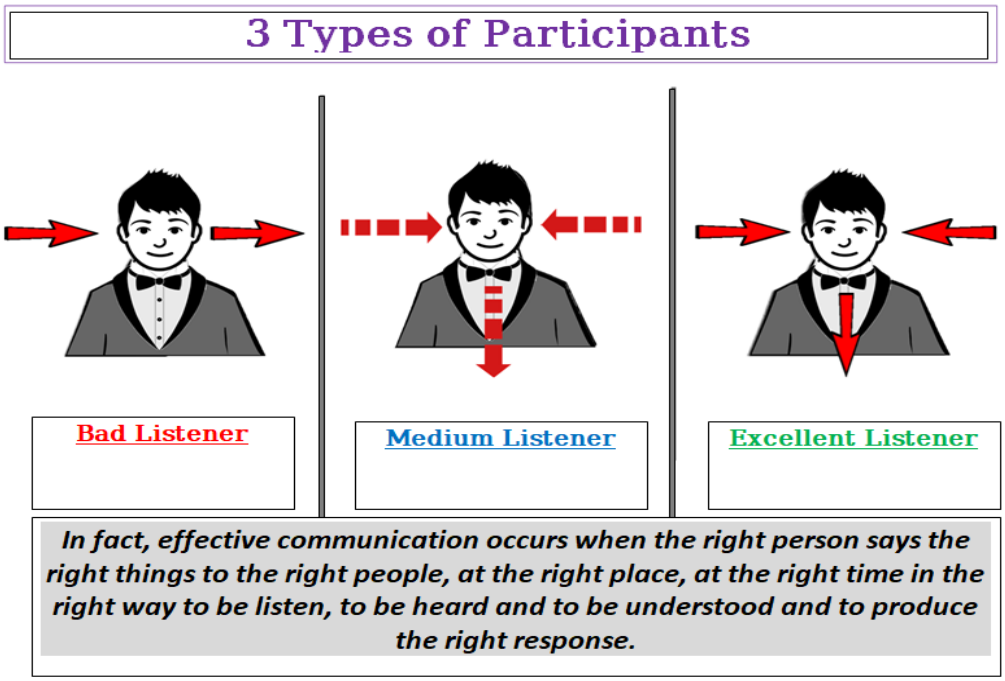
INTRODUCTION TO THE ENGINEERING ETHICS (LESSON-1)

Advice and Instruction to the Students for Effective Listening & Learning



Please go through the "Lesson Sheets" minutely (thoroughly), attentively, Attend all the classes and do not Miss the Classes and exams. If you do not comply with this advice and have no time for preparing for the lessons, attending the classes and prepare for the exams then you will be the loser and you will not be able to maintain your Grade. Now these lessons needs your concentration and dedication to prepare yourself for the classes, Assignments, Quizzes, Mid-term and Final-term examinations and submission of class assignment, home assignment, reports/mini research paper within 2000 words and presentation, Quiz and Short Question-Answers. If you are absent in classes, and do not listen to my lecture/lesson then your assignment will not be considered for grading. It will lower your grade and I cannot help you out because I won't be able to take any makeup classes/test etc. Please take note of it seriously. I remind you all that this course is not like Math, Physics, Chemistry, or Engineering courses and you won't be able to get more than 90% marks because this course is theoretical as well as tutorial. You can expect maximum 90 marks for excellent performance and 95 % marks for super excellent performance. Students must download the lessons notes in the Laptops/Smart Phones or copy of lessons and bring to the classes so that the class participation be ensured. After submission/publication of results no complain or explanation will be entertained.

LEARNING OUTCOMES IN TERMS OF ATTAINMENT	
Level of Competence	**Description**
A&A (Appreciation and Awareness) [ধারণা লাভ করা ও সচেতনতা]	Appreciation (Understanding, Perception, access, উপলব্ধি) and Awareness, be able to refer elements of Engineering Ethics
K&U (Knowledge & Understanding) [জ্ঞান লাভ ও বুজা]	Knowledge and Understanding and be able to explain and write elements of Engineering Ethics
E&P (Exercise & Practice) [অনুশীলন করা]	Be able to exercise and practice engineering judgment in ethical manner.
DA (Demonstrating Ability) [সক্ষমতা লাভ করা]	Demonstrate ability to professional responsibilities maintaining ethical standards and engineering judgment.

Engineering Ethics

Letter	Grade Point	Numerical %
A+	4.00	90-100
A	3.75	85-<90
B+	3.50	80-<85
B	3.25	75-<80
C+	3.00	70-<75
C	2.75	65-<70
D+	2.50	60-<65
D	2.25	50-<60
F	0.00	<50 (Failed)

Marks distribution	
Attendance	10%
Quiz	30%
Assignment	30%
Case Studies, Report Writing and Presentation	30%
Total=	**100 %**

Note: 1) 70% Attendance is mandatory for exams.
2) Assignments include Class Work, Home Assignment
3). Case Studies & Report submission within 2000 words and Presentation.
4).For absent in classes, Assignments will not be considered for grading.

Mid Term Class Plan **Semester- Spring, 2023**

- **Lesson-1: Ethics and Professional Practice**

  Introduction, Course Outline, Graduate attributes, Engineering Professional Practice and Obligation, Engineers and society, Environment & sustainability and Ethics. Ethical Terms, Meaning, Definition and Derivation of Ethics, Source of Ethics, Brief History of Codes &Engineering Ethics, Ethics and morality, TYPES OF MORALITY, Why Study Engineering Ethics? Engineering Code of Ethics and Professional Responsibilities for Engineers, Conflict of interest and Corrupt practices, Corruption & Bribery.

- **Lesson-2: Moral Frameworks (Ethical Theories)**

  Ethical Theories, Duty Ethics, Right Ethics, Virtue Ethics, Utilitarianism Ethics Self-Realization Ethics and Egoism.

- **Lesson-3: Code of Ethics**

  Importance of Code; Abuse of Codes; Limitations of Codes; Ethical Relativism; Justification of Codes; Engineering / Professional Practice, Ethical Duties, Responsibilities and Obligations, Negligence, Professional Misconduct and Conflict of Interest. CODE OF ETHICS - THE INSTITUTION OF ENIGNEERS, BANGLADESH (IEB), Rules of Ethics and Conduct for Engineers, The Code of Ethics for Procurement followed by Engineers in Bangladesh, International Code of Ethics for Engineering Profession (NSPE, IEEE, ASCE, ASME, ACM and Computer Ethics by Computer Institute, USA.

- **Lesson-4: Honesty and Research Integrity**

  Honesty, Truth and Truthfulness, AN AFRICAN FABLE [উপকথা / উপাখ্যান] regarding battle of Truth and Falsehood and Trust & Trust worthiness, What is academic integrity? Research Integrity, Bias and Self-deception, Protecting Research Subjects, Giving and Claiming Credits, Survey, Survey Methods.

- **Lesson-5: Ethical Dilemma and Moral Reasoning**

  Moral Choices and Ethical Dilemmas; Steps in Resolving Ethical Dilemmas; Right-Wrong or Better-Worse? Moral Decision Making as Design;

- **Assignment** will be submitted for lectures as per instruction of Course Teacher. For absent in classes assignment will not be considered for grading.

- **Quiz**
- **Presentation**

OUTCOME BASED EDUCATION (OBE)

OBE has been implemented since the 1980s with various forms at different levels of the education system, from nursery/primary schools to post graduate universities. OBE is well-defined by William Spady, often called the father of OBE, as: *Defining, designing, building, focusing and organizing everything in an education system on the things of lasting significant that we ultimately want every learner to demonstrate successfully as the result of their learning experiences in that system.*

Spady definition of Outcome:

- Outcome is a culminating demonstration of learning.
- Demonstration meant that learners would actually do something tangible, visible and observable – e.g. describe, explain, design, construct, produce, negotiate, operate etc. – with the concepts and content embodied in the typical curriculum.
- Doing required skill and competence, not just knowledge and understanding.
- Competence and its demonstration are equally important in an Outcome Statement.

OBE is a process that involves assessment and evaluation practices in education to reflect the attainment of expected learning and showing mastery in the program areas. Program outcome addresses knowledge, skills and attributes to be attained.

Demonstrating Attributes of Graduate Engineers Accredited by the Institution of Engineers, Bangladesh

The International Engineering Alliance (IEA) Graduate Attributes and Professional Competencies (GAPC) profiles defined the expected outcomes for engineering education programs and competencies for independent engineering practice for the professional engineers. UNESCO and the World Federation of Engineering Organizations (WFEO) also recognize the GAPC as a valuable international benchmark for engineering education as well as engineering profession.

Graduate attributes are the qualities, skills, attitude and understandings a university community agrees its students should develop during their time within the institution.

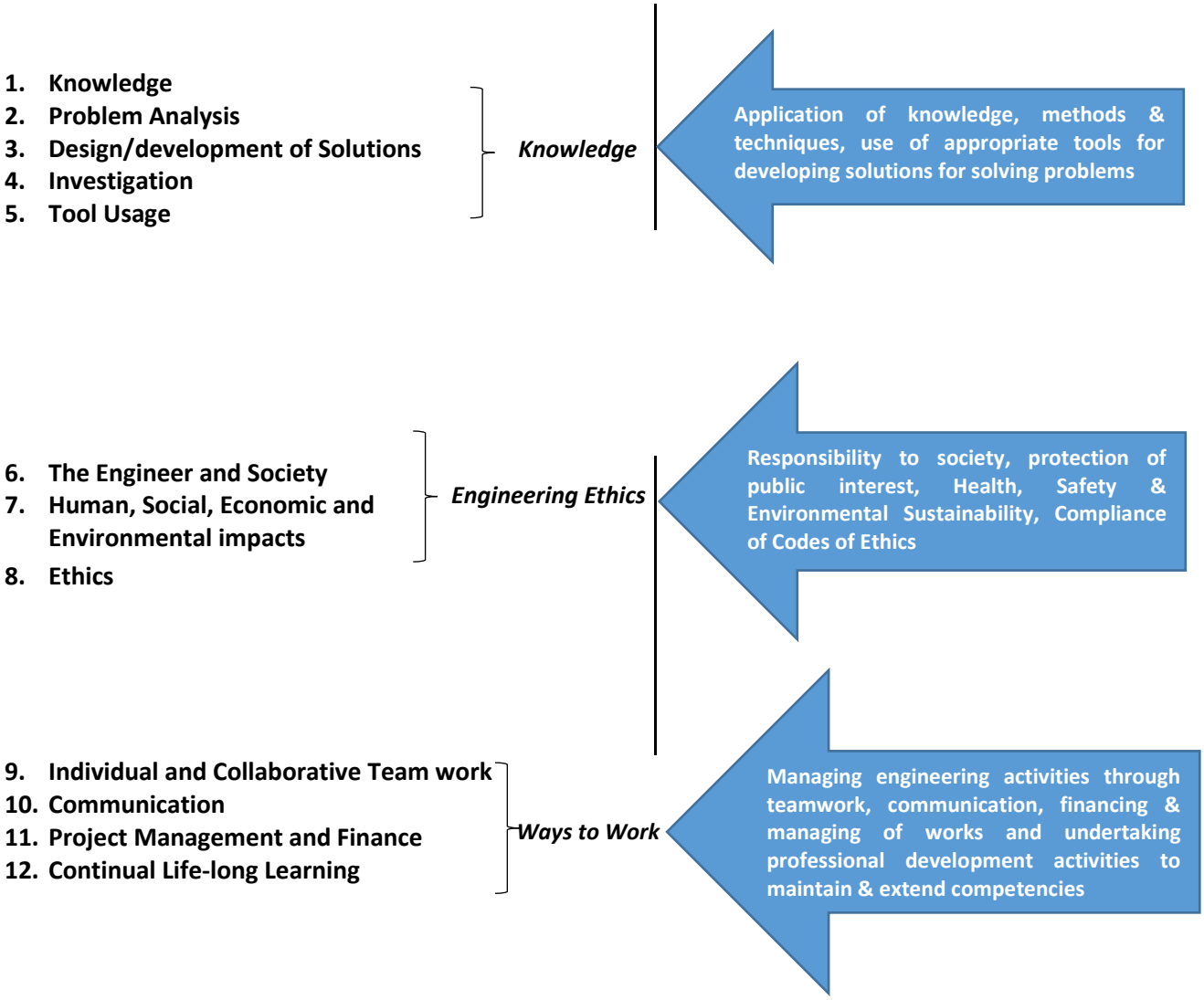
Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The graduate attributes are exemplars (model) of the attributes expected of graduate from an accredited program. Graduate attributes are clear, brief statements of the expected capability, qualified if necessary by a range indication appropriate to the type of program. Graduate attributes are defined for educational qualifications in the engineer. The graduate attributes serve to identify the distinctive characteristics as well as areas of commonality between the expected outcomes of the different types of programs.

The graduate attributes are organized using 12 (twelve) headings. Each heading identifies the differentiating characteristic that allows the distinctive roles of engineers to be distinguished by range information. For each attribute, statements are formulated for engineer using a common stem, with ranging information appropriate to each educational track, and demonstrate that by the time of graduation students have achieved an acceptable level of graduate attribute profile and will be able to –

1) Apply engineering knowledge;
2) Define-formulate-research and analyze complex engineering problems;
3) Design solution for complex engineering problems;

4) Conduct investigation of complex engineering problems, incidents & failures;
5) Usage of appropriate tools for solving complex engineering problems;
6) Perform societal responsibilities relevant to professional engineering practice and solution to complex engineering problems;
7) Undertake engineering activities complying with the principles of sustainable development in the performance of professional duties that contribute to sustainable development;
8) Apply ethical principles and commit to the professional ethics;
9) Work and function effectively as an individual and as a member of the team;
10) communicate effectively and inclusively on complex engineering activities;
11) Demonstrate knowledge and understanding of engineering and management principles and economic decision-making; and
12) Maintain, extend and enhance knowledge, skills by undertaking life-long learning as continuing professional development.

Engineering GRADUATE ENGINEERS ATTRIBUTE PROFILE



1. Ability to Apply the knowledge of natural science, mathematics, numerical analysis, statistics, computing, information science, computing and engineering fundamentals and an engineering specialization to the solution of complex engineering problems, universal knowledge and specialist knowledge, Codes & Standards, Engineering Ethics and fundamentals aimed at understanding the basics that ought to guide engineering practice, resolving issues in engineering and exercise sound judgments and making decisions concerning engineering problems , technical & non-technical issues.

2. Ability to define/identify, formulate, research and analyze complex engineering problems and reaching substantiated conclusions applying engineering knowledge stated in No. 1 and using the principles of mathematics, the natural sciences and the engineering sciences with holistic considerations for sustainable development.

3. Ability to apply engineering design to produce solutions for complex engineering problems and design systems, components or processes that meet the identified needs with appropriate consideration for public health and safety, whole life cost, net zero carbon, resource re-use, cultural, societal and environmental considerations and exercise sound professional engineering judgment for choosing alternative options for solutions using the knowledge that supports engineering design in a practice area.

4. Ability to develop and conduct investigations of complex problems, incidents and failures using research-based knowledge and research methods including design of experiments, inspections, collection & verification of evidence, measurements, developing models, obtaining exemplar products, analysis & interpretation of data related to the materials, components, products, structures, systems or project that failed and also synthesis of information to provide valid conclusions.

5. Ability to create, select and apply knowledge of appropriate technology including prediction and modeling, computing and information tools, and data analytics to complex engineering problems, with an understanding of the limitations. For example:- Artificial Intelligence, Building Information Modeling, Simulation, Optimization, Automation, Brainstorming & critical thinking, Six Sigma, Why-why Technique, PDCA model, Fishbone (Ishikawa) Model, SWOT analysis and other problem solving methods & models, Quality Assurance – Quality Control, measuring & calibrating, sampling, testing, Inspection, Verification, Monitoring, Auditing, Certification and Evaluation etc.

6. Ability to apply reasoning within sound decision making framework that are informed by contextual knowledge and stakeholder consultation to assess societal, health, safety, legal and cultural issues and the consequent responsibilities for sustainable development relevant to professional engineering practice and solutions to complex engineering problems.

7. Ability to understand and evaluate the sustainability impact of professional engineering work in the solution of complex engineering problems in human, cultural, economic, social and environmental contexts.

8. Ability to recognize ethical & professional responsibilities in engineering situations, and apply ethical principles and commit to the professional ethics, technology ethics, data ethics considering the impact of global, economic, environmental and societal context, and the norms of the engineering practice; and adhere to relevant national and international laws comprehending the need for diversity and conduct professional activities ethically.

9. Ability to work and function effectively as an individual and as a member or leader of diverse and inclusive teams in multi-disciplinary and long-distance settings. Ability to provide leadership, create a collaborative and inclusive environment, establish goals, plan task and meet objectives. In engineering activities of complex nature, require a diverse mix of individuals who must be integrated into an effective project team, and this should not be confused with bringing together a group of individuals to work on the team. The difference between a group and a team is how their level of work dynamics has an impact on the overall project performance. Gathering a number of individuals together in a group is the easy part, but it requires the use of special skills, new attitudes, and a strong commitment to turning those individuals into an effective team. As the meaning of TEAM is “Together Everyone Achieve More”.

10. Ability to communicate effectively with a range of audience and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend, write and present in a variety of ways effectively considering cultural, language and learning differences; make reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Ability to demonstrate knowledge and understanding of engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Recognize the need for and have the preparation and ability to engage in i) independent and life-long learning ii) creativity and adaptability to new and emerging technologies iii) critical thinking in the broadest context of technological change and undertake continuing professional development activities to maintain and extend knowledge, skill and competence and lifelong learning in the context of technological change.

COMPLEX ENGINEERING ACTIVITIES	
Complex activities means (engineering) activities or projects that have some or all of the following characteristics listed below:	
Range of Resource	Diverse resources (people, money, equipment, materials, information and technologies).
Level of interaction	Require resolution of significant problems arising from interactions between wide ranging or conflicting technical, engineering or other issues.
Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.
Consequence to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.
Familiarity	Can extend beyond previous experiences by applying principles-based approaches.

COMPLEX PROBLEMS	
Depth of knowledge required	Resolved with forefront in-depth engineering knowledge which allows a fundamentals-based, first principles analytical approach.
Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.
Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.
Familiarity of issues	Involve infrequently encountered issues.
Extent of applicable codes	Beyond codes of practice.
Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.
Interdependence	Are high level problems including many component parts or sub-problems.
Consequences	Have significant consequences in a range of contexts.
Judgment	Require judgment in decision making.

COMPLEX PROBLEM SOLVING

Ability to identify engineering problems and appropriate solution, selecting and using models or tools for possible solution of problems, such as-

- **DRIVE** (Define, Review, Investigate, Verify, Execute) model;
- **IDEAL** (Identify, Define, Explore, Anticipate & Act, Look & Learn) model;
- **DBCI** (Define the problem, Brainstorm alternative, Choose the best strategy, Implement solution) model;
- **FMECA** (Failure Mode, Effect, Criticality, Analysis) model;
- **DMADV** (Define, Measure, Analyze, Develop & Design, Verify) model;
- **DDDSIE** (Diagnose & Define the problem, Determine the root cause, Develop alternative solution, Select a solution, Implement the solution, Evaluate the outcome) model etc.

A tool for engineering process or design process:

- Defining or identification of problem
- Investigate/Research the problem (Gather or collect information)
- Analysis of the problem (Design/Project Constraints) & Exploit the optional solution of the problem
- Brainstorm alternative design/problem solution
- Modeling best solution
- Testing and evaluating model/prototype
- Refine and retest model/prototype
- Communicate final design (presentation and documentation)

NEW BLOOM'S TAXONOMY	
Remembering: can the student recall or remember the information?	Define, duplicate, list, memorize, recall, repeat, reproduce, state.
Understanding: can the student explain ideas or concepts?	Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate, and paraphrase.
Applying: can the student use the information in a new way?	Choose, demonstrate, dramatize, employ, illustrate, interpret, operate, schedule, sketch, solve, use, write.
Analyzing: can the student distinguish between the different parts?	Appraise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, and test.
Evaluating: can the student justify a stand or decision?	Appraise, argue, defend, judge, select, support, value, evaluate.
Creating: can the student create new product or point of view?	Assemble, construct, create, design, develop, formulate, and write.

OBJECTIVES

This course of ethics is designed to help prepare students for their professional responsibilities as engineers recognizing ethically significant problem situation that are common in engineering activities and to judge the best solution of ethical problems.

Engineers are often required to engage in negotiations, hold positions of responsibility to manage other engineers, make important decisions, write reports and ensure that work is safe, minimizing risks to people and environment.

Each of these requires an understanding of ethics, making ethical skills integral to engineering practice.

This course aims to encourage students to think critically about the ethical implications of what engineers do.

A secondary goal is to promote improved communication skills.

Engineers design and apply the principle of Science and Mathematics to develop economical solutions to technical problems. Engineers' works are to meet societal and uses requirements. A problem or situation that requires an engineer to choose between alternatives that must be evaluated as right (ethical) or wrong (unethical).

Apart from academic excellence, most employers would require engineers to possess qualities such as – good attitude, strong work ethics, be innovative & willingness to learn, contribute new ideas, able to communicate well with effort to improve interpersonal skills to encompass both general skill and able to interact socially within working environment.

ENGINEERING AND ENGINEERING PROFESSION

Engineering - The profession in which academic educational knowledge earned from an accredited engineering university/institute though the application of Science (physical and natural sciences), Technology (including Computer and IT), engineering, mathematics, and practical experience & skills gained, and enhanced during his/her work in engineering project or engineering activities such as design or developing structures, construction, supervision, maintenance, testing, manufacturing etc by applying with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of the society upholding health & safety, welfare of public and complying environmental sustainability and no harm to the environment.

The American Engineers' Council for professional Development has defined "engineering" as:
"The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation or safety to life and property."

Now, certainly engineering is a profession that requires extensive and sophisticated skills. Otherwise, why spend four years in accredited university just to get a start in engineering? The essence of engineering design is judgment: how to use the available materials, components, and devices to reach a specified objective. Engineering is a learned, responsible and important profession.

Engineering also requires extensive formal training. Four years of undergraduate training leading to a bachelor's degree is an accredited engineering program is essential, followed by work under the supervision of an experienced engineer. Many engineering jobs even require advanced degrees beyond the bachelor's degree. The work of engineers serves the public good by providing communication systems, transportation, energy resources, and medical diagnostic and treatment equipment etc.

Engineers are mainly concerned with the practical application of Science, Technology, Engineering and Mathematics (STEM) including computer & information technology. Engineers learn these engineering knowledge during their engineering courses and these knowledge link engineers to practice engineering activities such as: design and development, construction, supervision, maintenance, testing, manufacturing etc. During performing these activities, engineers evaluate, judge and take decision that affect life, property, health, safety, welfare and wellbeing of the society/public and environment as well. Here we mean Professional Practice as Engineering Practice.

ENGINEERING PRACTICE

Engineering Practice means any service or creative work, the adequate performance of which requires engineering education, training, and experience in the application of special knowledge of the mathematical, physical, and engineering sciences to such services or creative work as commissioning, consultation, investigation, expert technical testimony, evaluation, design and design coordination of engineering works and systems, design for development and use of land and water, performing engineering surveys and geo-technical investigation and studies, and the review of construction and installation for the purpose of monitoring compliance with drawings and specifications, any of which embraces such services or work, either public or private, in connection with any utilities, structures, buildings, machines, equipment, processes, work systems projects, and industrial or consumer products or equipment of control systems, chemical, communications, mechanical, electrical, environmental, hydraulic, pneumatic, or thermal nature, insofar as they involve safeguarding life, health, or property, and including such other professional services as may be necessary to the planning, progress, and completion of any engineering services.

<u>Engineering practice also includes:</u>

(1) consultation, investigation, evaluation, analysis, planning, engineering for program management, providing an expert engineering opinion or testimony, engineering for testing or evaluating materials for construction or other engineering use, and mapping;

(2) design, conceptual design, or conceptual design coordination of engineering works or systems;

(3) Development or optimization of plans and specifications for engineering works or systems;

(4) Planning the use or alteration of land or water or the design or analysis of works or systems for the use or alteration of land or water;

(5) Responsible charge of engineering teaching or the teaching of engineering;

(6) Performing an engineering survey or study;

(7) Engineering for construction, alteration, or repair of real property;

(8) Engineering for preparation of an operating or maintenance manual;

(9) Engineering for review of the construction or installation of engineered works to monitor compliance with drawings or specifications;

(10) a service, design, analysis, or other work performed for a public or private entity in connection with a utility, structure, building, machine, equipment, process, system, work, project, or industrial or consumer product or equipment of a mechanical, electrical, electronic, chemical, hydraulic, pneumatic, geotechnical, or thermal nature; or

(11) Any other professional service necessary for the planning, progress, or completion of an engineering service.

An engineer is responsible for the engineering plans and specifications of a building, structure, project, process, system etc. and the term "engineering plans and specifications" means:

(1) Plans for a structural, mechanical, electrical, electronic, fire suppression, or geotechnical system in a building;

(2) Specifications of structural elements and connections of a building;

(3) Foundation design;

(4) Hydrologic management calculations and design of surface water control and detention necessary for compliance with ordinances and regulations;

(5) design of building drain and waste system plumbing, fresh water plumbing, gray-water systems, and mechanical aspects of moving water in and out of a structure, other than simple roof drainage;

(6) Evaluation of structural framing members before the addition of roof-mounted equipment or a heavier roof covering;

(7) design of changes in roof pitch by the addition of structural framing members;

(8) Evaluation and repair of damaged roof structural framing;

(9) design of electrical and signal and control systems;

(10) Shop drawings by manufacturers or fabricators of materials and products to be used in the building features designed by the engineer; and

(11) Specifications listing the nature and quality of materials and products for construction of features of the building elements or systems designed by an engineer.

The preparation of engineering plans and specifications for the following tasks is within the scope of practice of engineering:

(1) Site plans depicting the location and orientation of a building on the site based on:

(a) A determination of the relationship of the intended use with the environment, topography, vegetation, climate, and geographic aspects; and

(b) The legal aspects of site development, including setback requirements, zoning and other legal restrictions, and surface drainage;

(2) The depiction of the building systems, including structural, mechanical, electrical, and plumbing systems, in:

(a) Plan views;

(b) Cross-sections depicting building components from a hypothetical cut line through a building; and

(c) The design of details of components and assemblies, including any part of a building exposed to water infiltration or fire-spread considerations;

(3) Life safety plans and sheets, including accessibility ramps and related code analyses; and

(4) Roof plans and details depicting the design of roof system materials, components, drainage, slopes, and directions and location of roof accessories and equipment not involving structural engineering calculations.

ENGINEERS AND SOCIETY

Engineering is a profession in which scientific knowledge and mathematics is used and experimented with to develop ways that benefit mankind, making it extremely important to society for several reasons. Engineering encompasses a whole range of industries that could include on-site, practical construction work as well as evaluating safety systems from an office. They use the knowledge they have within a specific industry in order to make things work and solve problems, whether this be with transport, medicine, entertainment, space or the environment. In fact, engineering is behind everything. Mobile phones? They're down to engineers. Make-up? Also, down to engineers. Cars, computers, shoes and even cutlery? It's all down to engineers.

No other profession demands so much from its practitioners than the Engineering profession. The society is expecting the Engineer to analyze and translate the knowledge acquire from pure science and mathematics to societal development. In fact, engineers have completely changed the world we live in, from modern homes, bridges, space travel, cars and the latest mobile technology. Innovative ideas are at the heart of what engineers do, and they use their knowledge to create new and exciting prospects and solve any problems that may arise. And also in health care, in development and application of technology and machine, equipment, engines, in communication etc.

Role of an engineer in our changing world is create new technologies to solve world problems. Technological and scientific discoveries have significant impact on people. The people that are most affected are those that are disadvantaged economically and politically. Engineers keep inventing for mankind to evolve, protect lives, prevent disease and protect the planet. Safe, clean and enhance our land. Engineers find an appropriate solution to an issue using their knowledge in science, mathematics, and logic.

Role of Electrical Engineer in the Society

Electrical and electronic engineers work at the forefront of practical technology, improving the devices and systems we use every day. From solar-energy systems to mobile phones, we innovate to meet society's communication, tech and energy needs.

People are born into the world with contemporary technological and electrical gadgets such as light, TVs, radios, computers, laptops, and even smartphones in the twenty-first century. Those electronic devices have altered human lives and have become integral aspects of our existence, not just in daily life and industry, but also in the community. As a result, electrical engineers have made significant contributions to society and improved our quality of life. Electrical engineers contribute to the generation of energy from power plants, contributions to medicine and biology, contributions to telecommunications, and contributions to computer systems. How Electrical Engineers help society is vital. The top regions you will observe Electrical Engineers are in development and assembling. Engineers are available in most everything utilized every day. Innovation with Electrical Engineers would be identical to kitchens without gourmet specialists.

An electrical and hardware engineer improves our entire lives and is more straightforward. How? Indeed, by delivering us benefits that are either straightforwardly or by implication connected with power and gadgets. They are the ones answerable for power age and support. Keep in mind, no gadget will work for a longer time in the absence of electricity. Thus, with the help of all these facts, you now know the importance of electrical and electronics engineering.

An engineer can assume the part of innovator and architect. As engineers improve or develop things, patent assurance can be tried to secure the thought. Things to reference as instances of this would be PCs, lights and cell phones. An electrical engineer will plan a circuit board with parts like resistors and capacitors to work for its expected use.

In the development industry an engineer would configure circuits and power convey gadgets to keep up with capacity to the end users. For instance in a Hospital setting, certain models exist for machines that need power and can't bear the cost of interference. An illustration of this would be life support machines. A doctor wouldn't want a patient to die because of power failure so electrical engineers would design configuration circuits, assess loads, and snare an emergency generator for instance to keep up with consistent power. These are only a portion of the manners in which engineers add to society. Through this article, I want to believe that I have set up the significance of Electrical Engineers to society. An engineer will find work in the electrical industry after graduating from school. An engineer's position in manufacturing, for example, will differ from that of a power industry or microprocessor engineer. Power, electronics, control systems, signal processing, and telecommunications are all subcategories of an EE. An electrical engineer's work is all around us.

Electrical engineers are responsible for everything from mobile phone design to computer design to the energy that powers your computer from the wall outlet. Many electrical and electronics engineers specialize in a particular field, such as controls systems, as well as a certain application area, such as medical, computer, or power distribution. These concentration zones have a big influence on how a typical day goes. Electrical engineers typically work in offices and have regular work hours, but they may be called upon to visit a manufacturing facility or a hospital to test or research products during development, and they may be asked to work longer hours if a product is in a critical development or testing phase. As they solve issues or build new products or processes, they will most likely collaborate with other engineers. Because most new or revised items involve electrical engineering, they'll be thinking about the most efficient designs for the next phone, a new satellite, a vehicle dashboard, a power strip, or even a better light bulb. Depending on your ability and interests, you can pursue a career in

Electrical engineering in one of numerous fields, Networks and electronic circuits, electromagnetic fields and waves, signal processing, microprocessors, communication and control systems, solid state electronics, electrical power systems, computer engineering, analogue and digital electronics, optoelectronics, remote sensing, robotics and automation, microwaves, radar, and power generation, transmission, and distribution are some examples. I'm sure you know someone who works in one or more of the following fields and can supply you with further information. Electrical engineers have historically had excellent job prospects. In comparison to the quantity of graduating seniors, the globe needs a lot more electrical engineers due to rapid advancements in technology and substantial inroads being made in emerging nations. Furthermore, when compared to other engineering fields throughout the world, beginning earnings for electrical engineering graduates are often the highest (on average). Sustainable power systems, artificial intelligence, nanotechnology - electrical engineers are at the forefront of emerging technology. But not only that, they impact our daily lives in ways we rarely notice. From power grids to traffic lights and mobile phones, electrical engineers have a hand in those. Indeed, what would the world be without them? With that said, here are other ways electrical engineering has contributed to our society.

The Construction Industry

Electrical engineers are essential to the construction industry. Although their primary duty is to design electrical systems, such as wiring, lighting, and generators, they also oversee and manage the electrical aspect of the construction by directing activities, guiding workers, and providing professional advice. If ever an electrical problem arises, electrical engineers are responsible for resolving the issue quickly and safely and with minimal expense. A practicable resolution helps avoid disruption and delay in construction. Lastly, electrical engineers conduct tests on the electrical systems they designed to ensure that they are efficient and comply with local and national safety codes.

The Medical Industry

The contribution of electrical engineers in the medical industry goes beyond ensuring hospitals can continue operations amid a power failure. Electrical engineers are so crucial to the modernization of the medical field that there is an increasing trend of recruiting them to join the industry. Over the years, electrical engineers have designed concepts that help the medical practice advance. We witness the invention of the implanted pacemaker in 1950, followed by the advancement of various transplants in the 1980s, then the enhancement of chemotherapy treatments in the 90s.

Electrical engineers contributed to the creation of prostheses and artificial limbs and the modernization of many diagnostic tools and surgery. They are also involved in ongoing research on artificial hearts, Nano-robotic devices, and brain implants to repair cognitive function.

Smart Technology

We are getting more connected each day as technology works its way into various aspects of our lives in the form of smart cars, smartphones, and smart appliances. The Internet of Things is a revolutionary development that links machines, data, processes, and people, enabling us to perform tasks conveniently and smartly. Think of wearable fitness trackers like Fitbit and voice assistants like Alexa and Siri.

How do electrical engineers figure in the Internet of Things? Simple, they help devise and develop codes and programs that allow smart devices to communicate with each other clearly, quickly, and accurately. Beyond innovating and designing, electrical engineers also ensure the system continues to run smoothly in manufacture. With the current developments in robotics and control systems there has been a boom in engineers keeping electrical engineering and controls and automation recruitment agencies, such as Samuel Frank Associates, very busy. They do this by performing a series of tests, then making product enhancements when necessary.

Nowadays in 21stcentury, people are born in the world with modern electronic and electrical devices such as, light, televisions, radio, computers, laptops and even smartphone. Those electrical gadgets have been changed human living lives and become parts of our life not only in daily life, industry but also important to the community. Therefore, electrical engineers contributed in many fields in the society and make our life better. The contributions of electrical engineer are generate electricity from power plant, contribution in medical field and biology, contribution in telecommunication fields and contribution to computer system.

The first contribution of electrical engineer is they developed generators to generate electricity and make good use of it into electrical appliances and devices. Electricity is generated by using fuel or

coal which are non-renewable energy. Scientists were worried these non-renewable resources will be drained one day but electrical engineer solved the problem by development to generate electricity by renewable resources such as sunlight, wind and water. They are solving the problems of the 21st Century, cleaning the environment and enhancing the world in which we live. Their role as problem solvers is highlighted in this era because they are using their knowledge of science, mathematics, logic, and appropriate experience to find suitable solutions.
Electrical engineers design, develop, and test electrical devices and equipment, including communications systems, power generators, motors and navigation systems, and electrical systems for automobiles and aircraft. They also oversee the manufacture of these devices, systems, and equipment. Electrical engineers contributed to the creation of prostheses and artificial limbs and the modernization of many diagnostic tools and surgery. They are also involved in ongoing research on artificial hearts, Nano-robotic devices, and brain implants to repair cognitive function.

In designing a structure or a product, the engineer selects methods, specifies materials, and determines shapes to satisfy technical requirements and to meet performance specifications. In fact, engineers have completely changed the world we live in, from modern homes, bridges, space travel, cars and the latest mobile technology. Innovative ideas are at the heart of what engineers do, and they use their knowledge to create new and exciting prospects and solve any problems that may arise. A primary role for electrical engineers is to design, develop, test, and supervise the manufacturing of turbines' electrical components, including electric motors, machinery controls, lighting and wiring, generators, communications systems, and electricity transmission systems.

Electrical engineers are working to create better solar cells and windmills, to harvest energy from tides and many other non-polluting sources. The smart grid is another engineering approach to more efficient energy use, to save the planet.

Engineers are at the forefront of technological advancement, designing new machines and algorithms to help tackle societal problems. Technology is being used to combat climate change, improve our quality of life and bring people closer together. Engineers play an important role in pushing the boundaries of applied science, solving technical problems that enable construction, manufacturing, medicine, and numerous other areas to reach new heights. The field is often at the leading edge of innovation and plays a significant role in shaping society and its future. The main goal of an engineer is to make a positive impact on society by designing new and improved products to make peoples' lives better, but to also make sure that those same peoples' children have access to a healthy, green planet in the future.
It arises from the accepted realization that technology has a significant and rapidly increasing influence on the evolution of society. Engineers play a major role in the development and application of technology and with this role comes a certain responsibility for the direction in which society develops. Engineers help clean the environment, develop prosthetic aids, create clean and efficient transportation systems, find new sources of energy, alleviate the world's hunger problems, and increase the standard of living in underdeveloped countries.

How the electrical engineering impact the environment and the society?

Making an impact on Sustainability: Electrical Engineers help the environment through improved energy efficiency, electric vehicles, electricity transmission, distribution and generation and uphold paramount the safety, health, welfare & wellbeing of the society/public and comply & demonstrate the principles of environmental sustainability and protect the environment by conserving, improving the environment, control and mitigating environmental pollution, using renewable energy, reducing emission by efficient power generation system and designing a system with ecofriendly and green concept.

PROFESSIONAL CONDUCT & ETHICS

Engineers are required to recognize social, cultural, environmental effects and meet all legal and regulatory requirements. The engineers have responsibility to society; to follow Rules & Regulations, Codes & Acts. They shall strive to update their knowledge continuously to solve problems of engineering with innovation. They shall apply engineering knowledge, specialist knowledge, universal standards, codes, local codes & standards in his engineering activities and uphold paramount the health, safety & welfare and wellbeing of the society/public, meeting all the related legal and regulatory requirements, principles of sustainable development and protection of environment. He will act ethically in the performance of his duties & responsibilities.

As members of engineering profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection against the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct. This helps an engineer to act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest. While acting in professional capacity, the engineer shall disclose in writing to his client of the fact if he is a director or member of or substantial shareholder in or agent for any contracting or manufacturing company or firm or business or has any financial interest in any such company or firm or business, with which he deals on behalf of his client. This knowledge of Code of Engineering Ethics and Duties, Responsibilities & Obligation of Engineers, encourages all of us as engineer to uphold and advance the integrity, honor and dignity of the engineering profession using their knowledge & skill and uphold paramount the safety, health and welfare of the public in the performance of our professional duties. Engineers are also accountable & responsible for their actions that mean they are liable, answerable and obligated for their deeds and course of action.

In order to safeguard life, health and property, to promote the public welfare, and to establish and maintain a high standard of integrity and practice, the rules relating to professional conduct, code of ethics which are formulated to make sure that the engineering profession clearly address the aspects of human wellbeing and uphold paramount the safety, health, welfare & wellbeing of the society/public and comply and demonstrate the principles of environmental sustainability.

ETHICS

The English word ethics is derived from the Ancient Greek word ēthikós (ἠθικός), meaning "relating to one's character", which itself comes from the root word êthos (ἦθος) meaning "character, moral nature".This word was transferred into Latin as ethica and then into French as éthique, from which it was transferred into English.

Ethics is a system of moral principles, which means custom, habit, character, a discipline concerned what morally good and bad, and morally right or wrong. A moral is the code of conduct that you develop over time and set for yourself to follow just like being good to everyone. Ethics are the principles accepted by the society and moral standards of human being.

Ethics means right and wrong, good and bad, truth and falsehood, duty and obligations, rights and virtues, moral issues, dilemmas, conflicting moral problems and moral judgments associated with our activities.

Ethical Terms: Ethical (নৈতিক)/ Unethical (অনৈতিক)- RIGHT AND WRONG, GOD AND BAD ETC.

Ethical (নৈতিক) , Unethical (অনৈতিক), Morals (নৈতিক), Immoral (অনৈতিক), Morally (নৈতিকভাবে),Immorally (অনৈতিকভাবে), Morality (নৈতিকতা), Immorality (অনৈতিকতা), Beliefs (বিশ্বাস), Doubtful, Disbelief (সন্দেহ, সংশয়, অবিশ্বাস), Principled (নীতিবান), Unprincipled (নীতিহীন), Conscience (বিবেক), Conscientous, Unscrupulous (বিবেকবর্জিত), Rights (অধিকার), Right (সঠিক), Rightious, Wrong, false, deceitful, Good, Bad, Truth, Falsehood; Honesty, Dishonesty, Duty (কর্তব্য), Not performing duties (কর্তব্য না করা), Responsibility, Irresponsibility, Obligations (বাধ্যবাধকতা), Disobedience of obligation (অবাধ্যতা), respect to rights (অধিকারের প্রতি সম্মান), No respect for rights (অধিকারের প্রতি সম্মান না করা), **Virtues** (গুণাবলী)- honesty, truthfulness, trustworthiness, competence, fairness, faithfulness, loyalty, commitment, humility, public wellbeing, self-respect, self-discipline, perseverance, character, decency, goodness, integrity, morality, righteousness, rightness, uprightness, virtuousness, bravery, courage, courageousness, daring, daringness, dauntlessness, fearlessness, great heartedness, guts, valor and conscientious/conscientiousness etc., **Vices** [দোষ ও রিপুসমূহ- Lust / greed লোভ-লালসা/কাম, Anger ক্রোধ, Arrogance অহমিকা, Delusion মোহ, Jealousy/Envy ঈর্ষা/হিংসা, Corrupt practice (দুর্নীতিগ্রস্ত কাজ), collusive practice, coercive practice, fraudulent practice, Misrepresentation, Bribery, Compliance, Non-compliance, Integrity (অখন্ডতা, বিশুদ্ধতা), Differences (বিভেদ), Honor (শ্রদ্ধা, সম্মান), Dishonor (অশ্রদ্ধা, অসম্মান), Dignity (মর্যাদা), Indignity (অসম্মান, অপমান, অমর্যাদা), Trust, mistrust, Sincere, Insincere, honest work, Loyalty, Disloyalty, Partial, Impartial, Biased, Unbiased, Competence, Incompetence, Conflict of Interest – Avoid or Not allowing, Conflict of Interest – Allowing Professionalism, Unprofessionalism, Fidelity (বিশ্বস্ততা), Infidelity (অবিশ্বস্ততা), Right activity, Wrong/bad activity, Right work, Wrong/bad work, Right View, Wrong view, Right Intention, Bad intention, Right Speech,Wrong speech, Right Conduct/Action, Misconduct / wrong action, Right Livelihood, Dishonest livelihood, Right Effort, Wrong effort, Right teaching, Bad teaching, Cheating, Plagiarism, Sabotage, Duty to take care, Negligence, Extortion and some other terms which are very much important in ethical conduct such as:

Virtuous- Conscientious, righteous ethical, good, honest, truthful dutiful, respects moral right of others responsible, accountable, meet obligations, utilitarian, honorable, just, moral, nice, right, right-minded, true, noble, principled, wholesome, blameless, celibate, chaste, clean, effective, effectual, efficient, excellent, exemplary, faithful, loyal, guiltless, incorruptible, inculpable, irreprehensible, moral, decent, moralistic, praiseworthy, pure, right-minded, spotless, straight, upright, worthy/ trustworthy and uphold paramount the safety, health and welfare/wellbeing of the public/society and shall try to comply with the principles of sustainable development in the performance of professional duties.

Conscientious- Virtuous, righteous honest, truthful faithful, loyal, honorable, just, scrupulous, upright, careful, diligent, self-discipline, efficient, dutiful, respects moral right of others, responsible, accountable, meet obligations, utilitarian, dependable, neat and systematic, hard-working, and reliable, worthy/ trustworthy and uphold paramount the safety, health and welfare/wellbeing of the public/society and shall try to comply with the principles of sustainable development in the performance of professional duties.

Righteous- Virtuous, conscientious, ethical, honest, truthful honorable, law-abiding, noble, pure, spiritual, upright, blameless, charitable, commendable, creditable, deserving, devoted, dutiful, respects moral right of others, responsible, accountable, meet obligations, utilitarian, equitable, exemplary, fair, faithful, loyal, guiltless, impartial, innocent, irreproachable, just, laudable, meritorious, moral, peerless, philanthropic, praiseworthy, punctilious, right-minded, saintly, scrupulous, sinless, worthy / trustworthy and uphold paramount the safety, health and welfare/wellbeing of the public/society and shall try to comply with the principles of sustainable development in the performance of professional duties.

WHAT IS MEANT BY ETHICS?

The concept of Ethics includes broad considerations of 'social conscience:
Synonyms of Ethics –Morals, Beliefs, Integrity, Principles, Conscience, Conscientiousness, Sense of right and wrong, Righteousness and Virtuousness, Faithfulness and Trustworthiness.
This course focuses on professional ethics, not personal ethics or common morality.
A moral is the code of conduct that you develop over time and set for yourself to follow just like being good to everyone one speaking truth and never telling lies going against what you know is wrong. Avoid cheating, teasing, hypocrisy, dishonesty, insincerity and being a nice human being. Respecting people and their right and keeping promises etc.

Ethics are the principles accepted by the society and moral standards of human being.

DEFINITION OF ETHICS

Socrates (470 BCE) and his followers, Plato (428 BCE), Aristotle (384-323 BCE) defined ethics as what is right and what is wrong. According to Socrates Virtue is knowledge and state of character.

According to John S. Mackenzie "*Ethics may be defined as the study of what is right or good in conduct. It is general theory of the conduct and considers the actions of human being with reference to their rightness or wrongness, their tendency to good or to evil*."

William Lillie defined ethics as the normative science of the conduct of human beings living in societies – a science which judges this conduct to be right or wrong, to be good or bad or in some similar way.

Ethics is the study of right or wrong, good, bad or evil, duty / obligations, rights and virtues, moral issues and dilemmas, conflicting moral problems associated with the activities.

According to J. H. Moorhead "*ethics is concerned with the analysis of conduct and character as the subjects of moral judgment (i.e. as right and wrong)*", whereas W. K. Frankena described moral judgment firstly "*.....we say that a certain action or kind of action is morally right, wrong, obligatory, a duty, or ought or ought not to be done*" and secondly "*.....not about actions or kinds of action, but about persons, motives, intentions, traits of character, and the like, and we say of them that they are morally good, bad, virtuous, vicious, responsible, blameworthy, saintly, despicable, and so on."*

Thus Ethics is the study of right and wrong, good and bad, truth and falsehood, duty and obligations, rights and virtues, moral issues, dilemmas, conflicting moral problems and moral judgments associated with our activities.

SOURCE OF ETHICS

Almighty Allah, God, Religion, Thinking and Teachings of philosophers, social thinkers, Culture, Human Consciousness & Conscience, Institution & Professional Bodies etc.

Religion:

- Buddha's (563-483 BCE) Ethical Principles - Right View, Right Intention, Right Speech, Right Conduct/Action, Right Livelihood, Right Effort, Right teaching, Right Determination (সৎ সংকল্প).

- Moses (1400 BCE) Ten Commandments contained in the Law of Moses. First four deal with duties which primarily religious but the last six of these commandments deal with duties which are distinctly moral and ethical.
- Jesus's Teachings also includes ethical issues regarding human conduct.
- Teachings of Islam (570-633 AD) regarding ethical conduct of human beings has been illustrated in the holy Quran and Hadis.

Most of the religion views that a righteous, conscientious and virtuous man possess all the traits of ethical behavior and he is honest, just, faithful, trustworthy, dutiful, loyal and successful in his deeds as he follows the right path.

Culture: Culture reflects the moral and ethical beliefs and standards that speak to how people should behave and interact with others.

Human Consciousness & Conscience: Ethics also derive from Human Consciousness; reflection of mind to be what is good and bad, what is right or wrong for doing any job or taking any decision after judging the situations.

Institution & Professional Bodies: The Institution of Engineers, IEEE, ASCE, Institute of Civil Engineers-UK etc.

The engineering ethics is the field of system of moral principles that apply to practice of engineering and the professional Body of Engineering Profession such as Institute of Engineers, or Council of Engineers which framed Code of ethics to comply and follow these codes of ethics as responsibilities and obligation in discharging professional duties & responsibilities. Thus engineers are required to Comply and follow moral Principles of Code of ethics of what morally /ethically ought to be done or morally /ethically ought not to be done by them in a given situation, what is right or wrong about handling of it or what is good or bad about the Policy, ideas involved and about the people or society and environment. For responsible Professionalism Engineer also focus on the good of Clients and the public at large, which means no harm to be done intentionally. The Code of Professional Conduct in the field of engineering includes avoiding harm, protecting environment, as well as promoting public safety, health and welfare.

Brief History of Codes & Engineering Ethics

Professional Codes have a long history. The first Code is credited to King Hammurabi of Babylon in Mesopotamia (Iraq) when, at about 1758 B.C. a law was enacted where by a builder could be executed if a house he built collapsed, resulting in the death of any person. In one form or another, building codes have been around since Hammurabi's time. Most were created after the occurrence of a fire or other disaster that resulted in the death and//or injury of many people or caused property damage or a disruption of life. Public outcry after these disasters provoked governments to pass law and Engineers Community to follow Code of Ethics and Conduct that they believed would protect the public from recurrences of such events.

Building Code

A building code (also building control or building regulations) is a set of rules that specify the standards for constructed objects such as buildings and non-building structures.

UK

After the Great Fire of London in 1666, which had been able to spread so rapidly through the densely built timber housing of the city, the Rebuilding of London Act was passed in the same year as the first significant building regulation.

USA

The City of Baltimore passed its first building code in 1859. The Great Baltimore Fire occurred in February, 1904. Subsequent changes were made that matched other cities. In 1904, a Handbook of the Baltimore City Building Laws was published. It served as the building code for four years. Very soon, a formal building code was drafted and eventually adopted in 1908.

France

In Paris, under the reconstruction of much of the city under the Second Empire (1852–70), great blocks of apartments were erected and the height of buildings was limited by law to five or six stories at most.

Bangladesh

Bangladesh National Building Code (BNBC) in 1993. But, enacted as Law in 2006 after the collapse of Spectrum Garments factory at Savar in 2005.

During industrial revolution from 1760-1840 when technological, socio, economic and cultural development were going ahead with the innovative process of engineering and the interaction of engineers with employer, employee, production, process, stakeholders there had been a lot of ethical issues which became concerns at that time. Technological advancement raises a host of questions for business and society. And the philanthropist felt that the management system should be interlinked with the solution of these ethical issues and this also led the necessity of addressing ethical issues.

"The phrase code of ethics emerged in written record around 1794, when English physician Thomas Percival published an influential pamphlet: Medical Jurisprudence, or a Code of Ethics and Institutes Adopted to the Professions of Physic and Surgery. Detailing duties and behaviors expected of medical personnel working at hospitals and charities, Percival's code became the basis for the American Medical Association's (AMA) own code of ethics, first drafted in 1847"

Many professional organizations have adopted codes of ethics to state their values and set out standards of conduct deemed responsible and honorable for their line of work. The American Library Association, the International Association of Chiefs of Police, the National Association of Realtors, and the National Society of Professional Engineers are just a few of the organization that have specific codes of ethics for their members and, ideally, for their professions as a whole. The Society of Professional Journalists' (SPJ) code of ethics, for example, features four principles: 1) seek truth and report it, 2) minimize harm, 3) act independently, and 4) be accountable and transparent. The code then describes best practices for each point. To uphold the first principle, for instance, SPJ members should "Identify sources clearly." The public is entitled to as much information as possible to judge the reliability and motivations of sources."

Private companies also typically develop their own internal codes of ethics. Walmart, Starbucks, McDonald's, Apple, and Twitter all have codes of ethics—sometimes called codes of conduct, among many other variations—that their employees are expected to follow, usually as a provision of employment. Like professional associations, companies like these will often detail their mission statement and core values in their codes of ethics.

While often adhering to a country's legal codes or broader moral codes, codes of ethics themselves don't have the force of law. The SPJ's code of ethics features this disclaimer: "The SPJ Code of Ethics is voluntarily embraced by thousands of journalists, regardless of place or platform, and is widely used in newsrooms and classrooms as a guide for ethical behavior. The code is intended not as a set of 'rules' but as a resource for ethical decision-making. It is not—nor can it be under the First Amendment—legally enforceable."

A violation of a code of ethics, however, could result in serious consequences. Improper conduct relative to an organizational code may also be a violation of official law. In the preamble to its code of ethics, for example, the AMA's first principle says: "A physician shall be dedicated to providing competent medical care, with compassion and respect for human dignity and rights." A doctor, then, might face significant fines and loss of license if they were found guilty of medical malpractice, a breach of both the AMA's code of ethics and US laws.

Structural Disaster & Failures

When the 19th century drew to a close and the 20th century began, there had been series of significant structural failures which had a profound effect on engineers and forced the profession to confront shortcomings in technical and construction practice, as well as ethical standards.

It may be noted here that there were 18 major structural failures in 19th Century, which includes spectacular failure such as:-

- Yarmouth Bridge, UK (1845, died 79),
- Angers Bridge, France (1850, 226 killed),
- The Ashtabula River Railroad Disaster, USA (1876, 92 killed, 64 injured),
- Tay Bridge Disaster, UK (1879, 75 killed),
- Bussuy Bridge Disaster, USA (1887, 38 killed, 40 injured),
- Point Elise Bridge, Canada (1896, 55 killed)
- Quebec Bridge collapse (1907, 75 killed, 11 injured),

Structural Failure & Disaster in Bangladesh which prompted BNBC to be enacted as Act/Law:

- Spectrum Garments Factory collapse, Savar, Bangladesh (2005)
- Rana Plaza collapse, Savar, Bangladesh (2013)
- FR Tower Fire, Banani, Dhaka, Bangladesh (2019)

These had a profound effect on engineers and forced the profession to confront shortcomings in technical and construction practice, as well as ethical standards which led the formation of Engineering Societies.

Development of Engineering Societies

In the United States growing professionalism gave rise to the development of four founding engineering societies:-

- The American Society of Civil Engineers (ASCE) (1851),
- The American Institute of Electrical Engineers (AIEE) (1884),
- The American Society of Mechanical Engineers (ASME) (1880),

- The American Institute of Mining Engineers (AIME) (1871),
- The Geological Society of America (1888), and
- The American Society of Heating and Ventilating Engineers (1894)

- Professional engineering institutions in the UK began in 1818 with the formation of the Institution of Civil Engineers ; The IMechE was formed next in 1847 ; The IEE was formed in 1871.
- The Engineering Institute of Canada (EIC), 1887.
- Japan Society of Civil Engineers (JSCE) was established as an incorporated association in 1914.
- Verein Deutscher Ingenieure (VDI) (English: Association of German Engineers) was established in 1856.

Development of Engineering Code of Ethics

In the USA-

- Formal Codes of Ethics by the 03 out of 04 founding engineering societies was developed and AIEE adopted theirs in 1912, ASCE and ASME did so in 1914.
- Development of Professional Engineering concerns for professional practice and protecting the public highlighted by those bridge & structure failures.
- National Society of Professional Engineers (NSPE) released in 1946 its Canons of Ethics for Engineers and Rules of Professional Conduct.

In the UK-

- The Institution of Civil Engineers of Great Britain seems to have been the first in this respect (1910).

In Germany-

- The Association of German Engineers developed an oath for all its members in 1950.

In France-

- The first code of ethics adopted in 1997.

- Engineering ethics is the study of applied ethics and system of moral principles that apply to the practice of engineering.
- Ethics in engineering is a study of characteristics of morals and conduct of engineers as professionals and individuals as human beings.
- Engineering ethics, where ethics are implemented in engineering by the engineers, is necessary for the good of the society. Engineering Ethics is the study of decisions, policies and values that are morally desirable in engineering practice and research.
- ***Among the universal ethical values are honesty, integrity, promise-keeping, fidelity, fairness, respect for others, responsible citizenship, pursuit of excellence and accountability." (*****Michael Josephson*****)***
- It is the study of ethics which resolves around morality – the concept of evil and good applied in Engineering Activities in broad ways: safety & honesty.

Engineering ethics is the study of applied ethics and system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession. As a scholarly discipline, it is closely related to subjects such as the philosophy of science, the philosophy of engineering, and the ethics of technology. Ethical practice in engineering is critical for ensuring public trust in the field and in its practitioners, especially as engineers increasingly tackle international and socially complex problems that combine technical and ethical challenges.

The field of engineering ethics emerged in the mid-1970s, when humanists and social scientists joined engineers in addressing issues of moral and social responsibility in engineering. In fact, Engineering Ethics developed a distinct scholarly field when the engineers were facing ethical problems and unethical choices had been damaging the reputation of professionals and organizations. Since then, ethics has been emphasized in engineering curricula, and engineering institutions are committed to educating their students on their ethical responsibility to prepare themselves for their profession. Accreditation Board of Engineering and Technology (ABET, Inc.) have been dedicated to include ethical knowledge of students as a part of the accreditation process for institutions. ABET, Inc. requires as per criterion 3 :

- 2) Outcomes articulated by engineering program such that students shall be able to apply engineering design (a system, component, or process) to produce solutions that meet specified needs with consideration of public health safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 4) An engineering graduate shall be able to recognize professional and ethical responsibilities and make informed judgments, which must consider the impact of engineering solutions in a global, economic, environmental, and societal context which is also under the scope of engineering ethics.

The Accreditation Board of Engineering and Technology (ABET, Inc.) requires universities to incorporate ethics and ethical considerations in their objectives.

ABET also requires that the program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers. To become a Professional Engineer (PE) he needs to demonstrate his ability to practice Core Professional Competence Standards including Professional conduct, ethical judgment, and commitment to society, health and safety, environment and regulation which is under the scope of engineering ethics. That means a professional engineer must study a course of engineering ethics during his course program to become an engineering graduate.

Professional engineering is the professional service which may include consultation, investigation, evaluation, planning, designing, or direct supervision of construction, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects wherein the public welfare, or the safeguarding of life, health, and property is concerned or involved, when such professional service requires the application of engineering principles and the interpretation of engineering data.

And Professional Engineering Services which meet the definition of the engineering practice as mentioned before, and which are required to be performed by or under the direct supervision of a professional engineer. A service shall be conclusively considered a professional engineering service if other services requiring a professional engineer by contract, or services where the adequate performance of that service requires an engineering education, training, or experience in the application of special knowledge or judgment of the mathematical, physical or engineering sciences to that service are also considered a professional engineering service.

In Bangladesh, Board of Accreditation for Engineering and Technical Education (BAETE), IEB, also specially requires that students acquire 12 graduate attributes including Engineer & Society, Environment & Sustainability, and Ethics [*source: BAETE Accreditation Manual, 4.8(f, g, h)*] which states that students should apply ethical principles and commit to professional ethics & responsibilities and norms of practice and act ethically while the performing his engineering activities considering the impact of engineering solutions in a global, economic, environmental and societal context which are under the scope of Engineering Ethics. Ethics also includes: technology ethics, data ethics, responsibility to maintain high standard of professional quality and responsibility against corrupt practices, upholding paramount the safety, health & welfare of the public and principles of environment & sustainability in the performance of professional duties following the Codes, Standards, Laws, Acts, Rules and Regulations etc. But in Bangladesh, BAETE has no such step to advice or suggest or emphasize to include Engineering Ethics in the engineering curricula though engineering universities/institutions are committed to educate their students on their ethical responsibility to prepare themselves for their profession. However American International University Bangladesh (AIUB) has started ethics course in 2012 and recently from Summer Semester in 2022 BRAC University has introduced a course on Professional Practice, Engineers and Society.

Ethics is of crucial importance to the engineering profession, as evidenced both in the codes of ethics published by numerous engineering professional societies and in the requirements for accredited engineering programs maintained by the Accreditation Board for Engineering and Technology (ABET). According to the ABET criteria, students in accredited programs must demonstrate an understanding of ethics and take it into account when designing a system, component, or process.

WHERE AND HOW DO MORAL PROBLEMS ARISE IN ENGINEERING?

Engineers design and apply the principles of Science and Mathematics' to develop economical solution to technical problems. Engineer's works are to meet societal, customers, consumers and users need. A problem or situation that requires an engineers to choose between alternative that must be evaluated as right (ethical) or wrong (unethical).

An engineered product or project goes through various stages of conception, design, and manufacture, followed by testing, sales, and service. Engineers carry out or supervise the appropriate activities at whatever stage of this process a convenient division of labor has assigned them. The nature of the activity or project will generally dictate whether the engineers involved are civil, electrical, mechanical, or chemical engineers, to name only a few of the major branches of engineering. Engineers from the different branches or engineering departments may be grouped together in teams, or they may be isolated from each other but with some form of liaison among them.

As engineers carry out their tasks, there will be times when their activities will ultimately lead to a product that is unsafe or less than useful. This may happen intentionally, or under pressure, or in ignorance. A product may be intentionally designed for early obsolescence; an inferior material may be substituted under pressure of time or budget; a product's ultimately harmful effects may not be foreseen. Then too, because of the size of a project, or because of the large numbers of a product sold on the mass market, many people may be affected. And these problems arise quite apart from the temptations of bribes and other forms of outright corruption.

ETHICS AND MORALITY

Ethics and **morals** relate to "right" and "wrong" conduct. While they are sometimes used interchangeably, they are different: **ethics** refer to rules provided by an external source, e.g., codes of conduct in workplaces or principles in religions. **Morals** refer to an individual's own principles regarding right and wrong. We greatly encounter moral and ethical issues, in our day to day life. Perhaps, these two defines a personality, attitude, and behavior of a person. The word Morals is derived from a Greek word "Mos" which means custom. On the other hand, if we talk about Ethics, it is also derived from a Greek word "Ethikos" which means character. Put simply, morals are the customs established by group of individuals whereas ethics defines the character of an individual. While morals are concerned with principles of right and wrong, ethics are related to right and wrong conduct of an individual in a particular situation. Every single individual has some principles which help him throughout his life to cope up with any adverse situation; they are known as ethics. On the other hand, Morals are not the hard and fast rules or very rigid, but they are the rules which a majority of people considered as right. That is why the people widely accept them. This is all for differentiating Morals from Ethics.

ETHICS AND LAW

Ethics, also described as moral philosophy, is a system of moral principles which is concerned with what is good for individuals and society.

Law is a system of rules and guidelines which are enforced through social institutions to govern behavior.

Similarities between ethics and laws

In general, laws are made based on moral values of a particular society. They describe the basic behavior of human beings. In another word, laws represent the minimum standards of human behaviors, that is, ethical behavior. [3] Besides, both laws and ethics are systems which maintain a set of moral values and prevent people from violating them. They both provide people guidelines of what may do or what may not do in certain situations. In a word, they exist in a purpose of making people benefit from being members of a well-regulated society.

Differences between ethics and laws

However, there are many distinctions between ethics and laws. Firstly, ethics comes from people's awareness of what is right and what is wrong while laws are written and approved by governments. . It means that ethics may vary from people to people because different people may have different opinions on a certain issue, but laws describe clearly what is illegal no matter how people arguing. To some extent, ethics is not well defined but laws are defined and precise. Ethics can also be distinguished by looking at whether people are being punished after they violate the rules. Nobody will be punished when they violate ethics; but whoever violates laws is going to receive punishment carried out by relevant authorities. Besides, an action can be illegal, but morally right. For example, in ancient China, some people rob properties from rich people, and give it to poor people, and it is considered to be morally right but be illegal. Similarly, an action that is legal can be morally wrong. For instance, some people spend thousands of dollars on their pets while some poor people on the street cannot have enough food. Moreover, some laws are nothing to do with ethics, like cars should

go on the left side of roads. Lastly, ethics emphasizes more on positive aspects while laws are more concerned with negative actions.

In Conclusion, ethics and laws and closely related since laws represent minimum ethical behaviors of human beings; but they are distinct from many aspects. Ethics provides people guidelines on how to behavior in order to create a peaceful society; but laws carry out restrictions through punishment. Sometimes ethics and laws do not necessarily have any overlap, but these two combined define how people should behavior in the society.

NATURE OF CODE OF ETHICS

We need to distinguish Codes of Ethics from laws. The fact that an action is legally permissible does not establish that is ethically and morally permissible. After all, what is legal is not necessarily moral. In other words, legality does not imply morality. For instance, it may be quite legal not to incorporate certain features in a construction site because we have failed so far to enact appropriate laws to ensure safe practices, yet, it would quite unethical on the part of the site engineer not to incorporate safety features in view of his or her commitment to the professional code of ethics. In another instance, an engineer working in a Bangladeshi industry finds that the plant is emitting through the stack a chemical, which has not yet been banned by the environmental laws of the country. However, the engineer has come across some recent scientific literature that indicate that the pollutant causes brain damage in young children. If the concerned engineer as a member of a professional society has vowed to uphold a Code of Ethics, which urges member of the profession to "protect the public from harmful pollutants", then it is a case where an action that is legally permissible should be considered ethically undesirable.

THREE TYPES OF ETHICS OR MORALITY

Common Morality: Common morality is the set of moral beliefs shared by almost everyone. It is the basis, or at least the reference point, for the other two types of morality that we shall discuss. ''Prevent killing,'' ''Prevent deceit,'' ''Prevent cheating,'' ''Help the needy,'' ''Promote human happiness,'' ''Protect the natural environment'' etc. The pedestrian is just as dead as if he had been murdered, but the driver's intention was not to kill him, and the law treats the driver differently, as long as he was not reckless. The result is the same, but the intent is different. If you convey false information to another person with the

Intent to deceive, you are lying. If you convey the same false information because you do not know any better, you are not

Lying and not usually as morally culpable. Again, the result is the same (the person is misled), but the intent is different.

Personal Morality: Personal ethics or personal morality is the set of moral beliefs that a person holds. For most of us, our personal moral beliefs closely parallel the precepts of common morality. We believe that murder, lying, cheating, and stealing are wrong. However, our personal moral beliefs may differ from common morality in some areas, especially where common morality seems to be unclear or in a state of change. Thus, we may oppose stem cell research, even though common morality may not be clear on the issue.

Professional Ethics: Professional ethics is the set of standards adopted by professionals insofar as they view themselves acting as professionals. Every profession has its professional ethics: medicine, law, architecture, pharmacy, and so forth. Engineering ethics is that set of ethical standards that applies to the profession of engineering. There are several important characteristics of professional ethics – i) usually stated in a formal code; ii) for a given profession, the focus is given on the issues that are important in that profession; iii) professional ethics is supposed to take precedence over personal morality so that it can create common professional ground;

Conflict: A complication occurs when the professional's personal morality and professional ethics conflict.

Some pharmacists in the US have objected to filling prescriptions for contraceptives for unmarried women because their moral beliefs hold that sex outside of marriage is wrong. Physicians who believe that abortion is wrong are not required to perform an abortion, but there is still an obligation to refer the patient to a physician who will perform the abortion. Suppose a client asks a civil engineer to design a project that the engineer, who has strong personal environmental commitments, believes imposes unacceptable damage to a wetland. Suppose this damage is not sufficient to be clearly covered by his engineering code. Sometimes the conflicts between professional ethics, personal morality, and common morality are difficult to resolve. It is not always obvious that professional ethics should take priority, and in some cases a professional might simply conclude that his professional ethics is simply wrong and should be changed. Ion within MORALITY

WHY STUDY ENGINEERING ETHICS?

Ethics of human character for any engineering venture are expressed as moral principles of conduct. Ethics are the elements which belong to a branch of philosophy dealing with the moral nature of human conduct, or it may be defined as, the principles and standards guiding moral conduct in everyday life or in a special field or profession. The word ethics suggests norms, moral responsibilities, personal values etc. When we talk about engineering profession, we talk about engineer's moral responsibilities and personal. For an example, an engineer, who is trained for technical skills, is required to observe certain code of conduct or norms for his acts or behavior. This code of conduct or behavior pattern is governed by ethical considerations, popularly known as professional ethics. The professional ethics signifies the code of conduct to be adopted in practice by the individuals who are in respective profession.

Role commitment is, in general, engineer's moral responsibility. The ethical conduct of engineers makes them accountable for their actions towards the society and the community which entrusts its young ones to their duties and work, towards the pupils, towards the authorities who supervise their actions and most importantly towards their own. The role of engineers is vital for progress and development of the country. All the engineers have committed to working in an ethical and socially responsible manner according to their professional engineering institution's code of conduct, issued in line with guidance from the Engineering Institute. The study on ethics helps to know the people's beliefs, values, and morals, learn the good and bad of them, and practice them to maximize their well-being and happiness. It involves the inquiry on the existing situations, form judgments and resolve the issues. In addition, ethics tells us how to live, to respond to issues, through the duties, rights, responsibilities and obligations.

Engineering ethics consists of the responsibilities and rights that ought to be endorsed by those engaged in engineering, and also of desirable ideals and personal commitments in engineering. In a second sense, engineering ethics is the study of the decisions, policies, and values that are morally desirable in engineering practice and research. We study engineering ethics for developing Moral Awareness (Proficiency in recognizing moral problems and issues in engineering.),cogent Moral Reasoning (Comprehending, clarifying, and assessing arguments on opposing sides of moral issues.), moral Coherence**(**Forming consistent and comprehensive viewpoints based on consideration of relevant facts.),moral Imagination**(** Discerning alternative responses to moral issues and finding creative solutions for practical difficulties.),moral Communication(Precision in the use of a common ethical language, a skill needed to express and support one's moral views adequately to others)

We also develop engineering ethical skills such as:

1. Proficiency in recognizing moral problems and issues in engineering. This involves being able to distinguish them from, as well as relate them to, problems in law, economics, religious doctrine, or the descriptions of physical systems.
2. Skills in comprehending, clarifying, and critically assessing arguments on opposing sides of moral issues.
3. The ability to form consistent and comprehensive viewpoints based upon consideration of relevant facts.
4. Imaginative awareness of alternative responses to the issues are creative solutions for practical difficulties.
5. Sensitivity to genuine difficulties and subtitles. This includes a willingness to undergo and tolerate some uncertainty in making troublesome moral judgments or decisions.
6. Increased precision in the use of common ethical language, which is necessary in order to be able to express and defend one's moral views adequately to others.
7. Enriched appreciation of both the possibilities of using rational dialogue in resolving moral conflicts and of the need for tolerance of differences in perspective among morally reasonable people.
8. An awakened sense of the importance of integrating one's professional life and personal convictions- that is, the importance of maintaining one's moral integrity.

ENGINEERING CODE OF ETHICS AND PROFESSIONAL RESPONSIBILITIES FOR ENGINEERS

Ethical Engineering practices positively affects engineering creativity, and the engineering profession benefits when ethics are followed and creativity is used by the engineer. When not followed, bad public relations are a possibility for the engineer, the company employing the engineer and the profession in general. As such, professional engineering societies play a significant role in ensuring that safety standards are maintained, and it is imperative that individual professional engineers adhere to what his/her society mandates.

Engineers should not only do as their professions code requires, but should also support it by encouraging others to do as it requires and by criticizing, ostracizing, or otherwise calling to account those who do not. They should support their profession's code in these ways for at least four reasons: First, engineers should support their profession's code because supporting it will help protect them and those they care about from being injured by what other engineers do. Second, supporting the code will also help assure each engineer a working environment in which it will be easier than it would otherwise be to resist pressure to do much that the engineer would rather not do. Third, engineers should support their profession's code because supporting it helps make their professions a practice of which they need not feel morally justified embarrassment, shame, or guilt.

And fourth, one has an obligation of fairness to do his part insofar as he claims to be an engineer and other engineers are doing their part in generating these benefits for all engineers.

Engineers are called upon to address problems and issues both internally and professionally that cannot be resolved just through the application of engineering methods alone. More often than not professional ethical issues need to be considered along with technical aspects in making engineering judgments. Members of the profession are to be guided in their work with certain moral values, which are traditionally enshrined in the Code of Ethics and Professional Conduct framed by professional bodies. Appropriateness and social acceptability of an engineer's conduct and behavior is judged against the standards set by such Code of Ethics.

Ethical standards or application of Code of Professional Ethics is often simply believed to deal with cases of corrupt practices, bribery, extortion and loyalty of an engineer to his or her employer in our country. However now in the modern world a Code of Ethics for an engineer has to deal with much wider issues encompassing a whole range of activities which include design, construction, supervision, and quality control, risk assessment , health, safety, environment etc. Thus the days when an engineer's only ethical commitment was eschewing bribery and disloyalty to his or her employer have long passed. Today, broader issues have to be addressed because, engineering, more than any other profession now involves considerable social experimentation and in every experiment there is a risk of negative consequences as well as positive ones. Technological advances do not always ensure blessing for the society. Society is holding engineering profession responsible and / or accountable for decision that influences everyday life of a citizen. Engineers are being made aware of their responsibilities, which go hand in hand with the professional status and the privileges accorded to them by the society. Given these recent developments around the world, professional societies in different countries have made appropriate revisions in their Code of Ethics to emphasize societal and environmental responsibilities of engineers.

Engineering Code of Ethics provides a framework for judgment. However, the codes should not be expected to outline the specific action to be taken in individual cases. The illustrations presented in the preceding paragraph are instances where the engineers are confronted with rather straightforward choices. However, there can be several instances during the professional lifetime of an engineer when he or she has to tread on gray areas when it comes to making ethical choices. Ethical reasoning often can be fuzzy and imprecise. Considerable qualitative thinking that goes on in applying the Code of Ethics is, in many instances, not susceptible to the same kind of precision that can be achieved in engineering science. Such contentions that have been subject to serious study regarding professional responsibilities of engineers and deliberation by professional societies in different countries may be grouped into the following broad areas, viz.

1. Responsibilities against Corrupt Practices, Corruptions, Bribery, Extortion and Political influence, fraudulent, collusive or coercive practices, conflict of interest (undue gift, commission and favor etc.) and theft.

2. Responsibility for upholding honesty, truth, trade secret, confidentiality, data integrity / misrepresentation of data & information etc.

3. Responsibility for safe product design, safe engineering design, construction, supervision and Quality Control of product and engineering process & activities.

4. Responsibility for Safety, Health & Welfare issues, Risk Assessment and mitigation of risk.
5. Responsibility for the Environment and Sustainability and no harm to environment.
6. Responsibility to uphold integrity, honor, dignity and values of engineering profession and commitment not to allow anything goes against the society and public interest.
7. Responsibility to maintain high standard of Professional quality and fair treatment, loyalty & accountability to employer, client and customers.
8. Responsibility and Obligation to maintain high standard of personal behavior in a responsible manner, principle of informed consent and exercise responsibilities in an ethical manner.

In dealing with these issues the professional societies the world over have realized that the Code of Ethics cannot remain as a static document like a religious edict. Instead, it needs to be continuously reviewed, renewed and recast to match the dynamics of changes in technologies, engineering practices and societal receptions. The Code of Ethics defines a high standard of personal and professional conduct. The Code of Ethics incorporates common sense, natural justice, and basic ethical concepts. The Code defines, in general terms, the duties of the professional to the public, to the employer or client, to fellow professionals, to the profession and to oneself.

Corrupt practices, Corruption & Bribery

Corrupt practices, Corruption & Bribery is widespread phenomenon. It raises serious moral, economic and political concerns, undermines good governance, hinders development and distorts competition. It erodes justice, undermines human rights and is an obstacle to development. It also increase the cost of doing business, introduces uncertainty into commercial transactions, increases the cost of goods and services , diminishes the quality of products and services, which may lead to loss of life and property, destroys trust in institutions and interferes with the fair and efficient operation of business & engineering activities etc.

Organizations as well as engineers, therefore have a responsibility to proactively contribute to combating corruption & bribery. This can be achieved by leadership commitment to establishing a culture of integrity, transparency, openness and compliance.

Corruption in the form of bribery, extortion and voluntary or involuntary political contribution has taken as endemic form in many countries- both developed and developing. Generally Codes of Ethics addresses the following in relation to the organizations and person's activities:

1. Corrupt Practices, Corruption & Bribery in the public, private and development sectors;
2. Corrupt Practices, Corruption & Bribery by the organization;
3. Corruption & Bribery by the organization's personnel acting on the organization's behalf or for its benefit;
4. Corruption & Bribery by the organization's business associates acting on the organization's behalf or for its benefit;
5. Corruption & Bribery of the organization;

6. Corruption & Bribery of the organization's personnel in relation to the organization's activities;

7. Corruption & Bribery of the organization's business associates in relation to the organization's activities;

8. Direct and Indirect Corruption & Bribery (e.g. bribe offered or accepted through or by a third party).

9. Corrupt practice includes corruption, fraudulent, collusive or coercive practices.

10. Corrupt practice also includes conflict of interest with employer, clients, friend, relations and business associate or with a public servant with whom he is dealing at that time and concealing such conflict of interest is unethical.

Corrupt practices in the engineering organizations are viewed as part of applied ethics. Since engineering decisions are usually tied to business decision. The question for example, of what is wrong with offering and accepting more than nominal. Gifts when negotiating contract for engineering services is at once an issue in engineering ethics and business ethics. Engineers are developing countries like Bangladesh have been in the receiving end of public criticism for indulging in corrupt practices. Corruption in the form of bribery is endemic in almost all professions. However, after effects of corrupt deals by engineers are far more "visible" in the public eye than in case of other professions. Also, engineering works affect the everyday life of the society more extensively than the outputs of other professionals and civil servants. Consequently, application of ethical practices in engineering is perceived to be critical in stemming the rot. Bribery of the organization personnel is most likely to occur in relation to personnel who are able to make or influence decisions on behalf of the organization.(e.g. Procurement personnel who can award contracts, engineer/Supervisor who can approve work done , a manager who can appoint personnel, or approve benefits, a person who prepares documents for granting of licenses, permit and work order, an accountant who prepares bills for payments or who has got signing authority for approving of fund or disbursement of fund.

Class Assignment:

(a) A study of and Ethical Terms: Ethical (নৈতিক)/ Unethical (অনৈতিক)- RIGHT AND WRONG, GOD AND BAD ETC. For Designing solution for complex engineering problem in accordance with professional practices.

(b) A Study Corrupt practices, Corruption & Bribery in relation to the organizations and person's activities for solution for complex engineering problem in accordance with professional practices.