5.1 Course Title: Moral and Civic Education (MCiE-1012)

Pre-Requisite: None

Course Objectives

This course is designed for undergraduate students with the aim of producing good citizens. It emphasizes on equipping learners with the necessary civic competence and active participation in public life. It will also help them to exercise their democratic rights and discharging their responsibilities effectively by familiarizing them with necessary civic knowledge and skills. In countries such as ours, where the process of cultivating modern constitutional and democratic values in the minds of citizens is experiencing serious challenges, largely because the country had no established civic culture and partly because these values and principles are not yet well-institutionalized, civics and ethical education remains to be imperative. To this end, the course introduces learners to the basics of civics and ethics, citizenship, morality and the goals of studying civics and ethics. It exposes students to the meanings, foundations, approaches, values and principles of ethics and civic virtue that learners must be equipped with both as citizens and professionals in their encounter with real life situations both to be morally matured and responsible while making decisions and taking actions. The course also elucidates the nature, purpose and forms of state and government, constitution, democracy and human rights, the nature of democratic citizenship, modes of cultivating civic-virtues in our citizens mainly within the context of Ethiopia.

Ethiopia is currently going through a twin process of hope and despair. On the one hand there are tremendous social, economic and political changes. On the other hand, significant challenges are affecting the process, the pace and magnitude of this change. For such changes to be successful however, it is imperative that citizens develop rational thinking, critical support and reasonable opposition to the growing culture of mob mentality. Moreover, citizens also need to go beyond their narrow individual interests and prioritize broad national interests. The prevalence of corruption, which has been spreading like a wild fire is also frustrating the productive capacities of citizens that could positively contribute to the development of the country. All the aforementioned national concerns have largely been overlooked by the common course syllabi currently under construction. Such glaring absence of citizenship and moral education from the curriculum could be considered as one of the gaps that need to be urgently addressed. In this regard, by encouraging civil discourse on contending national issues, prioritizing peace and inculcating honorable disposition, the course civic and ethical studies would prepare students to contribute to the overall peace, stability and prosperity of the nation at large, hence magnifying the relevance and urgency of this course.

Learning outcomes: Upon a successful completion of this course, students will be able to:

- Understand the subject matter of Civics and Ethics;

- Cultivate certain moral values and civic virtues that enable them to be morally matured and competent in their professional and citizenry lives by practically exposing them to moral and civic debates/discussions and engagements.
- Develop such values/ virtues as recognition, appreciation and tolerance towards diversity and also build culture of peace
- Gain knowledge about the theoretical discourses and practices of state, government and citizenship, and their mutual interplay especially in the context of Ethiopia;
- Develop individual and/or collective potential of becoming self-confident citizens who can effectively participate in their legal-political, socio-economic and cultural lives;
- Understand the essences of such values and principles as democracy and human rights, multiculturalism and constitution and constitutionalism with especial reference to Ethiopia;
- Develop analytical and reflective skill of identifying global or national level development, democracy/governance and peace related issues of civics and ethics and then be able to produce or evaluate policies and practices in a civically and ethically responsible manner.

Course Syllabus/Contents:

1. **Understanding Civics and Ethics:** Defining Civics, Ethics, Morality and amorality; The Origin and Development of Civics and ethical education; The purpose of civics and ethical education; Citizen: Rights and responsibilities; Competences of good citizen
2. **Approaches to Ethics:** Normative ethics, Teleological Ethics (Consequentialist); Hedonism; Ethical and psychological Egoism: Epicureanism and Cyrenaicism; Social Hedonism: Utilitarianism, Deontological Ethics (Non- Consequentialist); Performance of One's own Duty; Devine-based Morality; Kant's Categorical Imperative; W.D. Ross's Prima Facie duty, Virtue Ethics and Civic Virtues; Basic Principles of Civic Virtues; How to be virtuous person? Non-Normative Ethics; Meta Ethics; Absolutism/Objectivism; Relativism/Subjectivism and Conventionalism; Naturalism and Non-naturalism, Issues in Applied Ethics, Development Ethics; How should a society Develop? Who is morally responsible for Underdevelopment? A'Just' Development, Environmental Ethics; Ecosystem and the environmental pollutions; Principles of Environmental Ethics, Professional Ethics; Profession and Professionalism; The scope of Professional Ethics; Common Principles of Professional Ethics
3. **Ethical Decision Making and Moral Judgments:** Ethical Principles and Values of Moral Judgments, the principle of equal consideration of interest, conflicting goals and ethical Justifications, Ethical values and Justifiable exceptions; Why Should I act ethically?
4. **State, Government and Citizenship:** Understanding State, what is a state? Attributes of State, State Structures; Understanding Government, Major Function and Purpose of Government, Types of Government: Limited and Unlimited, Systems of Government; Understanding Citizenship, what is Citizenship, Inclusion and exclusion in Citizenship, Ways of Acquiring Citizenship, Ways of Losing

Citizenship, Citizenship in Ethiopian Context: Past and Present; State Formation and Nation-building in Ethiopian Context

5. **Constitution, Democracy and Human Rights:** Constitution and Constitutionalism, Peculiar features of Constitution, Major Purpose and Functions of Constitution, Classification of Constitutions, The Constitutional Experience of Ethiopia: pre and post 1931; Democracy and Democratization, Definitions and Forms of Democracy, Views on Democracy: Substantive and Procedural Views, Fundamental Values and Principles of Democracy, Democratization and Its Waves, Major actors in Democratization Process, Democracy and Good Governance in Ethiopia; Human Rights, Definitions and Nature of Human Rights, Basic Characteristics of Human Rights, Dimensions of Human Rights, The Protection and Promotion of Human Rights, Human Rights Instruments: Documents, Oversight Mechanisms: Institutions

Mode of Assessment

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Quiz=5%, Tests =15%, Assignments =15%, Mid-Exam =25%, Final Examination =40%

References:

1. Alexander, Larry (eds.). (1998). Constitutionalism: Philosophical Foundations. Cambridge: Cambridge University Press.
2. Assefa Fisseha. (2006). Federalism and Accommodation of Ethnic Diversity in Ethiopia: Comparative Study. Utrecht: Wolf Legal Publishers.
3. Charles F. Kettering Foundation. & Harwood Group.1991. Citizens and politics: a view from Main Street America. Dayton, Ohio: The Foundation.
4. David S. Oderberg and Timothy Chapel. (2004). Human values, new essays on ethics and natural law palgrave mac millan, Great Britain.
5. Fasil Nahum. 1997. Constitution for a Nation of Nations: The Ethiopian Prospect. Lawrence ville, NJ: Red Sea Publishers.
6. FDRE. (1995). The Constitution of the Federal Democratic of Ethiopia. Federal NegarritGazeta: Addis Abeba
7. Francis Snare (1992). The Nature of Moral Thinking. Rutledge, U.S.A and Canada
8. Frechette,S. (1981). Environmental Ethics. U.S.A.: The Boxwood Press.
9. Goodin, Robert E. 2005. Reflective Democracy. Oxford University Press: New York.
10. James Paul and Clapham .1972. Ethiopian Constitutional Development: A source book. Haile Selassie I university: Addis Ababa.

5.2 Course Name: Communicative English Skills I (FLEn-1011)

Pre-Requisite: None

Course Objectives: Communicative English Skills I is a course designed to enable students to communicate in English intelligibly with acceptable accuracy, fluency and ability to use English appropriately in different contexts. The course exposes students to English language learning activities designed to help students use English for their academic and social needs. Students would be engaged in language learning development activities through doing and reflection on action. This includes grammar and vocabulary as used in communicative events and all skills and their sub-kills: speaking, listening, reading and writing. The language and skills are integrated where one becomes a resource to the other. There are six units covering topics related to the life world of students as well as of societal relevance.

Learning outcomes: At the end of this course, students will be able to:

- Express themselves in social and academic events in English--Use English intelligibly with reasonable level of curacy and fluency
- Listen and comprehend to talks related to social and academic events given in English
- Read and understand texts written in English –texts on academic and social matters
- Write in English as academically and socially desirable.
- Learn and develop their English on their own—learning to learn: the language and the skills

Course Syllabus/Contents:

1. **Introducing Oneself**: **Listening**, introducing oneself (who you are, where you came from, where you finished your primary and secondary school), what you intend to study and why? **Reading,** reading a short biography written in simple English: using background knowledge, reading with comprehension, making notes while reading, guessing meanings, attending to reference words & discussing notes: Reading a short deductive essay: taking notes while reading, discussing notes, guessing meaning while reading, identifying descriptive words, using descriptive words in sentence writing
2. **Study Skills: Listening**-listening to a talk on habits of successful students: reflecting on one's study skills, taking notes while listening, discussing notes, answering listening comprehension questions, discussing answers; giving advice using tips from the listening text: using the language of giving advice; **Reading**-Reading an expository essay on study skills: reading with comprehension, attending to new vocabulary, writing notes while reading, writing brief summaries from notes; studying the present perfect tense and the past perfect tense: form, use and meaning of conditionals
3. **Sports and Health**: **Listening** -Listening about Zinedine Zidan (who he is, his childhood, his professional career): using prior knowledge (talking about a famous football player), predicting what comes next and checking prediction, taking notes while listening, discussing notes, presenting oral summary), asking and answering Wh-questions, studying conditionals (form, use and meaning);

Reading-Reading a short expository passage on sports and health: discussing how sports improve health, reading for main ideas, making notes while reading, developing notes into short summaries, comparing summaries, Working on vocabulary: using word formation;

4. **Cultural Values**: **Listening** -Listening about cultural tourism: discussing how culture attracts tourists, listening with comprehension, taking notes while listening, discussing notes, developing notes into one-paragraph summaries; **Reading**-Reading an expository text on cultural values: reading with comprehension, writing notes while reading, answering comprehension questions, summarizing the text based on notes made while reading, discussing summaries; Revision simple present, simple past, present perfect and past perfect tenses: revising form, use and meanings of these tenses, writing short meaningful sentences using simple present, simple past, present perfect and past perfect forms of verbs
5. **Tourism and Wildlife**: Listening -Listening about human-wildlife conflict (argumentative text): using prior knowledge, listening with comprehension, making notes while reading, writing summaries using the notes, discussing the summaries; Reading -Reading a text on tourism and wildlife: using visual, reading with comprehension, guessing meanings of words based on context, writing brief notes while reading, discussing notes and developing them into summaries, discussing summaries; Working on denotative and connotative meanings; Revising conditionals: constructing meaningful sentences based on pictures
6. **Population: Listening-**Listening about population density: learning the meanings of 'population', 'density' and 'population density', predicting what comes in the talk and checking prediction, listening with comprehension, taking notes while listening, discussing notes, writing short paragraphs using the notes and discussing them; **Reading** -Reading a text on population pyramid: interpreting tables, graphs and pie charts, reading with comprehension, making notes while reading, discussing notes, developing notes into paragraphs, discussing and improving paragraphs; Studying collocation: learning the definition of collocation, identifying words that collocate with 'population', doing exercise on collection, using collection in vocabulary study; Working on active and passive constructions (form, use, meaning): noticing grammar pattern in example sentences, listening to a brief lecture, writing lectures notes, discussing notes, identifying active and passive constructions, completing contextualized exercise, reading independently and compiling portfolio on passive constructions

Mode of Assessment:

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Active Participation=5%, Individual Assignment (portfolio) = 10%, Group Assignment = 15%, Written test = 10%, Oral presentation = 10%, Final Examination = 50%

References:

1. Alfassi, M. 2004. Reading to learn: Effects of combined strategy instruction on high school students. Journal of Educational Research, 97(4):171- 184.
2. Anderson, N. 1999. Exploring second language reading: Issues and strategies. Toronto: Heinle &Heinle Publisher.
3. Bade, M. 2008. Grammar and good language learners. In C. Griffiths (Eds.). Lessons from good language learners (pp.174-184). Cambridge University Press. https//doi.org/10.107/CBO9780511497667.016
4. Bouchard, M. 2005. Reading comprehension strategies for English language learners: 30research-based reading strategies that help students read, understand and really learn content from their textbooks and other nonfiction materials. New York: Scholastic.
5. Cameron, L. 2001. Teaching languages to young learners. Cambridge: Cambridge University Press.
6. Chamot, A.U. 1987. The learning strategies of ESL students. In A. Wenden & J. Rubin (Eds.). Learner strategies in language learning (PP 71-85). Prentice-Hall: Hemel Hempstead.
7. Gairns, R. & Redman, S. 1986. Working with words: A guide to teaching and learning vocabulary. Cambridge University Press. Department of Foreign Language and Literature. 1996. College English (Volume I and Volume II). Addis Ababa University Press.
8. McNamara, D.S. (Ed.). 2007. Reading comprehension strategies: Theories, interventions, and technologies. New York: Erlbaum.
9. Tilfarlioğlu, Y. 2005. An Analysis of the relationship between the use of grammar learning strategies and student achievement at English preparatory classes. Journal of Language and Linguistic Studies 1: 155-169.

5.3 Course Name: Communicative English Skills II (FLEn-1012)

Pre-requisite: Communicative English Language and Skill – I

Course objectives

Communicative English Language Skills II Module is a continuation of Communicative English I Module, and it mainly aims to provide first year University students proficiency with reading, speaking and writing skills. It also aims to help students learn vocabularies that are assumed unfamiliar to them**.** In the grammar part, with the intention of providing explanations, brief notes are given in each unit. The course consists of five units with three supplementary reading at the end of the Module. The supplementary readings are included to support ideas included in the reading passages in units 1-3.

Contents of the course:

- Life Skills
- Speculations about the future of Science
- Environmental protection
- Indigenous Knowledge
- Cultural Heritage

Supplementary Readings

A. Environmental Problems
B. The Origin of Humans: The Record from the Afar of Ethiopia
C. Tourism Can be Used to Preserve Ethiopia's Cultural and Historic Wealth

Mode of assessment; Active Participation =5%**,** Individual Assignment (portfolio)= 10%**,** Group Assignment = 15%**,** Written test = 10%**,** Oral presentation = 10%**,** Final Examination = 50%

- A student must attend at least 85% of the class

References

- Azar, B. S. (2003). Fundamentals of English grammar.
- Longman. Eggenschwiler, J., & Biggs, E.D. (2001). Writing: Grammar, Usage, and Style. New York. Hungry Minds. Inc
- Lucy, J. A., & Lucy, L. A. (Eds.). (1993). Reflexive Language: Reported Speech and Meta pragmatics. Cambridge University Press.
- Murphy, R. (2012). English Grammar in Use. Ernst Klett Sprachen.
- Naylor, H., & Murphy, R. (2007). Essential Grammar in Use. Supplementary Exercises. With Answers. Ernst Klett Sprachen

5.4 Course Title: Critical Thinking (LoCT-1011)

Pre-Requisite: None

Course Objectives

Ethiopian is striving to guarantee sustainable development and good living condition, where constant and consistent critical thinking plays an irreplaceable role. The course is designed to understand the relationship of logic and philosophy, recognize the core areas of philosophy, appreciate the necessity learning logic and philosophy, understand basic logical concepts, arguments, understand deductivness, inductiveness, validity, strength, soundness, and cogency, develop the skill to construct sound argument and evaluate arguments; cultivate the habits of critical thinking and develop sensitivity to clear and accurate usage of language; differentiate cognitive meanings from emotive meanings of words, differentiate standard forms of categorical propositions from other types of sentences used in any

language, apply symbols to denote standard forms of categorical propositions to form further logical assertions among them, develop logical and open-mind that weighs ideas and people rationally; develop confidence when arguing with others, demonstrate logical argumentative ability, develop logical reasoning skill in their day to day life, and appreciate logical reasoning, disproving mob-mentality and avoid social prejudice; understand the basic concepts and principles of critical thinking; understand the criterion of good argument; identify the factors that affect critical thinking; apply critical thinking principles to real life situation.

Learning outcomes: At the completion of the course, the student will have developed an understanding of the role logic plays in the reasoning process. Specifically, the students are expected to achieve:

- The ability to recognize and analyze arguments in everyday language, to detect hidden or implicit premises, and to extract the logical form of an argument;
- The ability to show the deductive validity or invalidity of an argument, to recognize and criticize the flaws of a weak argument, and to develop counterarguments;
- The ability to evaluate the strength of evidential support for scientific hypotheses, especially causal hypotheses, in relatively simple cases; and
- The ability to present arguments cogently in speech and in writing

Course Syllabus/Contents:

1. **Logic and Philosophy**: Introduction; Meaning and Definition of philosophy, Core Branches of Philosophy, Importance of Learning Logic and Philosophy
2. **Basic Concepts of Logic:** Introduction; Basic Concepts of Logic; Techniques of recognizing arguments; Types of Arguments, Deductive Arguments, Inductive Arguments; Evaluation of Arguments, Evaluating Deductive Argument, Evaluating Inductive Arguments
3. **Logic and Language**: Introduction; Logic and Meaning, Cognitive and Emotive Meaning of Words, Intentional and Extensional Meaning of Terms, Logic and Definition, Types and Purposes of Definition, Techniques of Definition, Extensional Techniques of Definition, Intentional Techniques of Definition Comments, added Comment, modified: Criteria for Lexical Definitions
4. **Basic Concepts of Critical Thinking:** Introduction; Meaning and Definition of Critical Thinking; Principles of Critical Thinking; Criterion/Standard of Argument Good Argument; Factors Affecting Critical Thinking; Relevance of Critical Thinking
5. **Logical Reasoning and Fallacies**: Induction; Types of Fallacies, Formal and Informal; Categories of Informal Fallacies, Fallacies of Relevance, Fallacies of Weak Induction, Fallacies of Presumption, Fallacies of Ambiguity, Fallacies of Grammatical Analogy
6. **Categorical Propositions**: Introduction; Categorical Propositions, The Components of Categorical Propositions, Attributes of Categorical Propositions: Quality, Quantity, and Distribution, Representing Categorical Propositions, Venn Diagrams, Boolean and Aristotelian Square of Oppositions,

Evaluating Immediate Inferences: Venn Diagrams and Square of Oppositions, Logical Operations: Conversion, Obversion, and Contraposition

Mode of Assessment: Continuous assessment method will be applied to evaluate the competence of students acquired from the course. The continuous assessment includes:
Test= 15%, Mid Exam= 20%, Assignment=15, Final Exam=50%

References:

1. Hurley, Patrick J. (2014) A Concise Introduction to Logic, 12th Edition, Wadsworth, Cengage Learning.
2. Hurley, Patrick J. (2012) A Concise Introduction to Logic, 11th Edition, Wadsworth, Cengage Learning
3. Copi, Irving M.and Carl Cohen, (1990) Introduction to Logic, New York: Macmillan Publishing Company.
4. Damer, Edward. (2005). Attacking faulty reasoning. A practical guide to fallacy free argument. Wadsworth Cengage learning, USA.
5. Fogelin, Robert, J, (1987) Understanding Arguments: An Introduction to Informal Logic, New York: Harcourt Brace Jvanovich Publisher.
6. Guttenplan, Samuel: (1991) The Language of Logic. Oxford: Blackwell Publishers Stephen, C. (200). The Power of Logic. London and Toronto: Mayfield Publishing company.
7. Simico, N.D and G.G James. (1983) Elementary Logic, Belmont, Ca: Wadsworth Publishing Company.

5.5 Course Name: General Psychology (Psyc-1011)

Pre-Requisite: None

Course Objectives: The course General Psychology encompasses the fundamental concepts and principles of psychology which have immense application to human life problems. Hence, this course is intended to introduce students to the basic concepts of psychology and acquaint them with how to apply psychological knowledge, principles, and theories to real life situation and problems. So, it is of paramount importance for students of any field of study to be effective in their personal, social, and professional life. Apart from that, it is to introduce students to the core set of life skills, which are important in realizing holistic development of students (i.e sense of well-being, confidence and academic performance) so that they can lead happy, healthy, successful, and productive life.

Learning outcomes: Up on the completion of this course, students will be able to:

- Describe basic psychological concepts.
- Compare and contrast the major theoretical perspectives in psychology.
- Discuss different aspects of human development

- Compare and contrast different learning theories
- Summarize motivational and emotional processes
- Demonstrate social and interpersonal skills in everyday life.
- Set an adaptive goal and plan for future.
- Apply knowledge of psychology to one's own life & to develop life skills.
- Explain ways how self-confidence, self-esteem, self-efficacy, assertiveness, responsible behaviors, interpersonal skills will be strengthened.
- Apply different stress coping mechanisms.

Course Syllabus/Contents:

1. **Essence of Psychology**: Definition of Basic Concepts; Goals of Psychology; Historical Background of Psychology; Theoretical Perspectives in Psychology; Branches of Psychology; Research Methods in Psychology
2. **Human Development**: Definition and Concepts of Human Development; Facts and Principles of Human Development; Aspects of Human Development; Theories of Human Development, Cognitive Theories, Psychosexual Theory, Psychosocial Theory, Moral Development Theory; Personality Development, Meaning of Personality, Trait theories of Personality, Humanistic theories of Personality
3. **Learning and Theories of Learning**: Definition, Principles and Characteristics of Learning; Factors Influencing Learning; Theories of Learning and their Applications, Behavioral Theory of Learning, Social Learning Theory, Cognitive Learning Theory
4. **Memory and Forgetting**: Memory, Meaning and Process Of Memory, Stages of Memory, Factors Affecting Memory; Forgetting, Meaning and Concepts of Forgetting, Theories of Forgetting; Improving Memory
5. **Motivation and Emotion**: Motivation, Definition and Types of Motivation, Theories of Motivation and their Applications, Conflict of Motives and Frustration; Emotion, Definition of Emotion, Components of Emotion, Theories of Emotion and their Applications
6. **Psychological Disorders and Treatment Techniques**: Nature of Psychological Disorders; Causes of Psychological Disorders; Types of Psychological Disorders; Treatment Techniques
7. **Introduction to Life Skills**: Nature and Definition of Life skills; Goals of Life Skills; Components of Life Skills
8. **Intra-personal and Personal Skills**: Self-Concept and Self-Awareness; Self-Esteem and Self-Confidence; Self-Control; Emotional Intelligence and Managing Emotion; Resilience and Coping with Stress; Anger Management; Critical and Creative Thinking; Problem Solving and Decision Making
9. **Academic Skills**: Time Management; Note-taking and Study Skills; Test-Taking Skill; Test Anxiety and Overcoming Test Anxiety; Goal Setting; Career Development Skill

10. **Social Skills**: Understanding Intercultural Diversity and Diversity Management; Gender and Social Inclusion; Interpersonal Communication Skills; Social Influences and Peer Pressure; Assertiveness; Conflict and Conflict Resolution; Team Work; Overcoming Risky Behavior

Mode of Assessment

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. The continuous assessment includes:
Test= 20%, Assignment=10%, Individual assignment=10%, Group presentation=10% and Final exam 50%

References:

1. Coon, D. & Mitterer, J.O. (2008). Introduction to psychology: Gateways to mind and behavior (12th ed). New York, NY: McGraw Hill.
2. Feldman, R.S. (2018). Essentials of understanding psychology (13th ed). New York, NY: McGraw Hill.
3. Gray, P. & Bjorklund, D.F. (2017). Psychology (7th ed). New York, NY: Worth Publishers.
4. Kalat, J.W. (2013). Introduction to psychology (13th ed). New York, NY: McGraw Hill.
5. Lahey, B.B. (2008). Psychology: An introduction (10th ed). New York, NY: McGrawHill.
6. Lilienfeld, S.O., Lynn, S.J., Namy, L.L. & Woolf, N.J. (2017). Psychology: From Inquiry to understanding (3rd ed). Upper Saddle River, NJ: Pearson Education.
7. Meyers, D.G. & DeWall, C.N. (2016). Exploring psychology in modules (10th ed). New York, NY: Worth publishers.
8. Weiten, W. (2014). Psychology: Themes and variations (briefer version, 9th ed). Belmont, CA: Wadsworth Publishing.
9. Burnard, P. (1989). Teaching interpersonal skills: A handbook of experiential learning for health professionals. London, UK: Chapman and Hall.
10. Cotnell, S. (2013). The study skills handbook. New York, NY: Palgrave MacMillan. Haddon, P.F. (1990). Mastering personal and interpersonal skills: Key techniques and personal success. London, UK: Thorogood Ltd.

5.6 Course Name: Physical Fitness (SpSc-1011)

Pre-Requisite: None

Course Objectives: This course will provide the students with basic concepts of the five components of health-related physical fitness (cardiovascular, muscular strength and endurance, flexibility, and body composition), conditioning, hypokinetic disease and general principles of training. It is mainly practical oriented. As a result, the students will be exposed to various exercise modalities, sport activities, minor and major games, and various training techniques as a means to enhance health related physical fitness components. In addition, they will develop the skills to assess each component of fitness and will practice

designing cardiovascular, muscular strength and endurance, and flexibility programs based on the fitness assessment. The course serves as an introduction to the role of exercise in health promotion, fitness, performance including the acute and chronic responses of the body to exercise.

Learning outcomes: At the end of this course, the students will be able to:

- Recognize the immediate and long-term responses of the body to various types of exercise.
- Understands the basic concepts of physical fitness and conditioning exercises.
- Understand the concept of hypokinetic disease and conditions.
- Distinguish the general principles of fitness training
- Develop conditioning programs to enhance the components of health-related physical finesses.
- Participate in conditioning programs which may help to develop the components of health-related physical finesses.
- Understand health issues in relation to excess body fatness and excessively low body fat.
- Develop skills to assess health related physical fitness components.
- Develop healthy body weight management skill.
- Appreciate and value the benefits of regular physical exercise to healthy living.
- Develop interest to engage in a regular physical exercise program as a life time activity.
- Develop self-confidence and effective communication skills in and out of the school environment.

Course Syllabus/Contents:

1. **Concepts of physical fitness and conditioning:** Meanings and definitions of terms, physical fitness, physical conditioning, Physical Activity, Physical exercise and sport; General principles of fitness training
2. **The Health Benefits of Physical Activity**: Physical Activity and Hypokinetic Diseases/Conditions; Physical Activity and Cardiovascular Diseases; physical activity and postural deformity
3. **Making Well-Informed Food Choices:** Sound Eating Practices; Nutrition and Physical Performance
4. **Health related components of fitness:** Cardiovascular fitness, Meaning and concepts of cardiovascular fitness, Means and methods of developing cardiovascular fitness; Muscle fitness, Meaning and concepts of muscle fitness, Means and methods of developing muscle fitness; Flexibility, Meaning and types of flexibility, Means and methods of developing flexibility; Body composition, Meaning of body composition, Health risks associated with over fatness, Health risks associated with excessively low body fatness
5. **Assessment of fitness components:** Assessment of cardiovascular fitness; Assessment of muscle fitness; Assessment of flexibility; Assessment of body composition
6. **Development and Assessment of the health-related components of fitness**

Mode of Assessment: Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Test (Written) = 10%, Group assignment (peer fitness assessment) =20%, Mid-term exam (Written) =30%, Final exam - practical group assignment (peer training on the five components of fitness) =40%

References:

1. Charles B. Corbin, Gregory J. Weik, William R. Corbin and Karen A. Welk. (2006). Concepts of fitness and wellness: a comprehensive lifestyle approach. 6th edt.
2. Schott k. Powers, Stepheen L. Dod and Virginia J. (2006), Total Fitness and Wellness.
3. Paul M, and Walton T. (2006), Core Concepts in Health, 10th edit.
4. Charles B. Corbin and Ruth Lindsey (1990), Fitness for life, 3rd Edition, Scott.

6. MODULE 2: SOCIAL STUDIES

This module helps students to recognize their environment, geographic locations and history of their country. It also gives the students awareness on how to peacefully leave with each other respecting our diversity and strengthening our unity. It is one way of motivating students to create their own job. Four courses are categorized under this module (Table 6-1).

Table 6-2 Social studies

Code	Course Name	Status	Cr H	L	T	L/P	HS	ECTS
GeES-1110	Geography of Ethiopia and the Horn	Compulsory	3	2	3	0	3	5
Anth-1012	Social Anthropology	Compulsory	2	2	2	0	2	4
GLAF-1013	Global Trends	Compulsory	2	2	2	0	2	4
Mang-1024	Entrepreneurship	Compulsory	3	2	3	0	2	5
SNIE-1012	Inclusiveness	Compulsory	2	2	2	0	2	4
		Sum	*12*	*10*	*12*	*0*	*11*	*22*

6.1 Course Title: Geography of Ethiopia and the Horn (GeES-1021)

Pre-Requisite: None

Course Objectives: This course attempts to familiarize students with the basic geographic concepts particularly in relation to Ethiopia and the Horn of Africa. It is also intended to provide students a sense of place and time (geographic literacy) that are pivotal in producing knowledgeable and competent citizens that are able to comprehend and analyze problems and contribute to their solutions. The course consists of four parts. The first part provides a brief description on the location, shape and size of Ethiopia as well as basic skills of reading maps. Part two introduces the physical background and natural resource endowment of Ethiopia and the Horn which includes its geology and mineral resources, topography, climate, drainage and water resources, soil, fauna and flora. The third part of the course focuses on the

demographic characteristics of the country and its implications on economic development. The fourth component of the course offers treatment of the various economic activities of Ethiopia and the Horn which include agriculture, manufacturing and service sectors. Moreover, Ethiopia in a globalizing world is treated in the perspectives of the pros and cons of globalization on its natural resources, population and socio- economic conditions.

Learning outcomes: Up on the completion of the course, students will able to:

- Acquire basic knowledge on the geographic attributes of Ethiopia and Horn
- Develop a sense of appreciation and tolerance of cultural diversities and their interactions
- Acquire general understanding of physical geographic processes, and human-environment relationships
- Develop ethical aptitudes and dispositions necessary to live in harmony with the natural environment
- Develop an understanding of national population distributional patterns and dynamics
- Conceptualize the comparative advantages of economic regimes; and understand the impacts of globalization.
- Understand their country's overall geographic conditions and opportunities; and be proud of the natural endowments and cultural richdom that help them develop a sense of being an Ethiopian.

Course Syllabus/Contents:

1. **Introduction:** Geography: Definition, scope, themes and approaches; Location, Shape and Size of Ethiopia and the Horn, Location and its effects, The shape of Ethiopia and its implication, The size of Ethiopia and its implications; Basic Skills of Map Reading
2. **The geology of Ethiopia and the Horn**: Introduction; The Geologic Processes: Endogenic and Exogenic forces; The Geological Time scale and Age Dating Techniques; Geological Processes and the Resulting Landforms, The Precambrian Era geologic processes and resultant features, The Paleozoic Era geologic processes and resultant features, The Mesozoic Era geologic processes and resultant features, The Cenozoic Era geologic processes and resultant features; Rock and Mineral Resources of Ethiopia
3. **The topography of Ethiopia and the Horn:** Introduction; Physiographic Divisions, The Western Highlands and Lowlands, The Southeastern Highlands and Lowlands, The Rift Valley; The Impacts of Relief on Biophysical and Socioeconomic Conditions
4. **Drainage systems and water resources of Ethiopia and the Horn:** Introduction; Major Drainage Systems of Ethiopia; Water Resources: Rivers, Lakes, and Subsurface Water; General Characteristics of Ethiopian Rivers; Water Resources Potentials and Development in Ethiopia
5. **The climate of Ethiopia and the Horn:** Introduction; Elements and Controls of Weather and Climate; Spatiotemporal Patterns and Distribution of Temperature and Rainfall in Ethiopia; Agro-

ecological Zones of Ethiopia; Climate and its Implications on Biophysical and Socioeconomic Aspects; Climate Change/Global Warming: Causes, Consequences and Response Mechanisms

6. **Soils, natural vegetation and wildlife resources of Ethiopia and the horn:** Introduction; Ethiopian Soils: Types, Degradation and Conservation; Types and Distribution of Natural Vegetations in Ethiopia; Natural vegetation: Uses, Degradation and Conservation Strategies; Wildlife Resources of Ethiopia: Types, Importance, and Conservation Strategies
7. **Population of Ethiopia and the Horn:** Introduction; Population Data: Uses and Sources; Population Dynamics: Fertility, Mortality and Migration; Population Distribution and Composition; Sociocultural Aspects of Ethiopian Population: Education, Health and Languages; Settlement Types and Patterns
8. **Economic activities in Ethiopia**: Mining, Fishing and Forestry; Agriculture in Ethiopian, Contributions, potentials and characteristics of agriculture in Ethiopia, Agricultural systems in Ethiopia, Major problems of Ethiopian agriculture; Manufacturing in Ethiopia, Manufacturing: essence and contributions, Types, characteristics and distribution of manufacturing, Industrial development in Ethiopia: Challenges and Prospects; The Service Sector in Ethiopia, Transportation and communication in Ethiopia: types, roles and characteristics, Trade in Ethiopia: types, contributions and characteristics, Tourism in Ethiopia: Types, major tourist attraction sites, challenges and prospects

Mode of Assessment

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Paper & presentation = 20 %; Mid exam =30 %; Final examination =50 %

References:

1. A.D. Tathe. (2012). Lecture Notes on Climatology: For Intermediate Met Training Course, Indian Meteorological Department.
2. Addis Ababa University (2001). Introductory Geography of Ethiopia, Teaching Text, Department of Geography.
3. Assefa M., Melese W., Shimelis G. (2014). Nile River Basin; Ecohydrological Challenges, Climate Change and Hydro politics. Springer International Publishing, Switzerland.
4. B. D, Ray (1989). Economics for Agriculture: Food, Farming and the Rural Economy. Macmillan.
5. CSA 1994 & 2007. Population and Housing Census Results. CSA: A.A.
6. Diao, Xinshen,. 2007. The Role of Agriculture in Economic Development: Implications for Sub Saharan Africa. Sustainable Solutions for ending Hunger and Poverty, Research Report 153. IFPRI.Ethiopia.

7. Engdawork Assefa (2015). Characterization and classification of major agricultural soils in CASCEP intervention weredas in the central highlands of Oromia Region, Ethiopia, Addis Ababa University
8. FDRE.2001 Ministry of Water Resources, National Metrological Survey, A.A.

6.2 Course Title: Social Anthropology (Anth-1022)

Pre-Requisite: None

Course Objectives: This course is designed to introduce the anthropology of Ethiopian societies and cultures to first year students of Higher Learning Institutions (HLIs). It covers basic concepts of anthropology such as culture, society and humanity. It also discusses themes including unity and diversity; kinship, marriage and family; indigenous knowledge systems and local governance, identity, multiculturalism, conflict, conflict resolution and peacemaking system; intra and inter-ethnic relations of Ethiopian peoples. In addition, the course explores culture areas of Ethiopia such as plough culture, enset culture and pastoralism. The course further covers marginalized minority and vulnerable groups in terms of age, gender, occupation and ethnicity by taking ethnographic case studies into account and discuss ways of inclusive growth.

Learning outcomes: Up on the successful completion of the course, students will be able to:

- Develop an understanding of the nature of anthropology and its broader scope in making sense of humanity in a global perspective;
- Understand the cultural and biological diversity of humanity and unity in diversity across the world and in Ethiopia;
- Analyze the problems of ethnocentrism against the backdrop of cultural relativism;
- Realize the socially constructed nature of identities & social categories such as gender, ethnicity, race and sexuality;
- Explore the various peoples and cultures of Ethiopia;
- Understand the social, cultural, political, religious& economic life of different ethnolinguistic & cultural groups of Ethiopia;
- Understand different forms marginalization and develop skills inclusiveness;
- Appreciate the customary systems of governance and conflict resolution institutions of the various peoples of Ethiopia;
- Know about values, norms and cultural practices that maintain society together;
- Recognize the culture area of peoples of Ethiopia and the forms of interaction developed over time among themselves; and
- Develop broader views and skills to deal with people from a wide variety of socioeconomic and cultural backgrounds.

Course Syllabus/Contents:

1. **Introducing Anthropology and its Subjects**: What is anthropology – a Mirror for Humanity?; sketching the subject matter, scope and concerns of anthropology; anthropological imagination:, asking questions and seeing the world anthropologically, Q- What does it mean by using the anthropological lens when looking at the world?, defining Features of Anthropology- holism, relativism & comparative perspectives, methods of research in anthropology, ethnography & ethnographic methods; sub-fields of Anthropology, four mirrors for understanding humanity; the relation between anthropology and other disciplines
2. **Human Culture and Ties that Connect**: Conceptualizing Culture, What Culture Is and What Culture Isn't? Characteristics features of culture, what differentiates culture from other traditions?;Aspects of Culture –Material & Non-material (values, beliefs & norms); Levels of culture: universality, generality and particularity (cultural diversity); Ethnocentrism, Cultural relativism, and human rights-**Discussion**-Debating cultural relativism: Human rights law and the demonization of culture and anthropology along the way, Cultural Change: what is cultural change?; Cultural Diffusion versus Cultural Assimilation, Innovation, **Discussion** - Contesting culture as sharply bounded versus unbounded 'cultural flows' or as 'fields of discourse' in the context of globalization; Ties that Connect: Marriage, Family and Kinship, Marriage -rules, functions and forms of Marriage, Family -types and functions of Family • Q. How families and marriage differ in different societies? Kinship System -types of kin groups and rules of descent, Kinship and Gender Across Cultures Sex and Gender: Mapping differences in cross cultural perspective Gender –as power relations; Cultural practices, norms and values that maintain society together
3. **Human Diversity, Culture Areas, and Contact in Ethiopia**: Human Beings & Being Human: What it is to be human? (a bio-cultural animal?); Origin of the Modern Human Species: Homo sapiens sapiens (that's you!); Religious, biological & evolutionary (paleo-anthropological) explanations; The Kinds of Humanity: human physical variation • Q. Why isn't everyone the same? Q. Why do people worldwide have differences in their phenotypic attributes? Human Races: the history of racial typing; The Grand Illusion: Race, turns out, is arbitrary • Q. What can we say for sure about human races? Why is Everyone Different? Human Cultural Diversity - anthropological explanations • Q. Why don't others do things the way we/I do? Culture areas and cultural contacts in Ethiopia; Plough culture area; Enset culture area; Pastoral societies culture area; Historical and social interactions between culture areas
4. **Marginalized, Minorities, and Vulnerable Groups**: Gender based marginalization; Occupational cast groups; Age based vulnerability (children and old age issues); Religious and ethnic minorities; Human right approaches and inclusive growth, anthropological perspectives
5. **Theories of inter-ethnic relations and multiculturalism in Ethiopia:** The Scales of Human Identity: Who am I? Understanding 'self' & 'other' • Q- What are the ways we tell for others who we are? Ethnicity and Race: What's in a name? Ethnic Groups & Ethnic Identity • Q. What is the basis of

one's ethnic identity? • Q. Is ethnicity a fundamental aspect of human nature & self-consciousness, essentially unchanging and unchangeable identity? Or • Q. Is it, to whatever extent, socially constructed, strategically or tactically manipulable, and capable of change at both the individual and collective levels? Race –the social construction of racial identity • Q. Do the claims of some people/groups about superior & inferior racial groups have any scientific validity? Primordialism; Instrumentalism; Social constructivism; Debates on inter-ethnic relations and identities

6. **Customary and local governance systems and peace making**: Indigenous knowledge systems and local governance; Intra and inter-ethnic conflict resolution institutions Ethnographic cases: commonalities and shared practices (e.g., Oromo and Somali, Afar and Tigray; Gedeo and Oromo; Guraghe and Siltie; Amara and Tigray); Customary/Local governance systems Ethnographic cases: Oromo Geda; Somali-Gurti; Gamo, Gofa, Wolayita-Woga; Guraghe-Sera; Legal pluralism: interrelations between customary, religious and state legal systems

Mode of Assessment:

Based on the progressive understandings of the course, students will be evaluated continuously through both non-graded assignments/activities, like (reading assignments) and graded assignments/activities and assessments including class discussion & participation, Test, Term Paper & presentation, Home Taken Exam/case studies and Final Exam.

References:

1. Asmarom Legesse (2006). Oromo Democracy: an Indigenous African Political System. The Red Sea Press, Inc.
2. Cameron, M. Smith and Evan T. Davies (2008). Anthropology for Dummies. Wiley Publishing, Inc., Indianapolis, Indiana.
3. Clifored Geertz. (1973). The Interpretation of Cultures. A division of Harper Collin Publishers.

4. Donald Donham . (1986). Marxist Modern. The Ethnographic History of Marxist Ethiopia.

5. Donald N. Levine. (1974). Greater Ethiopia: The Evolution of A Multiethnic Society. Chicago & London., University of Chicago.

6. Dunif-Hattis and Howard C. (1992). Anthropology: Understanding Human Adaptation. New York: Harper Collins, Inc.

7. Eriksen, T. H. (2001). Small Places, larger Issues: An introduction to social and cultural anthropology. London: Pluto Press.

8. Eriksen, T. H. (2004). What is anthropology? London: Pluto Press.

9. Eriksen, T. Hylland. (2002). Ethnicity and Nationalism. London; Pluto Press.

10. Eriksen, T.H. and Nielsen, F.S. (2001). A History of Anthropology. London: Pluto Press.

6.3 Course Title: Global Trends (GLAF-1013)

Pre-Requisite: None

Course Objectives: This module is basically designed for the course, Global Affairs. The course is designed to equip students with the basics of international relations so that they will be exposed to global challenges and perspectives. The course is very comprehensive, broad and multidisciplinary in its nature. Perhaps you may find it as an ice-breaking course since it touches up on wide range of issues, concepts, theories, approaches and debates that are helpful in understanding the contemporary international relations. Concepts, such as national interest, foreign policy, actors, globalization, balance of power, cold war, multi-polar systems, international law and other relevant concepts are being introduced. Different debates and approaches to the study of international relations including realism, liberalism are also given due emphasis. Due to the vastness of the course, its contents are organized into six chapters. The first chapter lays the foundation of the course by introducing major concepts, such as: the nature, scope, evolution, actors and levels of analysis, structure as well as theories of international relations. In the second chapter topics such as; national interest, foreign policy, diplomacy and Ethiopian foreign policy under successive regimes are discussed in some length. Chapter three brings out the contending issues of international political economy with emphasis on global institutions of governance. Last chapter the debates between regionalism and globalization with contemporary global issues that affect international relations.

Learning outcomes: Up on the completion of this course, the students will able to:

- Understand nations, nationalism and states
- Explain the nature and historical development of international relations
- Examine the extent and degree of influence of state and non-state actors in the international system
- Gain basic knowledge of the major theories of International Relations and develop the ability to critically evaluate and apply such theories
- Elucidate national interest, foreign policy and diplomacy
- Assess the overriding foreign policy guidelines of Ethiopia in the past and present
- Explicate the nature and elements of international political economy
- Examine the roles major international and regional institutions play inworld politic
- Explore Ethiopia‘s role in regional, continental and global institutions and affairs
- Critically evaluate the major contemporary global issues

Course Description/Contents:

1. **Understanding international relations:** Conceptualizing nationalism, nations and states, understanding international relations, the nature and evolution of international relations, actors in

international relations, levels of analysis in international relations, structure of international system, Theories of international relations.

2. **Understanding foreign policy and diplomacy:** National Interest, understanding foreign policy and diplomacy, Over view of foreign policy of Ethiopia
3. **International political economy (IPE):** meaning and nature of IPE, Theoretical perspectives of IPE, Survey of the most influential national political economy system in the world, Core issues and governance of IPE,
4. **Globalization and Regionalism:** Globalization, globalization debates, globalization and its impacts, Ethiopia in a globalized world, pros and cons of globalizations, defining regionalism and regionalization, regionalization, globalization and the state.
5. **Major contemporary global issues:** Survey of major contemporary global issues.

Mode of Assessment/Evaluation

Quiz=5%, Test=15%, Individual Assignment=25%, Presentation =5%, Final Exam 50%

References:

1. Balaam, David N., and Bradford Dillman. 2011. Introduction to International Political Economy. Boston: Longman.
2. Bates, R. (1982). Markets and States in Tropical Africa. Berkeley: University of California Press.
3. Baylis, J. and Steve S. 2001. The Globalization of World Politics: An Introduction to International Relations. Oxford University Press: New York.
4. Booth, K. and Smith, S. (eds), International Relations Theory Today (Cambridge: Polity
5. Brown, Chris, Understanding International Relations (London, Macmillan, 1977)
6. Bull, Hedley, The Anarchical Society (Basingstoke, Macmillan, 1977)
7. Burchill, Scott, ‗Introduction', in Burchill, Scott and Linklater, Andrew et al., Theories of International Relations (London, Macmillan, 1996)
8. Burton, John, Systems, States, Diplomacy and Rules (Cambridge, Cambridge University Press, 1968)
9. Carr, E.H., Twenty Years' Crisis, (New York, Harper and Row, 1964 [1939])
10. Cohn, Theodore H. 1999. Global Political Economy: Theory and Practice. New York: Longman.
11. Crane, George T. and Abal. Amawi (1997). The Theoretical evolution of International Political Economy:
12. A Reader (2nd Edition). Oxford University Press: New York.
13. Frank, A.G., Capitalism and Under Development in Latin America, (Harmondsworth, Penguin, 1971)
14. Giddens, Anthony, The Constitution of Society (Cambridge, Polity Press, 1984)
15. Gilpin, R. 2001. Global Political Economy: Understanding the International Economic Order. Princeton University Pres: Princeton and Oxford.

6.5 Entrepreneurship (Mang-5024)

Pre-Requisite: None

Course Objectives: This interdisciplinary course is designed to introduce students the meaning and concept of entrepreneurship, creativity, innovation and their manageable processes that can be applied across careers and work settings. It focuses on building entrepreneurial attitude and behavior that will lead to creative solution within community and organizational environments. The Course topics include the history of entrepreneurship, the role of entrepreneurs in the globalized economy and the identification of entrepreneurial opportunities. The development of a business ideas, products and services, marketing and developing new ventures, the examination of feasibility studies and the social and ethical implications of entrepreneurship are incorporated.

Besides, issues related to starting and financing a new venture are included. Finally, managing growth, transition and sustainability of the venture are considered. And forms of business organizations, legal and regulatory frameworks of governing the whole system are also encompassed in the course syllabus.

Learning outcomes: Up on the completion of this course, the students will able to:

- Define entrepreneurship within the context of society
- Identify business opportunities
- Prepare business plan
- Distinguish forms of business ownership
- Comprehend intellectual property rights in business practices
- Define basic marketing concepts
- Formulate context-based marketing strategies
- Identify and evaluate sources of financing new ventures
- Manage business growth and transition
- Practice ethical business with all stakeholders

Course Description/Contents:

6. **Introduction:** Definition and philosophy of Entrepreneurship Vs Entrepreneurs; Type of Entrepreneurs; Role within the economy; Entrepreneurial Competence and Environment; Entrepreneurship, creativity and Innovation.
7. **Business Planning:** Opportunity Identification and Evaluation; Business Idea Development and Identification; Sources of Business Ideas; The Concept of Business Planning; Business Feasibility; The Business plan and Developing a business plan.
8. **Business Formation:** The Concept of Business Development; Forms of Business; Definition and Importance of SMEs; Setting up small scale business; Roles of SMEs; Business failure and success factors; Problems of small-scale business in Ethiopia and Organizational structure and entrepreneurial team formation.

9. **Product or Services Development:** The Concept of product or service technology: Product or service development Process; Legal and regulatory frameworks; Intellectual Property Protection/Product or service protection.
10. **Marketing:** Concept and philosophy of marketing; Marketing Mix and Strategies; Marketing Information System; Competitive analysis and Selling and Customer Service.
11. **Financing the new venture:** Overview of Business Financing; Source of financing; Traditional Financing (Equib/Edir,); Crowd Funding and Micro finance in Ethiopia.
12. **Managing Growth and Transition:** Managing business growth; New venture expansion strategies; Business Ethics and Social Responsibility.

Mode of Assessment/Evaluation

Quiz=5%, Test=15%, Individual Assignment=10%= Business Plan Preparation=15%, Presentation =5%, Final Exam 50%

References:

1. Hirsh RobertD. and D. and Peters MichaelP. “Entrepreneurship” Fifth Edition, Tata McGraw Hill Edition, 2002.
2. Justin G. Longenecker and Carlos W. Moore, Small Business Management 12th edition, College Division South Western Publishing Co. Dallas, 2003
3. Holt David H. “Entrepreneurship – New venture Creation “Eastern Economy Edition, 2000.
4. Donald F.Kutatko and RichardM.Hodgetts, “Entrepreneurship: A Cotemporary Approach” Fourth Edition.
5. Hailay Gebretinsae, Entrepreneurship and Small Business Management, 2nd Edition.

6.6 Course Title: Inclusiveness (SNIE-1012)

Pre-Requisite: None

Course Objectives: The objective of this course is to develop knowledge, skill and attitude of the learners so that they can provide appropriate services, the tools and strategies that help to create a convenient inclusive environment. This course encourages learners exploring the benefits of collaborating with colleagues to design and implement inclusion an all sphere of life. It also guides the discovery of ways to modify environment as well as services and practices to meet the needs of all persons with disabilities and vulnerabilities in inclusive environment. As a result of reviewing various reading materials, completing the assignments, engaging in related discussions, and strongly workings on activities, towards the completion of the course.

Learning outcomes: Up on the completion of the course, students will able to:

- Identify the needs and potentials of persons with disabilities and vulnerabilities.

- Identify environmental and social barriers that hinder the needs, potentials and full participations, in all aspects of life of persons disabilities and vulnerabilities
- Demonstrate desirable inclusive attitude towards all persons with disabilities and vulnerabilities in full participations
- Apply various assessment strategies for service provisions for evidence-based planning and implementation to meet the needs of persons with disabilities and vulnerabilities
- Adapt environments and services according to the need and potential of the persons with disabilities and vulnerabilities
- Utilize appropriate assistive technology and other support mechanisms that address the needs of persons with disabilities and vulnerabilities
- Respect and advocate for the right of persons with disabilities and vulnerabilities
- Collaboratively work with special needs experts and significant others for the life success of all persons with disabilities and vulnerabilities in every endeavors and in all environments.
- Create and maintain successful inclusive environment for persons with disabilities and vulnerabilities
- Promote the process of building inclusive society Develop ethical aptitudes and dispositions necessary to live in harmony with the natural environment
- Develop an understanding of national population distributional patterns and dynamics
- Conceptualize the comparative advantages of economic regimes; and understand the impacts of globalization.
- Understand their country's overall geographic conditions and opportunities; and be proud of the natural endowments and cultural richdom that help them develop a sense of being an Ethiopian.

Course Syllabus/Contents:

1. **Understanding Disabilities and Vulnerabilities:** Definitions of disability and vulnerability, Types of disabilities and vulnerabilities, Causes of disability and vulnerability, Historical movements from segregation to inclusion, The effects of attitude on the move towards inclusion, Models of disability
2. **Concept of Inclusion**: Define inclusion, Discuss the concept of inclusion in education, Identify reason regarding shift from special education and integrated education inclusion, Differentiate the major rationales for inclusion, List factors that influenced development of inclusion, Identify benefits of inclusion to students, teachers' parents and society, Name major characteristics of inclusive school and inclusive classroom environments,Point out strategies to implement inclusion in teaching and learning processes, Differentiate the major barriers to inclusion.
3. **Identification and Differentiated services:** Impact of Disability and Vulnerability on daily life; The Family and Disability, Social Needs of Persons with Disabilities and Vulnerabilities, Gender

and disability, The Health Care Needs of Persons with Disabilities and Vulnerabilities; Disability, vulnerability and the Environment, Pathway from Functional Limitation to Disability

4. **Promoting Inclusive Culture:** Define Inclusive Culture, Discus the dimensions of Inclusive culture, Evaluate policy related to Inclusive Culture, Explain the process of building community for in, clusive culture, Discus approaches of establishing inclusive culture, Discuss inclusive values Explore and discuss indigenous inclusive values, Evaluate existing inclusive practices

5. **Inclusion for Peace, Democracy and Development:** Define Peace, Democracy and Development, Identify sources of exclusionary practices, Discuss exclusionary practices in the community, Discuss respecting divers needs, culture, values, demands and ideas, Discus conflict emanated from exclusion, Explain means and benefits of participation of the marginalized group of people, Discuss the democratic principles for inclusive practices, Explain the importance of inclusion for psychosocial development, Elaborate the importance of inclusion for economic development, Discus the importance of inclusion for peace
6. **Legal frame work:** Discuss the concept of legal framework, Identify international and national legal frameworks in relation to inclusiveness, Discuss legal frameworks and their implementation, Explore gaps in implementation of legal frameworks to implement inclusion
7. **Resources Management for Inclusion:** Provisions of Resources; Resources for work/social environment

Mode of Assessment

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Paper & presentation = 20 %; Mid exam =30 %; Final examination =50 %

References:

1. Abrams, B. J. & Segal. A. {1998). How to prevent aggressive behavior. Teaching Exceptional Children. 30(4), 10-15. Bradley, D. R, King-Sears, M. E., & Tessier-Switlick, D. M. (1996).
2. Alemayehu Teklemariam and Temsegen Fereja (2011). Special Need Education in Ethiopia: Practice of Special
3. Needs Education around the World. Washington: Gallaudet University Press.
4. Loreman, T., Deppeler, J. and Harvey, D. (2005). Inclusive education: a practical guide to supporting diversity in the classroom. Routledge, Falmer,UK, Taylor and Francis Group.
5. Lourens, H., McKinney, E. L. and Swartz, L. (2016). ―Disability and Education: More than Just Access‖. In The Palgrave International Handbook of Education for Citizenship and Social Justice. London: Palgrave.Macmillan

7. MODULE 3: BASIC ENGINEERING SKILLS

This algebra-based module provides science students with the basic concepts of physics and emerging technologies that enable them to understand, describe and explain natural phenomena. The objective of this module is to offer engineering mechanics and basic skills. In general, students will develop an ability to use and apply the techniques, skills, and modern engineering tools necessary for engineering practice like computer skill, programming, drawing. This module contains five courses as indicated in Table 7-1.

Table 7-1 Basic engineering skill

Code	Course Name	Status	Cr.H	L	T	L/P	HS	ECTS
Phys-1031	General Physics	Compulsory	3	2	3	0	3	5
ECEg-1032	Computer programming	Compulsory	3	2	1	2	3	5
Meng-2033	Engineering Drawing	Compulsory	2	1	0	3	3	4
Ceng-2034	Engineering Mechanics	Compulsory	3	2	3	0	3	5
EEng-2035	Basic Electricity and Electrical Machine	Compulsory	2	2	1	1	1	4
MEng-2036	General Workshop Practice	Compulsory	1	0	0	3	0	2
EmTe-1037	Introduction to Emerging Technologies	Compulsory	3	2	1	2	3	5
	Sum		***17***	***11***	***9***	***11***	***16***	***30***

7.1 General Physics (Phys-1031)

Pre-Requisite: None

Course Objectives: This algebra-based course provides science students with the basic concepts of physics that enable them to understand describe and explain natural phenomena. Emphasis is laid on general principles and fundamental concepts in measurements, mechanical and thermal interactions, fluid mechanics, electromagnetism, oscillations and waves with applications of physics in various fields of science**.**

The course is organized into 7 chapters. The chapters on mechanics introduce the principles and laws governing the motion of objects and the interaction between them as well as conservation laws. The chapter on heat and temperature discusses the interaction between systems through energy transfer and describes some basic thermal properties of such systems. The chapters on oscillations, waves and optics provide basic concepts of periodic motions, how waves transfer energy from one place to the other, and use the concepts of light rays to explain image formation by mirrors and lenses. Electromagnetism and electronics introduce the basic electric and magnetic phenomena using the concept of field and treats elementary concepts of semiconductors. Cross-cutting applications of physics explain the roles of physics in Agriculture, Industries, Medicine, Archeology, Power Generation, Earth and Space Sciences.

Learning outcomes:

Course Syllabus/Contents:

1. **Preliminaries:** Physical Quantities and Units of Measurement; Uncertainty in Measurement and Significant Digits; Vectors: composition and resolution; Unit Vectors
2. **Kinematics and Dynamics of Particle:** Kinematics in One and Two Dimensions, Displacement, Velocity and Acceleration in 1D and 2D, Motion with Constant Acceleration, Free Fall Motion, Projectile motion; Particle Dynamics and Planetary Motion (6hrs), The Concept of Force as a Measure of Interaction, Types of forces, Newton's Laws of Motion and Applications, Circular Motion, Newton's Law of Universal Gravitation and Examples, Kepler's laws, satellites motion and weightlessness; Work, Energy and Linear Momentum (3 hrs), Work and Energy, Linear Momentum, Conservation of Energy and Linear Momentum / Collisions, Power, The Concept of Center of Mass
3. **Fluids Mechanics:** Properties of Bulk Matter /Stress, Strain/; Density and Pressure in Static Fluids; Buoyant Forces, Archimedes' principle; Moving Fluids and Bernoulli's Equation
4. **Heat and Thermodynamics:** The Concept of Temperature: Zeroth Law of Thermodynamics; The Concept Heat and Work; Specific Heat and Latent Heat; Heat Transfer Mechanism; Thermal Expansion; Energy Conservation: First Law of Thermodynamics
5. **Oscillations, Waves and Optics:** Simple Harmonic Motion; The Simple Pendulum; Wave and Its Characteristics; Resonance; Doppler Effect; Image formation by thin lenses and mirrors
6. **Electromagnetism and Electronics**: Coulomb's Law and Electric Fields; Electric Potential; Current, Resistance and Ohm's Law; Electrical Power; Equivalent Resistance and Kirchhoff's Law; Magnetic Field and Magnetic Flux; Electromagnetic Induction; Insulators, Conductors, Semiconductors; Diodes / Characteristics Curve; Transistors
7. **Cross Cutting Applications of Physics:** Application in Agriculture, Energy balance concept, energy balance in soils, moisture content, soil densities, soil moisture characteristics; Physics and Industries, Principle of Motor and generator; Physics in Health Sciences and Medical Imaging, Radiation and its biological effect, x-ray, MRI, Ultrasound; Physics and Archeology, Radioactive Dating; Application in Earth and Space Sciences, Geothermal Energy, Seismometer, Radio and TV communications; Application in Power Generation, Solar and Wind Energy, Nuclear Power Plants, Hydroelectric power

Mode of Assessment/Evaluation

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Demonstration/Lab work 15%, Quizzes/Assignments 5%, Mid Exam 30%, Final Exam 50%

References:

1. Serway, R. A. and Vuille, C., 2018, College Physics, 11th ed., Cengage Learning, Boston, USA
2. University Physics with Modern Physics by Young, freedman and Lewis Ford

3. Physics for Scientists and Engineers with Modern Physics by Douglas C. Giancoli
4. Fundamentals of physics by David Halliday, Robert Resnick and Gearl Walker
5. College Physics by Hugh D. Young Sears Zemansky, 9th edition
6. Herman Cember and Thomas A. Johnson, Introduction to Health Physics, 4th ed., (2008).
7. William R. Hendee and E. Russell Ritenour, Medical Imaging Physics, 4th ed., (2002).
8. Tayal D.C. Basic Electronics. 2nd ed. Himalaya Publishing House Mumbai, (1998).
9. Theraja B.L., R.S. Sedha. Principles of Electronic Devices and Circuits, S.Chand and Company Ltd, New Delhi, (2004).
10. Introduction to Space Physics, M. G. Kivelson and C. T. Russell, Cambridge University Press, 1995.

7.2 Computer programming (ECEg-1032)

Pre-requisite: None

Objectives: To introduce students to basic concepts and skills of computer programming.

Outcome: At the end of the course students will be able to write and run simple programs using FORTRAN and C++.

Contents

1. **Introduction to computers:** Hardware, software. Number representation in computers: fixed and floating–point numbers.
2. **Fundamental programming concepts:** Program organization, modularity in programming, algorithms, and flow charts; Data types: intrinsic and user-defined data types, variables, initialization, assignment statements, and control statements, loops. Input and output statements; files for input and output. Intrinsic and user-defined subprograms.
3. **Possible language:** R-studio, FORTRAN (latest version) and C.
4. **Introduction to Microsoft offices:** Words, excel and others

Mode of Assessment/Evaluation:

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

Demonstration/Lab work 30%, Quizzes/Assignments 10%, Mid Exam 20%, Final Exam 30%

Practical tasks to be done in the computer lab

Students will go to computer laboratory and they will practice how to write and run different C++, R-studio and other programs under the guidance of their instructor.

References:

1. Stephen, J. Chapman. (2003). Fortran 90/95 for Scientists and Engineers

2. Brain, D.H. (1996). Fortran 90 for Scientists and Engineers

3. Smith, I.M. (1995). Programming in Fortran 90

7.3 Engineering Drawing (Meng-2033)

Pre-Requisite: None

Course Objectives: The course is designed to provide the students with concepts of Technical Drawing, Preparing the objects to visualize the dimensions with the help of various drawing instruments in the drawing room like mini drafter, set squares, scale protractor, board and also with the help of latest tools like cut models made up of wood paper or any other material.

Learning outcomes: Up on completion of the course, students will able to:

- Reading and prepare of Technical Drawings
- Draw various views of an object
- Draw an object from different views

Course Syllabus/Contents:

1. **Basic concept of Geometric construction:** Overview of Projections; progress to principles of projection techniques; Multi-View Projection; Pictorial Projection
2. **Auxiliary Views:** Sectional Views
3. **Intersections and Development of Simple Transition Pieces**

Mode of Assessment/Evaluation

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

(Quizzes, tests, mid exam, assignments, projects=50%), Final exam= 50%

References:

1. French, T. E. and Helsel, J. D. (2003), Technical Drawing: Board and CAD Techniques, Student Edition, 13th edition, Glencoe, McGraw-Hill.
2. Giesecke, F.E., Mitchell, A., Spencer, H.C.and et al. (2002), *Technical Drawing*, 12th edition, Prentice Hall.

7.4 Engineering Mechanics (Ceng-2034)

Pre-Requisite: None

Objectives: This course is designed to develop skills in treating the static analysis of rigid bodies like concepts of equations of static equilibrium and basic principles governing motion of objects, analysis of motion variables, and deriving equation of motion relating forces acting and resulting motion.

Learning outcomes: At the end of this course the student will be able to:

- Analyze and draw free body diagrams for single particles and rigid body systems.
- Establish equilibrium equations of particles/rigid bodies for solve for forces and support reactions.
- Calculate centroids of areas and moments of inertia

Course Syllabus/Contents:

1. **Principles of statics**: Resultants of coplanar force systems: Equation of equilibrium for coplanar force systems; equilibrium of simple structures
2. **Free body diagrams:** Trusses; frames and machines
3. **Properties of surfaces:** Moments of inertia of areas and bodies
4. **Non-coplanar force systems**: Static friction; Method of virtual work

Mode of Assessment/Evaluation

Continuous assessment method will be applied to evaluate the competence of students acquired from the course. And the continuous assessment will incorporate:

(Quizzes, tests, mid-term exam, assignments, projects) =50%, Final exam= 50%

References:

1. F.P. Beer, E.R. Johnston and E.R. Eisenberg, Vector Mechanics for Engineers Statics, 7th edition, McGraw- Hill, 2004.
2. Meriam, J.L. and Kraige, L.G. (2006), Engineering Mechanics (Statics), 6th edition, Wiley.
3. Beer, F.P. and Johnston, R.E. Jr. (2007), Vector Mechanics for Engineers, Statics, 5th edition, McGraw-Hill Science/ Engineering /Math

7.5 Basic Electricity and Electrical Machine (EEng-2035)

Objective: As a hydraulic and water resources engineers are exposed in hydropower and water supply project they may be engaged with the select ion of appropriate type of pumps and generators therefore this course will equip Students with basic electrical engineering concepts that are applicable in the Field of Hydraulic and water resources engineering.

Outcome

- Students will be able to have knowledge on basic electricity

- understand the working principles of electrical machines
- They will gain knowledge on electric distribution systems of two-phase and three phases.

Course Syllabus/Contents

1. **Basic Electricity:** electrostatics, basic circuit concepts, magnetic field and alternating circuit (AC) concepts; Polyphase (3-phase) systems;
2. **Electrical Machines:** transformers; DC machines; AC machines; Synchronous machines.
3. **Electrical Instruments.** Electronics

Mode of Assessment/Evaluation

- Quiz (2*5%), Test (25%), Practical work (15%), Final Exam (50%)
- Practical tasks to be done in the electrical workshop: The students will see various electrical devices like millimeter, voltage meter, Transformers, Dc machines and Ac machines. And they will do by themselves simple electrical circuit systems under the guidance of their instructor.

7.6 General Workshop Practice [MEng-2036]

Objectives: Impart to students a practical exercise on plumbing, masonry, woodwork, welding and others

Learning outcomes: The students will acquire basic skills of plumbing, woodwork, concrete mixing, masonry and etc.

Course Syllabus/Contents:

- Plumbing
- Welding
- Woodwork
- Concrete
- Plastering
- Masonry
- Basic electrical installation

Mode of Assessment/Evaluation: Practical task in the workshop

During the practical study the students are supposed to carry out cutting and filing steel materials to make the objects to the desired regular shape as per needs, then regular pieces joined by different types of joints like welding rivets etc. The students also try to bring the wooden pieces to different regular shapes with even surface and will be fixed to the required shapes.

References:

1. Jim Forrest & Peter Jennings (1998), Workshop Construction (Workshop Practice), Special Interest Model Books.
2. Workshop practice manuals.

8. MODULE 4: APPLIED & ADVANCED MATHEMATICS

Hydraulic and water resources engineers require a strong background in mathematics for successful Accomplishment of their study. They also need ability to formulate and solve engineering problems numerically. The objective of this module is to offer applied and advanced mathematical techniques; and basic numerical methods and engineering applications.

Students will be able to understand advanced mathematical techniques and be able to demonstrate knowledge of programming fundamentals and numerical methods. They will be able to plan, analyze, and write computer programs for numerical methods and basic engineering applications.

Table 8-1 Applied & advanced mathematics

Code	Course Name	Status	Cr.H	L	T	L/P	HS	ECTS
Math-1041	Mathematics for Natural Sciences	Compulsory	3	2	3	0	3	5
Math-1042	Applied Mathematics –I	Compulsory	3	2	1	2	3	5
Math-2043	Applied Mathematics –II	Compulsory	4	3	3	0	4	6
Math-2044	Numerical Analysis	Compulsory	2	1	2	1	2	4
Stat-2045	Probability and Statistics	Compulsory	2	2	2	0	2	4
	Sum		***14***	***10***	***11***	***3***	***14***	***24***

8.1 Course title: Mathematics for Natural Sciences [Math-1041]

Pre-requisite: None

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

- apply propositional logic in reasoning,
- use quantifiers in open propositions in mathematical logic
- understand concepts of sets and set operations,
- understand the fundamental properties of real numbers
- use mathematical induction in proofs,
- analyze least upper bound and greatest lower bound,
- understand the fundamental properties of complex numbers
- express complex numbers in polar representation
- explain different types of functions, their inverses and their graphs

- evaluate zeros of polynomials
- Understand basic properties of logarithmic, exponential, hyperbolic, and trigonometric functions
- Understand basic concept of analytic geometry
- derive equations of conic sections

Course content:

- Propositional logic and Set Theory: Definition and examples of proposition; Logical connectives, Compound (or complex) propositions, Tautology and contradiction, Open proposition and quantifiers, set theory, the concept of a set, Description of sets, Set operations and Venn diagrams
- The real and complex number systems: The real number system, The natural numbers, Principle of mathematical induction and the Well Ordering Principle, The integers, rational numbers and real numbers. Upper bound and lower bound: least upper bound and greatest lower bound; Completeness property of real numbers, Complex number system, Definition of complex numbers and their operations, Polar representation of complex numbers and the De-Moivere's formula, Extraction of roots
- Functions: Review of relations and functions, Real-valued functions and their properties, Types of functions and inverse of a function, Polynomials, zeros of polynomials, rational functions, and their graphs, Definitions and basic properties of logarithmic, exponential, trigonometric and hyperbolic functions, and their graphs.
- Analytic Geometry**:** The straight-line: Division of segments and various forms of equation of a line. Circles; Definition of circle and examples, Equation of a circle center at the origin and different from the origin. Intersection of a circle and a line, Parabola, Definition of parabola and standard form of equation of parabola. Equation of parabola parallel to the x-axis (the y-axis), Ellipse, Definition of Ellipse and examples, Equation of ellipse center at the origin and different from the origin, Hyperbola, Definition of circle and examples, Equation of hyperbola of center at the origin transverse axis to x-axis (the y-axis)

Mode of assessment: Assignments/quizzes/tests = 20%**,** mid-term exam = 30%**,** Final examination = 50%

References

1. Abera Abay (1998), An Introduction to Analytic Geometry, AAU
2. Alemayehu Haile and Yismaw Alemu, Mathematics an Introductory Course, Department of Mathematics, AAU

8.2 Course title: Applied Mathematics-I [Math-1042]

Pre-requisite: Mathematics for Natural Sciences

Objective*:* The student will learn the basics of vectors, matrices, integrals and solve problems within technical and scientific problems they will be introduced to linear algebra.

Learning outcomes:

- Students will be able to apply linear algebra to various applications in Engineering.
- They will be able to solve systems of linear equation using direct methods and iterative methods
- They will be able to differentiate and integrate functions of several variables during applications to various engineering problems.

Course Syllabus/Contents:

1. Vector and Vector spaces
2. Matrices
3. Limit and Continuity
4. Derivatives and Application of Derivatives
5. Integration
6. Application of Integrals

Mode of assessment: Assignments / quizzes / tests = 20%**,** Mid Exam = 30%**,** Final examination = 50%

References;

1. Larson, R., Hostetler, R. P., and Edwards, B.H. (2005), *Calculus with Analytic Geometry*, 8th edition, Houghton Mifflin Company.
2. S.Lang (2004), *Linear Algebra*, 3rd edition, Springer.
3. Stewart, J. (2002), *Calculus*, 5th edition, Brooks Cole.

8.3 Course title: Applied Mathematics-II [Math-2043]

Pre-requisites: Applied Mathematics-I

Objective: Students will learn about representations of transdental functions in Taylor series and Maclaurain series. Moreover, student will be introduced the calculus of functions of Several variables.

Outcome: Students will apply Taylor Series, Macluarian Series and Fouries Series in solving engineering problems. Moreover, they will be able to differentiate and integrate functions of several variables during applications to various engineering problems.

Contents

1. Sequence and Series
2. Power Series

3. Fourier Series
4. Differential Calculus of Functions of Several Variables
5. Integral Calculus of Functions of Several Variables

Mode of assessment: Assignments / quizzes / tests = 20%**,** Mid Exam = 30%**,** Final examination = 50%

References

1. Ellis, R. and Gulick, D. (1998). *Calculus with Analytic Geometry*, 5th edition. Harcourt.
2. Larson, R. (2002), *Calculus with Analytic Geometry*, 7th edition, Houghton Mifflin College Div.
3. Erwin Kreyszig (2005). *Advanced Engineering Mathematics*. 9th edition, Wiley.

8.5 Course title: Numerical Analysis [Math-2044]

Pre-requisites: Applied Mathematics-II

Objective: Enabling students to apply knowledge of linear algebra and differential equations in the context of engineering problem-solving. Introduce classical and contemporary engineering problems to students at the lower division level.

Outcome: Students will be able to:

- To perform a range of matrix and vector operations.
- Solve mathematical models of engineering systems and/or components.
- Find roots of nonlinear equations.
- Solve systems of linear and non-linear equations.
- Perform least-squares fitting of a curve to data.
- Numerically integrate ordinary differential equations.

Contents

1. **Fundamentals of numerical methods:** Recursion formulas, iteration. Errors in machine computation.
2. **Computation:** Truncation and round-off errors, error propagation, total numerical error.
3. **Roots of equations:** bracketing methods, the bisection method, and false position Method. Open methods: The Newton-Rap son method, the Secant method, and multiple roots.
4. **Systems of linear algebraic equations:** LU decomposition methods; Crout and Chelosky decomposition; Iterative methods: Gauss-Seidel method, convergence criteria, successive over relaxation.
5. **Systems of non-linear equations.** Algorithms for LU decomposition and Gauss-Seidal methods. Interpolation and approximation: Newton's divided difference and LaGrange interpolating polynomials, spline interpolation. Least-squares regression: linear, polynomial and multiple regressions.

6. **Numerical differentiation and integration; Integration of equations:** Romberg integration and Gauss quadrature. Finite difference approximation to derivatives, Richardson extrapolation;
7. **Numerical solutions of Ordinary Differential Equations:** Euler's method modified Euler's method and Runge-Kutta method, adaptive step size control.

Mode of assessment: Assignments / quizzes / tests = 20%**,** Mid Exam = 30%**,** Final examination = 50%

Practical tasks to be done in computer laboratory

Students will go to computer laboratory and they will write different programs that are used to solve different numerical and mathematical problems.

References

1. Recktenwald, Gerald. Numerical Methods with Matlab, Prentice Hall, 2000.
2. Erwin Kreyszig (2005), Advanced Engineering Mathematics, 9th edition, Wiley.
3. Stewart, J. (2002), Calculus, 5th edition, Brooks Cole.
4. Ellis, R. and Gulick, D. (1998), Calculus with Analytic Geometry, 5th edition, Harcourt.
5. Brown, J.W. & Churchill, R.V. (2003), Complex Variables and Applications, 7th

8.5 Course title: Probability and statistics [Stat-2045]

Pre-requisites: Applied Mathematics-II

Objective: To introduce the students to the fundamental topics in probability theory and basic descriptive statistics, hypothesis testing, and selection of test procedures, and estimation of confidence intervals.

Outcome: Students will be able to understand the concepts of probability and statistics. Acquire basic knowledge of fundamental probability distribution functions, discrete and continuous, univariate and multi-variate and etc.

Contents

1. **Introduction:** Definition and classification; categories and nature of data; frequency distribution; various types of graphs; measure of central tendency; measure of dispersion; skew ness and kurtosis
2. **Random variables and distribution functions:** definition of random variables; discrete and continuous distribution functions; concepts of sampling; sampling with and without replacement, simple random sampling, stratified sampling, cluster sampling;
3. **Test hypothesis:** test of mean, test of differences of two means; test of several means;
4. **Linear regression and correlations:** regression line and coefficients; simple correlation coefficient; partial correlation coefficient; multiple correlation coefficient (R2).
5. **Introduction to experimental design**

References

1. Devore, Jay L., (2007). Probability and Statistics for Engineering and the Sciences, 5th Edition, Duxbury Press.
2. Ang, Alfredo H-S. and Tang, Wilson H., (2001). Probability Concepts in Engineering Planning and Design: Volume I – Basic Principles, John Wiley & Sons

9. MODULE 5: SURVEYING

In any type of engineering design, measurements are very important before realizing any project on the ground; one has to take accurate measurement such as topographic, bathymetric and so on to accurately locate the point of implementation with reference to given sound datum. Hence, this module exposes the students with the knowledge of geodetic measurement. Students will learn theory and field work in construction and land Surveying. They will be made familiar with the use of surveying equipment and the preparation of field book records. Moreover, interpretation of aerial imagery is also dealt with (Table 9-1).

Table 9-1 Surveying Module

Course Code	Course Name	Status	Cr.H	L	T	L/P	HS	ECTS
CEng-2051	Surveying-I	Compulsory	2	2	1	1	2	4
CEng-2052	Surveying-II	Compulsory	3	2	1	2	2	5
	Sum		*5*	*4*	*2*	*3*	*4*	*9*

9.1 Course Title: Surveying-I (CEng-2051)

Pre-requisites: None

Objective: The course is intended to provide the students with the basic principles of geodetic surveying and land information system.

Outcome: Students will be able to accurately measure distances and angles using high precision and up-to-date surveying equipment.

Course Description/Course Syllabus/Contents

1. **Types and principles of surveying;**
2. **Measurement of distances:** principles of different methods and their accuracy; sources of errors; precautions and corrections;
3. **Measurement of angles and directions:** reference meridians; bearings and azimuths; magnetic declination and its variation; use and adjustment of compasses, use and adjustment of theodolite; measurement of horizontal angles; measurement of vertical angles; measurement of elevations: use and adjustment of levels; leveling staffs; different methods of leveling; sources of errors and precision

of leveling procedures; Traversing: principles; traversing by compass and theodolite; computation of coordinates; sources of errors and precision of traversing; checking and adjusting traverses; omitted measurements; tachometric surveying; electronic survey; instruments.

Tasks to be done in the field exercise: The students will practice in the field with the help of chain and prismatic compass to measure the linear dimensions and also to measure the angles subtended between two lines. With the help of an Instrument like Theodolite, Dumpy level, leveling staff, ranging rods, cross staff and Etc.

Mode of Assessment

- Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%
- Field practice = 20 %
- Final examination = 40%

References

1. Uren, J. and Price, W.F. (2005), Surveying for Engineers, 4th Edition, Palgrave Macmillan.
2. Wolf, P.R. and Brinker, R.C. (2002). Elementary Surveying, 9th Edition, Prentice Hall

9.2 Course Title: Surveying-II (CEng-2052)

Pre-requisites: Surveying-I (CEng-2051)

Objectives:

- Students shall learn basic theories of contours and digital terrain model and be able to demonstrate an ability to produce field topographic maps.
- The students shall also understand the fundamentals of engineering survey, GPS, topographic survey, photogrammetry, GIS and remote sensing.

Learning outcomes

- Ability to apply Least Squares Adjustment to other applications e.g photogrammetry, GPS networks
- Understanding of role of photogrammetry in modern engineering practice
- Knowledge of accuracy and precision of photogrammetric digitizing
- Ability to apply how to calculate reservoir area
- Analyze and interpret data independently and come up with contour maps for a given plot in groups.

Course Description/Course Syllabus/Contents

1. Control surveying;
2. Topographical surveying;
3. Contour lines and
4. Digital Terrain Model;
5. Curve setting;
6. Cartography and photogrammetry;
7. Topographic survey of reservoir area

Tasks to be done in the field exercise: The students will be able to practice land labeling and prepare the contour map of certain area like hill, depression, pond or reservoir with the help of, Dumpy level, chain, ranging rods and able to compute the areas enclosed between various contours with the help of planimeter. They are also able to calculate the geographical features of the area like longitude & latitude, elevation with the help of GPS instrument.

Mode of assessment/Evaluation

- Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%
- Field practice = 20 %
- Final examination = 40%

References

1. Uren, J. and Price, W.F. (2005), Surveying for Engineers, 4th Edition, Palgrave Macmillan.
2. Wolf, P.R. and Brinker, R.C. (2002). Elementary Surveying, 9th Edition, Prentice Hall

10. MODULE 6: SOIL ENGINEERING

Engineering properties of soil form a basic input to the salient design of foundations up on which dams, and other hydraulic and water resources engineering systems. The soil engineering module is aimed at equipping students with the engineering properties and parameters of soils. The outcome is students will be able to solve several classical problems in hydraulic and water resources engineering problems such as settlement, shear failure, earth pressure and stability problems related to the behavior of soils. The course catalogue in this module is given in Table-10-1.

Table 10-1 Soil engineering module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
CENG-3061	Soil Mechanics I	Compulsory	2	2	1	1	2	4
CENG-3062	Soil Mechanics II	Compulsory	2	2	1	1	2	4
	Sum		4	4	2	2	4	8

10.1 Course Title: Soil Mechanics I (CEng-3061)

Pre-requisite: Fluid Mechanics

Course objectives: The major objective of this course is designed to introduce hydraulic and water resource engineering students to the properties and behaviour of soil to understand fundamental and mechanical properties of soil. To develop adequate procedure to determine index properties of soils and performing experiments.

Learning outcomes: At the end of this course students will be able to:

- Describe and classify soils,
- Determine the rate of flow of water through soils,
- Calculate one dimensional consolidation settlement and time rate of settlement.

Course Description/Course Syllabus/Contents:

1. **Introduction:** Definition, Origin of soils and Formation of soils;
2. **Physical properties of soils:** Weight-Volume relationships, Index properties of soils, Consistency of clays, Soil texture and structure.
3. **Hydraulic properties of soils:** Capillarity and surface tension, Neutral and effective stresses, Darcy`s law, Permeability of soils, Flow net and seepage analysis, Critical hydraulic gradient and piping.
4. **Compaction:** Theory of compaction, Compaction in the lab and Field compaction.
5. **Consolidation:** Types of consolidation, Theory of consolidation and Time rate of consolidation.

Tasks to be done in the field exercise: Soil tests in the laboratory: Determination of moisture content and field density, determination of specific gravity, Sieve analysis, Atterberg`s limits, Permeability tests, Proctor`s compaction tests and Consolidation test.

Mode of assessment/evaluation

- Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%
- Field practice = 20 %
- Final examination = 40%

References

1. Teferra, A. & Mesfin, L., 1999. Soil Mechanics, AAU
2. Budhu M., 2000. Soil Mechanics and Foundations, Wiley and Sons.
3. Cernica, J. N., 1995. Geotechnical Engineering - Soil Mechanics, Wiley and sons.
4. Prakash, S., 1995. Fundamentals of Soil Mechanics, Prakash Foundation.
5. Das, B. M., 1995. Principles of Foundation Engineering, PWS pub. Co.
6. Bowles, J. E., 1996. Foundation Analysis and Design, Joseph E. Bowles, McGraw-Hill.
7. Arora, Soil mechanics and foundation engineering by

10.2 Course Title: Soil Mechanics II (CEng-3062)

Pre-requisite: Soil Mechanics I

Course objectives: The major objective of this course is to determine the magnitudes of the engineering property of soil and to utilize geotechnical analysis of soil.

Learning outcomes: At the end of this course students will be able to:

- Understand and estimate shear strength of soils,
- Evaluate the state of stress in a soil mass,
- Estimate lateral earth pressure on earth retaining structures and sheet pile walls,
- Know how to calculate stability of slopes.

Course Description/Course Syllabus/Contents:

1. **Shear strength of soils:** Introduction, Definition of key terms, Coulomb`s friction law, Mohr`s circle for stress, Mohr-coulomb failure criterion, Drained and undrained shear strength, Laboratory shear strength tests and Field tests;
2. **Stress distribution in soils due to surface loads:** Introduction, point load, line load, strip load, uniformly loaded circular area, uniformly loaded rectangular area, approximate method for rectangular loads and vertical stresses below arbitrarily shaped area.
3. **Lateral earth pressure:** Introduction, definition of key terms, lateral earth pressure at rest, active and passive lateral earth pressures, Rankine active and passive earth pressures and Coulomb`s earth pressure theory.
4. **Slope stability:** Introduction, definition of key terms, some types of slope failure, some causes of slope failure and two dimensional slope stability analysis.

Modes of assessment:

- Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%
- Field practice = 20 %
- Final examination = 40%

Tasks to be done in the field exercise: The students will practice in the laboratory Coulomb`s friction law, Mohr`s circle for stress, Mohr-coulomb failure criterion, Drained and undrained shear strength, Laboratory shear strength tests and Field tests;

References

1. Teferra, A. & Mesfin, L., 1999. Soil Mechanics, AAU
2. Budhu M., 2000. Soil Mechanics and Foundations, Wiley and Sons.
3. Cernica, J. N., 1995. Geotechnical Engineering - Soil Mechanics, Wiley and sons.
4. Prakash, S., 1995. Fundamentals of Soil Mechanics, Prakash Foundation.
5. Das, B. M., 1995. Principles of Foundation Engineering, PWS pub. Co.
6. Bowles, J. E., 1996. Foundation Analysis and Design, Joseph E. Bowles, McGraw-Hill.
7. Arora, Soil mechanics and foundation engineering by

11. MODULE 7: GEOTECHNICAL ENGINEERING

This module aims at equipping students with essential knowledge for analyzing and designing foundations of hydraulic structures and related hydropower engineering structures. Hence, a sound understanding of the design of foundation of structures is of paramount importance. Last but not least, methods of investigating stability of slopes which might be faced during construction of dams, roads and the like should be studied. The course catalogue in this module is given in Table 11-1.

Table 11-1 Course catalogue of geotechnical engineering module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
Geol-3071	Engineering Geology & Rock Mechanics	Compulsory	3	2	2	1	2	5
CENG-4072	Foundation Engineering	Compulsory	3	2	2	1	3	5
		Sum	6	4	4	2	5	10

11.1 Course Title: Engineering Geology & Rock Mechanics (Geol-3071)

Pre-requisite: None

Course objectives: The students shall learn the fundamentals of engineering geology and importance of geology in the planning and design of water resources infrastructures. Moreover, this course provides insights in to geology of rock.

Learning outcomes: At the end of this course, students will be:

- Introduced to the relevant terminology,
- Determine engineering classification of rock and discontinuity,
- Classifications and concepts with the aim of ensuring effective communication between engineers and engineering geologists in the team

Course Description/Course Syllabus/Contents:

1. **Introduction:** Definition of geology and engineering geology, Internal structure of the earth, Composition of internal zones of the earth and scope of engineering;
2. **Minerals and Rocks:** Definition, Major groups, Abundance and their description.
3. **Earth processes and Their Effects:** Geomorphologic processes and the landforms, Faulting, Folding, Jointing, Landslide and Earth quake.
4. **Engineering Properties of Rocks and Engineering Classification of Rocks:** Engineering properties of rocks and Engineering classification of rocks.
5. **Geological and Engineering Geological Site Investigation:** Objective and methods of site investigation, Geological investigation of dam site, Geological investigation of reservoir site, etc.
6. **Natural Geologic Materials for Construction:** Definition of quarry and quarrying, types of quarry, products of quarry, controlling factors for selection of quarry site, methods of quarrying, properties of building stones, etc.
7. **Introduction to Rock Mechanics:** Definition of rock mechanics, Scope and tasks of rock mechanics, Engineering properties of rock and Factors affecting engineering properties of rock.
8. **Rock Deformation, Strength and Failure Criteria:** Deformation behavior of rocks, Initial stresses in rocks, Stress distribution in a rock mass, Modes of failure in rocks, rock strength, stress strain behavior in compression, etc.
9. **Discontinuity Characterization and Classification of Rocks for Engineering Purpose:** Definition and types of discontinuities, geometric properties of discontinuities, classification of rock masses for engineering purpose, Terzaghi`s rock classification, the rock quality designation (RQD), rock mass rating system (RMR), etc.
10. **Application of Rock Mechanics in Rock Slope Engineering and Underground Piping:** Introduction, plane of failure, toppling failure, wedge failure, opening in competent rock, horizontal layered rocks and rock with inclined layers.

Modes of assessment:

- Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%
- Field practice = 10 %
- Final examination = 50%

Tasks to be done in the field exercise: The students will practice in the lab and define rock strength, stress strain behavior in compression, measuring discontinuity, classify rocks, RQD and RMR.

References

1. Bell F.G., (2007). Engineering Geology. 2/e. Butterworth-Heinemann.
2. Fundamentals of engineering geology by F.G.Bell
3. Blyth & Freitas. Geology for engineers by, 7th eddition

4. Hunt, R.E. (2005). Geotechnical Engineering Investigation Handbook.
5. B.P. Verma. 1997. Rock Mechanics for Engineers. Khanna Publishers, Delhi, India.

11.2 Course Title: Foundation Engineering (CENG-4072)

Pre-requisite: Soil Mechanics II, Reinforced Concrete Design-II

Course objectives: The objective of the course is to introduce students to the fundamentals and basic techniques used in foundation engineering. Specifically, it will provide students provide students with the necessary geotechnical engineering skills to analyze and design of shallow and deep foundation systems under different loading and soil conditions, and introduce about site investigation system.

Learning outcomes: After completing this course, students should be able to:

- Know the purpose, plan and methods of soil exploration by direct and indirect ways
- Identify various types of foundation and their selection criteria
- Execute geotechnical and structural design of shallow footings and pile foundation based on dimension, thickness, area and length, conforming to Ethiopian building code standard (EBCS)
- Determine the bearing capacities of pile foundation in different soil condition and distribution of load in group piles and their efficiencies
- Know the characteristics of expansive soils and types of foundations which can be recommended on such soils.

Course Description/Course Syllabus/Contents:

1. **Type of foundation and their selection criteria:** Introduction, purpose of foundation, types of foundation and selection of foundation type;
2. **Site exploration:** Introduction, purpose of site exploration, planning of exploration program and methods of site exploration.
3. **Design of shallow foundation:** General, general design procedure, geotechnical design aspect, structural design aspect and design examples of shallow foundation.
4. **Analysis and design of pile foundation:** Load transfer mechanism of pile foundation, methods of determining bearing capacity of a single pile foundation, pile groups, settlement analysis of piles and design of pile caps.
5. **Introduction to foundation on expansive soils:** Introduction, origin and mineralogical composition of expansive soils, identification of expansive soils, methods of preventing damages and foundation in swelling soils.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%, Final examination = 50%.

References

1. Alemayehu Teferra (Prof). Principles of Foundation Engineering. Addis Ababa: Faculty of Technology, Addis Ababa University Press. 2nd ed
2. Budhu, M, 2000. Soil Mechanics and Foundations, 3rd ed, Wiley and Sons
3. Murthy V.N.S., 2002. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering, New York
4. Arora R. K., Soil mechanics and foundation engineering, Nai Sarak, Delhi: Standard Publishers distributers, 2004
5. Braja M.Das, Principles of Foundation Engineering, 7th, Ed., Stamford: Cengage Learning, 2010
6. Bowles E. Joseph, Foundation Analysis and Design, 5th ed., Peoria: McGraw-Hill Companies, Inc., 1997
7. Donald P. Coduto (2001). Foundation Design: principle and practices, 2nd ed. California

12. MODULE 8: BUILDING AND CONSTRUCTION

In hydraulic and water resources engineering discipline engineers should know characteristics, behavior and application of different construction material for dam, building, channel, tunnel, etc Moreover, they should know the proportion of each constituents of the materials and they should be able to choose appropriate types of construction machinery for hydropower, water supply and irrigation projects. The course catalogue in this module is given in Table 12-1.

Table 12-1 Course catalogue of building and construction module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
CENG-2081	Construction Materials & Equipment	Compulsory	3	2	1	2	3	5
CENG-2082	Building Construction	Compulsory	2	1	1	2	3	4
		Total	**5**	**3**	**2**	**4**	**6**	**9**

12.1 Course Title: Construction Materials and Equipment (CENG-2081)

Pre-requisite: None

Course objectives: The course is designed to help students understand about the properties of construction materials under different conditions, know the production process of some construction materials, to have basic skill on how to mix and produce concrete, how to conduct laboratory tests on mechanical properties of both fresh and hardened concrete and how to select construction equipment.

Learning outcomes: At the end of the course, students able to:

- Select and Classify Construction Materials

- Define the Properties of Construction Materials (i.e. Mechanical Properties of Construction Materials) Nature and Performance of Materials Under Load (i.e. Cementing Materials)
- Perform Mix Design for Concrete
- Conduct Mechanical Properties of Both Fresh and Hardened Properties of Concrete
- Acquired the Management of Construction Equipment, Operation, Maintenance, Finance and Safety of Equipment

Course Description/Course Syllabus/Contents:

1. **Stones-Bricks-Concrete blocks:** Stone as Building Material, Criteria for Selection, Tests on Stones, Deterioration and Preservation of stone Work; Bricks, Bricks Classification, Tests on Bricks, Use of Bricks; Concrete Blocks, Light Weight Concrete Blocks
2. **Lime-Cement-Aggregate-Mortar:** Lime, Preparation of Lime; Cement, Ingredients of Cement, Cement Manufacturing Process, Types and Grades of Cement, Properties of Cement; Aggregates; Mortar
3. **Concrete as construction material:** Concrete Ingredients; Batching of Concrete; Properties of Fresh Concrete, Slump, Flow and Compaction Factor; Properties of Hardened Concrete, Compressive, Tensile and Shear Strength; Mix-Design of Concrete, Curing Techniques of Concrete; Concrete Admixtures
4. **Timber and other construction materials**: Timber: - Market Forms, Industrial, plywood, Veneer, Panels of Laminates; Steel: - Aluminum and Other Metallic Materials, etc.; Glass, Ceramics, Sealants for Joints and Clay Products, Applications of Laminar Composites, Geo-membranes and Geotextiles for Earth Reinforcement
5. **Construction equipment:** Selection of Equipment for Earth Work**,** Earth Moving Operations-Borrow, Handling and Placement, Soil Stabilization and Compaction**,** Equipment for Earth Work, Conveying and Compacting**,** Equipment for Foundation and Pile Driving**;** Selection of Equipment for Batching & Mixing and Concreting**;** Equipment for Material Handling and Erecting of Structures**;** Dredging, Trenching and Tunneling Equipment

Tasks to be done in the field exercise: Selection of cement, aggregate and mortar; Batching of Concrete; Mix-Design of Concrete, Curing Techniques of Concrete; Concrete Admixtures; Batching & Mixing and Concreting

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 45%, Field practice = 15 % and Final examination = 40%

References

1. Day, K. W. (2006). *Concrete Mix Design, Quality Concrete Mix Design, Quality* (Third Edition ed.). Madison Ave, New York: Taylor & Francis.

2. Kett, I. (2010). *Engineered concrete-mix design and test methods, second edition.* New york: CRC. Press.
3. Li, Z. (2011). *Advanced Concrete Technology.* Hoboken, New Jersey: JOHN WILEY & SONS, INC.
4. Mamlouk, M. S., & ZANIEWSKI, J. P. (2011). *Materials for Civil and Construction Engineers, Third Edition.* New York: Prentice hall.
5. Merritt, F. S., & Ricketts, J. T. (2001). *Building design and construction handbook* (Sixth Edition ed.). New York: McGraw-Hill Companies, Inc.
6. Newman, J., & Choo, B. S. (2003). *Advanced concrete technology constituent materials.* London: British Library Cataloguing in Publication Data.
7. Ramachandran, V. S. (1995). *Concrete admixtures handbook: Properties, Science, and Technology* (Second Edition ed.). Mill Road, Park Ridge, New Jersey: Noyes Publications.

12.2 Course Title: Building Construction (CENG-2082)

Pre-requisite: Construction Materials and Equipment

Course objectives: This course is designed to acquaint students to gain knowledge on various components of building, to gain skills on the preparation of working drawing for building, to gain knowledge on how to construct power house in hydropower project and to understand the fundamentals of construction planning and design procedures, and site selection.

Learning outcomes: At the end of this course, students will be able to:

- Select building site,
- prepare working drawing for buildings and
- Understand the basics of framed and domed structures.

Course Description/Course Syllabus/Contents:

1. **Types of buildings and building drawings**
2. **Site works:** Site features, site preparation and setting out.
3. **Walls, floors, doors, windows, roofs and roof coverings:** Masonry, load bearing walls, cavity walls and partition walls.
4. **Power house construction**
5. **Shell and dome structures**
6. **Introduction to architectural drawing:** define architecture, architectural drawings, how to produce architectural drawings and standard size of drawing paper;
7. **Components of architectural drawings:** site plan, floor plan, elevation, section, detail drawing and 3D perspective.

8. **Materials, hatching, symbols and notation used in architectural drawings:** materials symbol, hatching and schedules.
9. **Types of line (drawing language):** lines, alphabets of lines, symbols, lettering and notes.
10. **Project:** a record drawing of, turbines, selected hydropower power house.

Tasks to be done in the field exercise: Design of hydraulic structures on AutoCAD/ArchiCAD, architectural drawings and standard size of drawing paper, detail drawing and 3D view,

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 45%, Field practice = 15 % and Final examination = 40%

References

1. Edward Allen and Joseph, Fundamentals of Building Construction: Materials and Methods, Wiley publishers; 4th edition 2003
2. Abebe Dinku, A text book of building construction, AAU Press, 2007
3. Francis D. K. Ching and Cassandra Adams, Building Construction Illustrated, 3rd edition, Willey, 2000
4. French T.E and Helsel J.D (2003) Mechanical Drawing: Board and CAD techniques, Student`s edition, 13th edition
5. Architectural Drawings and design, Allen Jefris and David

13. MODULE 9: MATERIAL STRENGTH & STRUCTURAL DESIGN

Structural analyses and design of water and water resources engineering systems require knowledge of strength of materials and structures design. This module will equip students with material properties, stresses and methods of structural analysis. A thorough understanding of the mechanical behavior of materials is essential for the safe design of all structures like buildings, bridges, reservoirs, and pressure vessels.

The module enables students to come up with the knowledge and skills of structural design of commonly encountered structural members. Moreover, they will have sound knowledge about the behavior of reinforced structural elements under loads and the fundamental principles necessary for the analysis and design of reinforced concrete structural members (Table 13-1).

Table 13-1 Material Strength and Structural Design Module

Code	Course Name	Status	Cr.H	L	T	L/P	HS	ECTS
CEng-2091	Strength of Materials	Compulsory	3	2	3	0	3	5
CEng-3092	Reinforced Concrete Design-I	Compulsory	3	2	3	0	3	5
CEng-3093	Reinforced Concrete Design-II	Compulsory	2	2	2	0	2	4
		Total	8	6	8	0	8	14

13.1 Course Title: Strength of Materials (CEng-2091)

Pre-requisites: Engineering Mechanics (CEng-2032)

Objective: To develop and apply analytical methods for determining the mechanical behavior of solid bodies (for example: stress, strain, strength, stiffness, deflection, and stability) subjected to various types of loading which include: axial loading, bending, shear, torsion, or a combination.

- To develop and apply deflection methods for structures

Outcome: Students will be able to: -

- Apply knowledge of mathematics, science, and engineering dealing with mechanics of materials under axial loading.
- Know the meaning of torsion and the computation of the corresponding stress & strain on shafts.
- Know the different types of lateral actions on beams and computation of reactions at supports.
- Able to draw shear force & bending moment diagrams
- Understand the course and analyze the effect of the external actions on structural members.
- Know the methods of deflection for structural members
- Deal with and solve structurally indeterminate problems
- Acquire a knowledge of the three-moment equation

Course Description/Course Syllabus/Contents

1. Mechanical properties of materials - Stress and strains: types of stresses and strains; Hook's law and basic elastic theory;
2. Theory of bending: shear force and bending moment in beams; shear force and bending moment diagrams; bending and shear stresses; torsion;
3. Compound stresses: Stresses in members under axial load combined with bending; plane stresses and strains.
4. Deflection of beams, Energy method; Statically indeterminate structures; Columns; Pressure vessels

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References

3. F.P. Beer, E.R. Johnson, J.T. DeWolf and D.F. Mazurek. (2014) Mechanics of Materials, 7th Edition, McGraw-Hill.
4. Meriam, J.L. and Kraig, L.J. Engineering Mechanics (Statics), 6th Edition, Wiley & Sons, 2006.
5. Popov, E.P. (1998), Engineering Mechanics of Solids, 2nd edition, Prentice Hall.

13.2 Course Title: Reinforced Concrete Design I (CEng-3092)

Pre-requisites: Strength of Materials (CEng-2091)

Objectives:

- To know the type, nature and estimation of loads on any structure.
- Check the stability and determinacy of structures against combinations of loads/actions.
- To develop an understanding of the behavior of reinforced concrete elements under various loading and environmental conditions
- To introduce the standard approach to and the methods of reinforced concrete analysis and design; present the related codes and procedures.

Learning outcomes At the end of this course students will be able to:

- Identify various types of loads on structures and estimate their quantities.
- Evaluate whether the structure is stable against any external and internal actions statically & kinematically.
- Analyze and design singly reinforced concrete beams and slabs under flexure, including regular (rectangular shaped) and T-beams.
- Analyze and design structural concrete beams subjected to shear loading.
- They will attain a skill on basic assumption on elastic theory

Course Description/Course Syllabus/Contents

1. **Introduction to Reinforced Concrete Design:** Mechanical Properties of concrete and reinforcing steel, Concrete Mix Design.
2. **Basic Concepts of Design:** Design Philosophy, Limit State Design (LSD) method.
3. **Design of beams:** Single and double reinforced for Rectangular and T-sections, Design Aids, detailing of flexural reinforcement, Shear in beams - truss model, Bond, anchorage and development length, Detailing of shear reinforcement.
4. **Design of Slabs:** One-way solid and ribbed slabs on ULS method, Two-way solid slabs, Serviceability- elastic analysis of beam sections, cracking, moment curvature relationship, deflection.
5. **Comparison of hand calculations with SAP/Etabs/Excel**

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%, Field practice = 10% and Final examination = 40%

References

1. D. Darwin, and C. Dolan, A. Nilson, (2014). Design of concrete structures, 15th Ed, McGraw-Hill.

2. W.H. Mosley, R. Hulse, J.H Bungey (2012). Reinforced Concrete Design, 7th Ed, Red Globe Press
3. Jack C. McCormac, R.H. Brown (2015). Design of Reinforced Concrete, 10th Ed, Wiley
4. EBCS-2 and ECBP-2, The Ethiopian Building Code of standards, 1995

13.3 Course Title: Reinforced Concrete Design II (CEng-3093)

Pre-requisites: Reinforced Concrete Design I (CEng-3092)

Objectives:

- To design reinforced concrete components such as two-way slabs, and columns.
- To know the design principle of water conveyance structures and reinforcement details for tunnels, canals, penstocks, surge tanks and culverts.

Learning outcomes

- Students will be able to design reinforced concrete; axially and eccentrically loaded columns, Two-way slabs and cantilever by using latest sciences and engineering technologies
- Students will have the capacity to design retaining structures and water conveyance structures

Course Description/Course Syllabus/Contents

1. Design of axially and eccentrically loaded columns – short and slender;
2. Design of two-way slabs and introduction to yield line analysis;
3. R.C. column footings; isolated and combined;
4. Design of cantilever retaining structures; design methods; joints and reinforcement details;
5. Water conveyance structures design and reinforcement details for tunnels, canals, penstocks, surge tanks and culverts

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 45%, Field practice = 15 % and Final examination = 40%

References

1. D. Darwin, and C. Dolan, A. Nilson, (2014). Design of concrete structures, 15th Ed, McGraw-Hill.
2. W.H. Mosley, R. Hulse, J.H Bungey (2012). Reinforced Concrete Design, 7th Ed, Red Globe Press
3. Jack C. Mc Cormac, R.H. Brown (2015). Design of Reinforced Concrete, 10th Ed, Wiley
4. EBCS-2 and ECBP-2, The Ethiopian Building Code of standards, 1995

14. MODULE 10: PLANNING AND DESIGN TOOLS

There is a need to develop how to manage any construction resources scientifically in order to economize on both time and resources. This module introduces techniques and methodologies on how to effectively make use of the usually scarce resources available for construction, the legal concepts relevant to construction contracts and management of construction conflict and resolution of disputes. The student will be familiarity with various construction methods and arrange the sequence of construction operations at the planning stage. Moreover, the gets acquainted with official contracting terms for the award of construction performance contracts, calculation of time value of money; economic analysis of hydropower development. The course catalogue in this module is given in Table 14-1.

Table 14-1 Planning and Design Tools Module

Code	Course Name	Status	Cr. H	L	T	L/P	HS	ECTS
CEng-5101	Contract Specification and Quantity Surveying	Compulsory	2	2	2	0	2	4
CEng-5102	Construction Planning and Management	Compulsory	2	2	2	0	2	4
CEng-5103	Economics	Compulsory	3	2	3	0	3	5
		Sum	7	6	7	0	7	13

14.1 Course Title: Contract Specification and Quantity Surveying (CEng-5101)

Pre-requisites: Building Construction

Course Objectives: This course is designed to provide students with basic knowledge on how to administer contract, prepare tender documents and carry out measurement of work.

Outcome: After completion of this course students will be able to

- Prepare tender documents
- Prepare take-off sheets
- Settle claims

Course Description/Course Syllabus/Contents

1. **Principles of contract law in construction**
2. **Types of construction contracts;** contents of construction and consultancy contract documents;
3. **Specification writing;** subject matter of civil engineering specifications; national codes of standards and practices;
4. **Quantity surveying;** areas; volumes and material taking-off; Preparation and writing of bill of quantities; cost estimates.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 40%

References

1. John Adriaanse, Construction Contract Law, Palgrave Macmillan, 2004
2. Ivor H. Seeley, George P. Murray, Civil Engineering Quantities, Palgrave Macmillan, 2001
3. R.W. Thomas, Construction Contract Claims, Palgrave Macmillan, 2001
4. FIDIC Conditions of Contract for works of Civil Engineering Constructions,1991
5. BATCODA Conditions of Contract, 1991

14.2 Course Title: Construction Planning and Management (CEng-5102)

Pre-Requisite: Building Construction

Course Objectives: At the end of this course the student is expected to have learnt how to plan construction projects, schedule the activities using network diagrams, determine the cost of the project, control the cost of the project by creating cash flows and budgeting and how to use the project information as an information and decision making tool. Students also have the basic idea of financial, labor, material as well as time management from project planning up project completion.

Learning outcomes: Up on the completion of this course, the students will able to:

- Defining Work Tasks, Estimating Activity Durations and Resource Requirements for Work Activities
- Presenting Project Schedules by using Different Scheduling Techniques
- Know Cost Control and Monitoring
- Analyze the Quality Controls Methods
- Clarify the entire of Construction Execution Management

Course Content/syllabus

1. **Construction planning:** Basic Concepts in the Development of Construction Plans**,** Choice of Technology and Construction Method**;** Defining Work Tasks**;** Defining Precedence Relationships Among Activities**;** Estimating Activity Durations**;** Estimating Resource Requirements for Work Activities and Coding Systems
2. **Fundamental scheduling procedures:** Relevance of Construction Schedules; The Critical Path Method; Calculations for Critical Path Scheduling; Activity Float and Schedules; Presenting Project Schedules; Critical Path Scheduling for Activity-on-Node and with Leads, Lags, and Windows; Calculations for Scheduling with Leads, Lags and Windows; Resource Oriented

Scheduling; Scheduling with Resource Constraints and Precedence and Improving the Scheduling Process.

3. **Cost control, monitoring and accounting:** The Cost Control Problem**;** The Project Budget**;** Forecasting for Activity Cost Control**;** Financial Accounting Systems and Cost Accounts**;** Control of Project Cash Flow**;** Schedule Control**;** Schedule and Budget Updates and Relating Cost and Schedule Information.
4. **Quality control and safety during construction:** Quality and Safety Concerns in Construction; Organizing for Quality and Safety**;** Work and Material Specifications**;** Total Quality Control**;** Quality Control by Statistical Methods**;** Statistical Quality Control with Sampling by Attributes**;** Statistical Quality Control with Sampling by Variables and Safety Management.
5. **Construction management:** Project Construction Execution Management; Project Resources Management, Construction Time Management and Cost Management in Construction Projects; Risk Management of Construction Projects and Project Close Out.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References

1. Chitkara, K.K. “Construction Project Management Planning”, Scheduling and Control, Tata McGraw-Hill Publishing Co., New Delhi, 1998.
2. Srinath,L.S., “Pert and CPM Priniples and Applications “, Affiliated East West Press, 2001
3. Chris Hendrickson and Tung Au, “Project Management for Construction –Fundamentals Concepts for Owners”, Engineers, Architects and Builders, Prentice Hall, Pitsburgh,2000.
4. Moder.J., C.Phillips and Davis, “Project Management with CPM”, PERT and Precedence Diagramming, Van Nostrand Reinhold Co., Third Edition, 1983.
5. Willis., E.M., “Scheduling Construction projects”, John Wiley and Sons 1986.
6. Halpin,D.W., “Financial and cost concepts for construction Management”, John Wiley and Sons, New York, 1985.

14.3 Course Title: Economics (HWRE-5103)

Pre-requisites: None

Course Objectives: The objective of this course is to introduce time vale of money its Management and financial project appraisal and cash flow analysis by using different methods of comparing alternative proposals or Evaluation techniques. It will also able to familiarize tax and Depreciation concepts and different Methods of Depreciation accounting.

Learning outcomes: Up on the completion of this course, the students will able to:

- Distinguish the Importance of Engineering Economics and Characteristics of Project
- Grip Idea of Time Value of Money and Equivalence
- Drive All Interest Derivation Factor Formulas
- Work with The Financial Project Appraisal and Cash Flow Analysis
- Evaluate and Work with Economic Analysis of Water Resources Projects
- Have Tax and depreciation Concepts and the Methods of depreciation Accounting

Course Content/syllabus

1. **Introduction:** Definitions and Basic Terminologies; Importance of Engineering Economics and Project Concept.
2. **Interest Formulas and Their Applications:** Time Value of Money; Interest; Cash Flow Diagram; The Concept of Equivalence and Interest Derivation Factors and Formulas.
3. **Financial Project Appraisal and Cash Flow Analysis:** Present Worth Method of Analysis; Annual Worth Method of Analysis; Future Worth Method of Analysis; Rate of Return Method of Analysis; Break-Even Comparison Method or Break-Even Analysis; Benefit-Cost Ratio Method of Analysis and Case Study on Economic Analysis of Water Resources and Irrigation Projects.
4. **Taxes and Depreciation:** Importance, Types and Effects of Tax on cash Flow; Depreciation Accounting and Methods of Depreciation Accounting.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References

1. Bent, J. A., & Albert Thumann, P. C. (1994). Project Management For Engineering And Construction (2nd Edition Ed.). Lilburn: The Fairmontpress, Inc.
2. Gorold D., O. (2000). Project Management For Engineering & Construction (2nd Ed.). Boston: Thomas Casson.
3. James, L. D., & Lee, R. R. (1971). Economics Of Water Resources Planning. New York: Mcgraw-Hill.
4. Niall M. Fraser, E. M. (2013). Engineering Economics : Financial Decision Making For Engineers. Toronto: Pearson Canada In.
5. Panneerselvam, R. (2001). Engineering Economics. New Delhi: Asoke K. Ghosh, Phi Learning Private Limited.
6. Sullivan, W. G., Wicks, E. M., & Koelling, C. P. (2015). Engineering Economy (Sixteenth Edition Ed.). New York: Pearson Higher Education, Inc., Upper Saddle River.

15. MODULE 11: HYDRAULICS ENGINEERING

Hydraulics**,** branch of science concerned with the practical applications of fluids, primarily liquids, in motion or at rest. It is related to fluid mechanics, which in large part provides its theoretical foundation. Hydraulics deals with such matters as the flow of liquids in pipes, rivers, and channels and their confinement by dams and tanks. Some of its principles apply also to gases, usually in cases in which variations in density are relatively small. Consequently, the scope of hydraulics extends to such mechanical devices as fans and gas turbines and to pneumatic control systems. The course catalogue in this module is given in Table 15-1.

Table 15-1 Hydraulics module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
HWRE-2111	Fluid Mechanics	Compulsory	3	2	1	2	3	5
HWRE-3112	Hydraulics	Compulsory	3	2	1	2	3	5
HWRE-3113	Open channel Hydraulics	Compulsory	3	2	1	2	3	5
	Total		9	6	3	6	9	15

15.1 Course Title: Fluid Mechanics (HWRE-2111)

Pre-requisite: Engineering Mechanics

Course objectives: To introduce Hydraulic and water resources engineers to properties and principles of fluid mechanics at a more fundamental level and with a more mathematical approach.

Learning outcomes The students will be able to understand the physical properties of fluids (density, viscosity, pressure, stress/strain relationship) and their relation to molecular properties ,identify types, direction of forces and compute forces on hydraulic structures (e.g. dams, weirs, pipes) resulting from water pressure , determine forces of buoyancy and exertion on submerged body, understand fluid pressure distributions in moving fluids, and perform control volume analyses of mass, momentum, and energy conservation in accordance with Reynolds Transport Theorem.

Course Description/Course Syllabus/Contents:

1. **Properties of Fluids:** Physical properties of fluids like viscosity, density and Specific gravity, bourdon pressure gauge, compressibility and elasticity, surface tension and capillarity elevation;
2. **Pressure Measurement:** Fluid pressure at a point, Pressure vibration in a fluid at rest, pressure in simple and differential manometers.
3. **Hydrostatic forces on surfaces:** Pressure excreted by a liquid at rest on a plane or curved surface.
4. **Buoyancy and Floatation:** The tendency for an immersed body to be lifted up in the fluid due to an upward force opposite to action of gravity.

5. **Kinematics of fluid flow**: dimensions of flow, pattern of flow, stream function and velocity potential, flow net analysis,
6. **Dynamics of fluid flow**: forces influencing fluid flow, hydraulic and energy grade line, continuity and Bernoulli's equations, Impulse and momentum principle and its applications.

Laboratory Practice: Tasks to be done in hydraulics laboratory**,** Students will go to hydraulic laboratory and they will carry out the following experiments: Measurement of viscosity, determination of fluid properties like density and specific gravity, measurement of capillary elevation, Verification of Pascal's law, Determination of hydrostatic pressure on a plate surface, impacts of jet, equilibrium of floating body and they will verify Bernoulli's theory etc. Finally, they will provide a report in groups from their experiment result based on procedure given for them.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory practice = 20% and Final examination = 40%

References;

1. Crowe, Roberson and Elger. Engineering Fluid Mechanics, 8th Edition, John Wiley & Sons, 2005.
2. Streeter V., Fluid Mechanics, 1997
3. Fluid Mechanics with engineering application, Joseph B Franzinil
4. Hydraulics in civil Engineering, A. Chadwick & J. Morfett
5. Introduction to fluid mechanics, R. W.Fox, Allan T.Mc Donald

15.2 Course Title: Hydraulics (HWRE-3112)

Pre-requisite: Fluid Mechanics

Course objectives: The aim of this course is to familiarize the students with flow through orifices and mouth pieces, notch and weirs, dimensional analysis and similitude, flows through pipe networks, and boundary layer theory.

Learning outcomes

- Ability to determine discharge, velocity, and contraction coefficient
- Ability to analyze and design piping systems, including water distribution systems.
- Gain knowledge of categorizing flow as lamina, turbulent and their characteristics;
- Understanding of physical model type and their purpose to model big hydraulic structure in diminishing way
- Conducting flow over physical model weir, spillway and observe the effect on the structure;
- Ability to identify various pieces of hydraulic equipment such as weir, spillway, dams, turbines, pumps, pipes; valves, pipe networks, pipe branches and their pressure at elbow, bending, etc.
- Sizes and material of construction of physical model at laboratory.

- Ability to operate hydraulic equipment such as pumps, valves, meters, turbines
- Ability to conduct hydraulic experiments; and to collect, analyzes and interprets collected data.
- Be familiar with boundary layer theory;
- Ability to use computer to solve complex hydraulic problems.

Course Description/Course Syllabus/Contents:

1. **Flow through orifice and Mouth pieces:** classification of orifices, flow through an orifice, hydraulic coefficients, discharge through a large rectangular orifice, discharge through fully and partially submerged orifice, time required for emptying through an orifice at its bottom a hemispherical tank, a circular horizontal tank, classification of mouthpieces, discharge through an internal and external Mouthpieces, mouthpieces running free and full.
2. **Characteristics flow over notch and weir:** Types/classification of notches and weirs, advantages of triangular notch or weir over rectangular notch or weir, effect on discharge over a notch or weir due to error in the measurement of head, discharge over a triangular weir, a trapezoidal weir, a stepped weir, cipolletti weir and notch, Broad –crested, narrow crested, an ogee weir, sub-merged or drowned weir, Velocity of approach.
3. **Dimensional analysis and similitude:** dimensional analysis, similitude & hydraulic models
4. **Flow through pipes:** Major & minor losses in pipe flow, Solution of single-pipe flow problems, Pipe Line with Pump or Turbine, Pipeline system (series & parallel), Equivalent pipes, Branching pipes, and pipe networks.
5. **Boundary layer Theory:** Definition& characteristics, momentum equation for boundary layer by Von Karman, Laminar boundary layer, turbulent boundary layer, total drag due to laminar and turbulent layers, and boundary layer separation and its control

Laboratory Practice: Tasks to be done in hydraulics laboratory**,** Students will go to hydraulic laboratory and they will carry out the following experiments: Flow through orifices and mouthpieces, flow over rectangular notch, flow over a vee notch, flow over broad crested weir and flow through venture flume to study characteristics of flow over different shapes of material and to determine the coefficient of discharge, velocity and contraction coefficient for different materials ,head losses in pipes (major & minor losses), determination of Reynolds number in pipe flows(visually separate flow pattern; laminar, turbulent, and transition flows)

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory practice = 20% and Final examination = 40%

References

1. Streeter V., Fluid Mechanics, 1997
2. Fluid Mechanics with engineering application, Joseph B Franzinil
3. Fluid Mechanics and Hydraulic Machine, Er.R. K-Rajput,2013

4. Fluid mechanics, Streeter, V.L., Wylie, B.E., Bedford, K.W. (1997), 9th ed. McGraw Hill
5. Fluid mechanics, Douglas, J.F., Gasoriek, J.M., Swaffield, J. and Jack, L. (2006), 5th ed. Prentice Hall.
6. Fundamentals of Fluid mechanics, Munson, B.R, Young, D.F, Okiishi, T.H. (2006), 5th ed. Wiley and sons.
7. Fluid mechanics, Donald F. Young, Bruce R. Munson

15.3 Course Title: Open Channel Hydraulics (HWRE-3113)

Pre-requisite: Fluid Mechanics

Course objectives: The goal of this course is for students to introduce open channel flow with its characteristics and to develop an advanced understanding of steady and unsteady water flow in open channels including streams, rivers, and tidal wetlands.

Learning outcomes The students will be able to apply energy and momentum concepts to analyze open channel flow, the Manning Equation and Chezy Equation to describe uniform flow and principle of continuity equation, identify flow as gradually varied flow and rapidly varied flow and determine their flow profiles in different types of channels hydraulic structures, recognize the unsteady flow types, equations of St. Venant and understand the concept of characteristics of unsteady flow and develop simple software that solves open channel flow equations, flow profiles and apply the software for analysis and design purposes.

Course Description/Course Syllabus/Contents:

1. **Introduction to open channel flow:** Types of open channel flows, selection of best (economic) hydraulic sections, specific energy, critical depth and hydraulic jump.
2. **Energy principles in open channel flows:**
3. **Flow Computation formulas:** Critical flow; Uniform flow: Computation of uniform flow & design of unlined alluvial Canals
4. **Gradually Varied Flow:** definitions, gradually varied flow equations, profiles and computation of gradually varied flow
5. **Rapidly Varied flow:** Characteristics of RVF, flow over spillway, flow under sluice gate, hydraulic jump analysis and its use as energy dissipater, spatially varied flow
6. **Introduction to Unsteady Flow in Open Channels:**Characteristic of unsteady flow, application of St. Venant to solve unsteady flow

Laboratory Practice: Tasks to be done in the hydraulics Laboratory; The students were demonstrated on observation of various types of flow pattern like laminar and Turbulent, and transition based on

Reynolds number, Hydraulic Jump, Specific Energy, Manning's coefficient for channel bed material, and observation of various types GVF & RVF phenomenon**.**

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory practice = 20% and Final examination = 40%

Literature:

1. Crowe, Roberson & Elger. Engineering Fluid Mechanics, 8th Edition, John Wiley & Sons, 2005.
2. Open Channel Hydraulics, by Ven TeChow,
3. Open Channel Hydraulics, by French
4. Flow in Open Channels, by Subramanian
5. Fundamentals of Hydraulic Engineering, by Alan L. Prasuhn

16. MODULE 12: HYDROLOGY

The science of hydrology deals with the occurrence and movement of water on and over the surface of the earth. It deals with the various forms of moisture that occur, and the transformation between the liquid, solid and gaseous states in the atmosphere and in the surface layers of land masses. It is concerned also with the sea –the source and store of all the water that activates life on this planet. The course catalogue in this module is given in 16-1.

Table 16-1 Hydrology module

Course No.	Course Name	Status	Cr.H	L	T	LP	HS	ECTS
HWRE-2121	Introduction to Hydrology	Compulsory	2	2	2	0	2	4
HWRE-3122	Hydrological Measurements & Analysis	Compulsory	2	1	1	2	2	4
HWRE-3123	Engineering Hydrology	Compulsory	3	2	2	1	3	5
HWRE-3124	Groundwater Engineering	Compulsory	3	2	1	2	3	5
	Total		10	7	6	5	10	18

16.1 Course Title: Introduction to Hydrology (HWRE-2121)

Pre-requisite: None

Course objectives: The objective of the course is to give students an introduction on various phases of hydrologic cycle; Precipitation, Evaporation, Infiltration, and to give basic knowledge on the occurrence, distribution and movement of surface water.

Learning outcomes

- After completion of this course students will be able to understand the hydrologic cycle in the globe, know how they measure different phases of hydrologic cycle
- Understand the basic concepts of precipitation, evaporation &transpiration, infiltration, and runoff.

Course Description/Course Syllabus/Contents:

1. **Hydrologic cycle**; To understand the complicated relationship between precipitation and runoff;
2. **precipitation:** Types of precipitation; measurement of rainfall; analysis and interpretation of precipitation data;
3. **Evaporation and Transpiration:** factors controlling evaporation and transpiration process; measurement of evaporation; estimation of potential evaporation;
4. **Infiltration:** factors affecting infiltration; measurement of infiltration; infiltration indices;
5. **Runoff:** Components of stream flow, catchment characteristics, mean and median elevation, classification of streams, factors affecting runoff.

Laboratory Practice: Students will go to Hydraulic laboratory and meteorology laboratory and they will carry out laboratory practice on basic hydrology, and they will also go for felid visit at metrological station.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 45%, laboratory practice = 15% and Final examination = 40%

References

1. Elizabeth M.Shaw(1994),Hydrology in practice,3rd Edition
2. Ray K.Linsley,JR etal,(1982), Hydrology for Engineers,3rd edition
3. R.W.Herschy,(1985),Stream flow measurement.2nd edition
4. R.W.Herschy,(1979) Hygrometry principles and practice
5. H.M. Raghunath (2006) Hydrology. Principles. analysis and design Revised 2nd edition

16.2 Course Title: Hydrological Measurement and analysis (HWRE-3122)

Pre-requisite: Introduction to Hydrology, Probability and statistics

Course objectives:

To understand how to measure stream flow and discharge in a stream, Moreover, this course introduces student's method of measuring of stream cross section and they will know different hydrological measuring instruments and hydrological data analysis.

Learning outcomes After completion of this course students will be able to

- Plan hydro-metrological networks; establishment and operation of hydro-metrological stations

- Know methodology to measure stream cross section
- Measure river velocity at different depths of the river
- Measure river discharge by using different flow measurement techniques and data analysis

Course Description/Course Syllabus/Contents:

1. **Hydro-Metrological Network Design:** Introduction of hydro-metrological network design, Objectives of network design, the basic network, minimum network ,network design process, WMO Criteria for minimum network density, financial aspects, Rain gauge network design methods, stream gauging stations, criteria for location of site, evaluation and adequacy of networks, site selection survey, general site selection guideline, criteria for water level gauging sites, WMO Criteria for selection of site, lake and reservoir stages, criteria for streamflow measurement sites, criteria for natural control sites, criteria for artificial control sites, sediment discharge and sedimentation, and water quality stations.
2. **Measurement of river Stage, depth, velocity:** The reference gauge, Staff gauge, bubble gauge, recording gauge, Inclined gauge, the float-tape gauge, electric tape gauge, the wire weight gauge, crest-stage gauge, stage data analysis, velocity measurement (current meter method, floating method, ultrasonic method).
3. **Hydrometric Measurement:** Direct measurement techniques **(**Area-velocity method, Moving Boat method, Dilution or chemical method, Electromagnetic method, and Ultrasonic method), indirect measurement techniques (Slope-Area method, flow measuring structures).
4. **Discharge-stage relationship (Rating curve):** Control (permanent or shifted), extrapolation of rating curve, conveyance method, logarithmic – plot method, hydrometry stations, and analysis of rating curve by using different techniques.

Field Practice: The students will go field to visit metrological station of various equipment and prepare report. Measurements of discharging in channels (natural streams, rivers) by surface floats etc. The velocity distributions of channels are studied by measuring velocities at various depths using current meter and finally they will beinterpret and present their result.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory and field practice = 20% and Final examination = 40%

References;

1. Reginald W. Hershy, 2009, Streamflow Measurement,3rd Edition
2. Elisabeth M. Shaw, 1994, Hydrology in Practice, 3rd Edition
3. R.K. Linsley, 1982 Hydrology for Engineers, 3rdEdition
4. K. Subramanya, 1994, Engineering Hydrology, 3ndEdition
5. H.M. Ragunath,2006, Hydrology (Principles. analysis .design), Revised 2rdEdition

16.3 Course Title: Engineering Hydrology (HWRE-3123)

***Pre-requisite*:** Introduction to Hydrology, Probability and statistics

Course objectives: To Understand how to predict risks and reliabilities of flood control systems, to provide students basic knowledge on Hydrologic model, catchment characteristics, hydrology of different size of catchment, interpretation of data using statistics and probability, and reservoirs.

Learning outcomes: After completion of this course students will be able to

- Understand about Hydrographs,
- Processing of hydrological data, frequency analysis of floods.
- Flood routing
- Spillway design flood estimation.
- Estimation of reservoir capacity.

Course Description/Course Syllabus/Contents:

1. **Rainfall-runoff relationship**: Application of different models; hydrology of ungauged catchments
2. **Flood routing:** reservoir routing; channel routing;
3. **Frequency analysis**:**(**probability in hydrology**)** rainfall, low flow and floods;
4. **stochastic hydrology:** basic concepts of stochastic hydrology
5. **Reservoir capacity determination**: determination of reservoir capacity, reservoir sedimentation;
6. **Urban Hydrology**: Basic concepts of urban hydrology, application of IDFand DAAD curves.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References:

1. Elisabeth M. Shaw, 1994, Hydrology in Practice, 3rd Edition
2. R.K. Linsley, 1982 Hydrology for Engineers, 3rd Edition
3. K.Subramanya, 1994, Engineering Hydrology, 2nd Edition
4. E.M. Wilson 1982, Engineering Hydrology 3rd Edition

16.4 Course Title: Groundwater Engineering (HWRE-3124)

Pre-requisite: Engineering Hydrology, Fluid Mechanics

Course objectives: This course is designed to aware students about the groundwater resource. It also acquaints students with the scope and occupancy of groundwater, in hydrologic cycle, different types of aquifers and their characteristics, Study of groundwater movement, Darcy's law, laboratory and field

determination of hydraulic conductivity, and hydraulics of wells, steady and unsteady states of flow in confined and unconfined aquifer is the core of this course.

Learning outcomes After completion of this course students will be able to

- Know the basic concepts of occurrence, laws of movement and distribution of groundwater in relation to natural and artificial influences.
- Understand the directional flow of groundwater, well hydraulics, how to explore groundwater, pumping tests of wells, tube wells and tube well development
- Analyze pumping test data and interpretation of the result.
- Have a clear idea of groundwater resource development for various purposes.
- Aware of the complex nature of groundwater balance and its management.
- Know the basic concepts of groundwater models; analyze two dimensional groundwater flows by using MODFLOW and related software.
- Understand artificial recharge, need of artificial recharge and methods employed to apply artificial recharge.

Course Description/Course Syllabus/Contents:

1. **Introduction to groundwater:** definition, uses of groundwater, global water resources, groundwater in hydrologic cycle
2. **Ground water resources:** Scope and occurrence; ground water in hydrologic cycle; different types of aquifers and their characteristics.
3. **Ground water movement:** Darcy's law, mathematical treatment of frequently occurring flow problems, one-, two- and three-dimensional flow in phreatic, confined and semi-confined aquifers. Laboratory and field determination of hydraulic conductivity, determination of ground water flow parameters.
4. **Groundwater and well Hydraulics:** steady and unsteady states of flow in, phreatic, confined and unconfined aquifers. Solution methods; graphical methods, use of images; numerical analysis, application of mathematical models to the study of ground water flow problems; unsteady flow in leaky aquifers; partially penetrating wells; multiple well system.
5. **Pumping tests of wells:** design of piezometer, analysis and interpretation of data. Ground water exploration.
6. **Groundwater Exploration:** surface investigation of groundwater, sub-surface investigation of groundwater.
7. **Design of tube wells (water wells):** screened and gravel wells; methods of construction based on drilling equipment's; well development and maintenance; well failures and rehabilitation.
8. **Ground Water balance and ground water management**:

9. **Artificial recharge of ground water**: Recharge in general, objectives of artificial recharge, methods of artificial recharge
10. **Groundwater flow modeling techniques**: Types of groundwater models, steps in the development of groundwater model, simulation of two-dimensional groundwater system, and introduction to groundwater modeling software's (MODFLOW-2005, MODPATH)

Laboratory Practice:

The students will go to field to demonstrate the computation of aquifer parameters like storage coefficient, transmissibility coefficient, and Permeability coefficient. They also conduct experiments on pumping test for drawdown computations, use different software for modeling groundwater

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory practice = 20% and Final examination = 40%

References:

1. Groundwater Hydrology, by Todd, D.K.
2. Groundwater, by Raghunath,H.M.
3. Groundwater Resources Evaluation, by Walton, W.C.
4. Groundwater Hydrology, by Bouwer, H.
5. Groundwater, by Freeze and Cherry
6. Groundwater Engineering by Abdel-Aziz Ismael Kashef
7. Applied Geophysics for Geophysists and Engineers by Giriffiths and King
8. Water Well Technology by Campbell Lehr

17. MODULE 13: HYDRAULIC STRUCTURES

In a developing country like Ethiopia, design of economically viable hydraulic structure is very important. This module aims to expose students to design and analyze water storage and hydraulic structures such as dams, intakes, outlets, energy dissipating structures, water diversion structures, and others. Beside students will gain knowledge on construction materials for dams, dam appurtenant structures and related ones. The course catalogue in this module is given in Table 17-1.

Table 17-1 Hydraulic structures module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
HWRE-3131	Hydraulic Structures I	Compulsory	3	2	2	1	3	5
HWRE-4132	Hydraulic Structures II	Compulsory	3	2	2	1	3	5
	Total		6	4	4	2	6	10

17.1 Course Title: Hydraulic Structures I (HWRE-3131)

Pre-requisite: Open Channel Hydraulics, Soil Mechanics I

Course objectives: This course is designed to acquaint students with the basic design principle of hydraulic structures. Emphasis will be given to elements of dam engineering; classification of dams; site assessment and selection of appropriate type of dam; foundations and their treatment; concrete and embankment dams: loading; analysis and design of different dam types.

Learning outcomes After completion of this course students will be able to

- Define dam & reservoir and know its basic importance and also list the types of dam
- Identify the various reservoir parameters and prepare area-elevation-storage curve
- Differentiate the general characteristics of concrete and embankment dams
- Select appropriate site for construction of different types of dams and know the method of foundation preparation
- Know the basic design principle and analysis of gravity, buttress, arch and embankment dams
- Understand the various mode of failure in all type of dams and recognize its constructional feature
- Familiar with the technique of diverting river water for the purpose of constructions

Course Description/Course Syllabus/Contents:

1. **Elements of dam engineering:** classification of dams; site assessment and selection of appropriate type of dam; foundations and their treatment;
2. **Concrete dams**: loading concepts and criteria; analysis and design of gravity dam, arch and buttress dams, design features and construction; roller compacted concrete gravity dam; Dam stability analysis using ANSYS, CADAM.
3. **Embankment dams:** types of embankment dams, nature and characteristics of engineering soils, design and analysis of embankment dams, material and construction; Dam stability analysis using Geostudio.

4. **River diversion:** Methods of stream diversions during construction; design of dykes. Students will go to Hydraulic lab. And they will see different models of hydraulic structures like concrete dams, embankment dams and etc.

Laboratory work: Students will go to computer laboratory and analyze concrete and embankment dam stability using different software such as ANSYS, Geostudio/CADAM

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%, laboratory practice = 10% and Final examination = 40%

References

6. Novak, Moffat, Nalluri & Narayanan (1996) Hydraulic Structures, 2nd Ed. Chapman & Hall
7. Davis & Sorrensen, Hand Book of Hydraulics, 3rd Ed. 1984 Reissue
8. Thomas (1979) The Engineering of Large Dams, Parts 1 & 2, John Willey and Sons, London
9. USBR, Design of Gravity Dams, US Government Printing Office Denver 1977
10. USBR, Design of Small Dams, A Water Resource Technical Publication, 1974
11. Robin Fell, Patrick MacGregor, Geotechnical Engineering of Embankment Dams, 1992 K.R. Arora, Irrigation, Water Power and Water Resource Engineering, SPD. 1996

17.2 Course Title: Hydraulic Structures II (HWRE-4132)

Pre-requisite: Hydraulic Structures I

Course objectives: The main objectives include construction and design principles of dam appurtenant structures like dam outlet works, energy dissipation, dam safety: instrumentation and surveillance, diversion works, cross-drainage and drop structures.

Learning outcomes After completion of this course students will be able to: -

- Design dam appurtenant structures
- Have knowledge on Dam Safety: Instrumentation and Surveillance
- Design weirs and barrages on permeable foundations

Course Description/Course Syllabus/Contents:

1. **Dam outlet works:** Factors to be considered in design of outlet works; hydraulics of outlet works; bottom outlets; spillways: types; hydraulic design; constructions and operations features of each type; aeration and cavitation on spillways;
2. **Energy dissipation:** Energy dissipation on spillways, stilling basins, plunge pools and energy dissipation at bottom outlet.

3. **Intakes, gates and valves:** Types of intakes and selection criteria, Crest gates, High-head gates and valves, Tidal barrage and surge protection gates, Hydrodynamic forces acting on gates, Cavitation, aeration, vibration of gates, Automation, control and reliability.
4. **Dam safety; instrumentation and surveillance:** Instrumentation, surveillance, Dam safety legislation, Reservoir hazard and risk assessment.
5. **Diversion head works:** Parts of diversion head works; design of weirs and barrages on permeable foundations; Bligh's theory; Lane's theory; Khosla's method of independent variables.
6. **Cross-drainage and drop structures:** Aqueducts and canal inlets and outlets, culverts, bridges and dips, low level water crossings, drop structures.

Laboratory work: Students will go to hydraulics laboratory and practice energy dissipation using structures, Calculate different losses on intakes, gates and valves.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%, laboratory practice = 10% and Final examination = 40%

References

1. Novak, Moffat, Nalluri & Narayanan (1996) Hydraulic Structures, 2nd Ed. Chapman & Hall
2. Garg, S.K. Irrigation Engineering and Hydraulic Structures" Khanna Pub. Delhi,2000
3. Arora, K.R. "Irrigation, Water Power and Water Resource Engineering", St. Pub. Delhi 2001
4. Davis & Sorrensen, "Hand Book of Hydraulics", 3rd Ed. 1984 Reissue
5. Varshney, R.S, "Hydropower Structures", Nem Chand & Bros, Roorkey 2001.

18. MODULE 14: HYDROPOWER AND HYDROMACHINE

Hydraulic and Water Resources Engineers are required to design, construct and supervise various types of Hydropower plants. The purpose of this module is to provide the students with a solid knowledge and understanding of the principles governing the design and analysis of the different hydropower scheme components and to provide them with an opportunity to apply the design, construction and supervision procedures learned in class to a "real life" Hydropower project. The course catalogue in this module is given in Table 18-1.

Table 18-1 Hydropower and hydromachine module

Course No.	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
HWRE-3141	Hydropower Engineering-I	Compulsory	3	2	2	1	3	5
HWRE-4142	Hydropower Engineering-II	Compulsory	3	2	2	1	3	5
HWRE-4143	Hydraulic Machines	Compulsory	2	2	1	1	2	4
		Total	8	6	5	3	8	14

18.1 Course Title: Hydropower Engineering-I (HWRE-3141)

Pre-requisite: Open Channel Hydraulics, Soil mechanics I

Course objectives: This course is designed to expose students to plan, design and analysis of the different hydropower scheme components.

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

- Know the different energy sources of electricity generation and also identify different alternative energy sources
- Know the hydropower potential of the Ethiopia river basins and the world
- Plan and design different hydropower scheme components
- Do hydrological analysis for hydropower development and estimate water potential using power equation
- Estimate firm and secondary power and do load prediction and demand assessment
- Identify different hydropower plants and know plant capacity determination
- Design water passage structures such as intake, canal, tunnel, forebays, surge tank and penstocks and do water hammer analysis
- Identify, design and select the appropriate type of turbines
- Design scroll case and draft tube, know how to set turbines
- Understand and formulate the problem associated with turbines and hydraulic machines
- Know about generators and turbine controls

Course Description/Course Syllabus/Contents:

1. **Sources of Energy**: Renewable and non-renewable energy sources; conventional and non-conventional energy sources; alternative energy sources; merits and demerits of hydropower energy
2. **Development of Hydropower**: hydropower potential, status and development in Ethiopia; hydropower potential status in the world
3. **Development and Layout of Hydropower Plants**: layout of hydropower developments; hydrological analysis for hydropower development; estimation of water power potential; firm and secondary power; load prediction and demand assessment
4. **Classification and Types of Hydropower Development**: classification and basis; classifications based on hydraulic feature, actual operation in meeting demand, pant capacity, head, constructional features, storage and pondage, reservoir (storage) capacity; plant capacity determination.
5. **Water Conveyance Structures**: Design of Intakes, Canals and Tunnels; design of sediment trap and settling basin; design of forebays, surge tank and penstocks; water hammer analysis

6. **Hydraulic Turbines**: definition of hydraulic turbines; classification of turbines; characteristics of turbines; procedures in preliminary selection of turbines; design of turbine scroll case; design of draft tube; cavitation in turbine and turbine setting; generators and turbine controls

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References

1. Harvey, A. & Brown, A. (2004), Micro-Hydro Design Manual, Practical Action.
2. P. Novak (2007). Hydraulic Structures. 1/e. Taylor & Francis.
3. Hydraulic Structures by Novak
4. Water Power Engineering by Barrows
5. Water Power Engineering by Dandaekar & Sharma
6. Hydropower Structures by Varshney and Others

18.2 Course Title: Hydropower Engineering-II (HWRE-4142)

Pre-requisite: Hydropower Engineering-I

Course objectives: The main objectives this course is to expose students to plan, design and analysis power house and transmission lines. Plan and supervise rehabilitation and maintenance of hydropower and design full component of min and small-scale hydropower plant. Plan and supervise construction of hydropower plant.

Learning outcomes After completion of this course students will be able to:

- Investigate hydropower resources, flow duration curves for hydropower design and planning hydropower projects.
- Plan and design power plant stations
- Selection of appropriate site for underground power stations
- Understand overall layout of power stations and know the transmission and distribution system design
- Know the construction features of hydropower projects like reservoir, concrete dam, RCC dam
- Understand dam instrumentation and safety principles and concepts
- Define mini and small-scale hydropower projects and also know the benefit of developing in terms of supplying electricity for rural areas.
- Identifying the different impacts of developing hydropower projects in social life, environment and general politics
- Learn the economic and financial appraisal of hydropower projects

Course Description/Course Syllabus/Contents:

1. **Hydropower Project Investigation and Planning**: investigation of resources; investigation of hydropower projects, hydrologic study of hydropower projects, geotechnical studies, environmental issues, projects appraisal and Scio-economic considerations, planning
2. **Power Plant Station**: **Conventional Type of Power Stations**: component of hydropower projects; power house types and planning; components of power house; layout and dimensions of power house; types of power house
3. **Underground Power House:** locations and arrangement of power stations; comparison of power stations alternatives, main characteristics of underground power plants, overall plant layout, power house tunnelling system, location and arrangement of transformer, rock stress
4. **Transmission of Electric Power:** transmission and distribution system design, design philosophy of overhead lines, framework of standard and right way of planning, tower spotting and conditions influencing it, sag calculations and drawing of catenaries, design of tower and tower foundations, conductors and insulators
5. **Construction Features of Hydropower Projects**: reservoirs; concrete dam construction; RCC dam construction; dam instrumentation and safety principles and concepts
6. **Mini and Small-Scale Hydropower Project Development:** definitions of mini and small-scale hydropower; energy supplies in rural area; mini and small-scale hydropower development; factors of mini and small-scale hydropower development; preferential policy for the development; funding and appropriate technology; benefits of development
7. **Environmental, Social and Political Feasibility of Hydropower Projects:** impacts rising from operation of hydropower schemes, land scape impact, preliminary questions and check list of considerations, impact evaluation methodology, other social and political considerations
8. **Economical and Financial Evaluation of Hydropower Projects:** economic and financial feasibility; cost and benefit analysis; methods of economic and financial appraisal of hydropower projects.

Laboratory work/visit: Students will go to visit demo farm to demonstrate the working principles of pumped storage power plant and also try to design mini and small-scale hydropower model by using different materials in group

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50% and Final examination = 50%

References

1. Water Power by Mosonyi, Vol. I & II
2. Hydraulic Structures by Novak
3. Water Power Engineering by Barrows

18.3 Course Title: Hydraulic Machines (HWRE-4143)

***Pre-requisite*:** Hydraulics

Course objectives: This course is designed to expose students to design and analysis of the Hydraulic machines, select the appropriate type of turbines for a hydropower scheme, develop performance curves for hydraulic machines, identify the basic differences of hydraulic machines, develop specification of hydraulic machines

Learning outcomes At the end of this course, students will be able to:

- Understand the flow principles through turbines
- Know the basis of classification of turbines and select the appropriate type of turbines for a hydropower scheme
- Identify the different Characteristics of turbines
- Know the different types of pumps and differentiate between reciprocating and centrifugal pump
- Develop pump efficiency curve and understand the working principles of other miscellaneous hydraulic machines

Course Description/Course Syllabus/Contents:

1. **Basic principles of flow**: Continuity and energy equations; principles of moment of momentum
2. **Hydraulic Turbines**: Classification of Turbines; Characteristics of Turbines; Velocity diagrams and efficiencies of each type; Cavitation and turbine setting height; Draft Tubes; Draft Heads; Dynamic similarity and model testing; Specification and selection criteria; Efficiencies and installation; Specific speed and performance curves
3. **Pumps:** Types of pumps; Reciprocating pump; Centrifugal pumps; Submersible pumps; pumps in series and parallel; Pump efficiency curve; pumping stations; classification and intakes; pump sump design
4. **Miscellaneous hydraulic machines**: Air vessels; Hydraulic press; Hydraulic intensifier; Hydraulic accumulator; Hydraulic crane; Hydraulic crane; Hydraulic lift; Hydraulic Ram

Laboratory Practice:

The students will go to hydraulic laboratory and carryout an experiment on various types of turbines and calculating the specific speed of turbine. They also carry out the experiments on various types of pumps and prepare the characteristic curves of machines. They also identify the various components namely shafts, propeller, impeller and blades of hydraulic machines through cut models. And they will visit different type of hydraulic machines which are found nearby to the university.

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%, laboratory practice = 10% and Final examination = 40%

References

1. Fluid Mechanics and Hydraulic Machines, Rajput
2. Hydraulic Structures by P.Novak et al

3. Text book of Hydraulic Machines,Prof Dr. Magdy Abou, Zagazig University
4. Water power Engineering by Dandaekar and Sharma

19. MODULE 15: WATER AND WASTE MANAGEMENT

Water Supply & waste water management addresses sustainable provision of safe and reliable drinking water. This is the major challenge facing both developing and developed countries around the world. In rural and pri-urban areas in developing countries, there is a continued need for the development and application of low-cost appropriate treatment and distribution technologies. In urban areas, the fast growth of population, particularly in developing regions and countries in transition, puts enormous pressure on the local infrastructure, utilities and environment.

This module shows students how to develop and then operate a water supply system and waste water management units. Emphasis is given to practices in rural and urban areas for water supply and sanitation system. This module contains two courses, as indicated in Table 19-1.

Table 19-1 Water and waste management

Code	Course Name	Status	Cr. H	L	T	LP	HS	ECTS
WSEE-3151	Water Supply & Treatment	Compulsory	3	2	3	0	3	5
WSEE-4152	Wastewater & Solid Waste Management	Compulsory	2	2	1	1	2	4
		Total	8	6	5	3	8	14

19.1 Course title Water Supply Engineering (WSEE-3151)

Pre-requisites: Fluid Mechanics

Objectives

- To identify the sources and quantity of surface and ground water bodies, and their demand for the public
- To equip students with the principles and design of water distribution system.
- To give students a broad understanding of population forecasting, water demand, water sources, and collection & distribution of water.
- To depict the information on water treatment processes and its design
- To introduce students to various methods of treating drinking water along with water quality analysis

Learning outcomes Up on successful completion of the course the students will be able to;

- Describe water sources, compute water demand,
- Determine population forecasting methods,
- Describe how to collect & distribute water with its analysis,

- Describe different materials used to provide water for buildings & etc.
- Have an insight into the structure of drinking water supply systems, including water transport, and distribution
- Acquire an understanding of water quality criteria and standards, and their relation to public health,
- Attain the ability to design and evaluate water supply project alternatives on basis of chosen selection criteria
- Understand coagulation, flocculation, sedimentation, filtration and disinfection processes

Course Description/Contents;

1. **Sources of water:** Public water supply system; Planning, Objectives, Design period, Population forecasting, Water demand; Sources of water and their characteristics, Surface and Groundwater, Impounding Reservoir, Development and selection of source, Source Water quality, Characterization, Significance, Drinking Water quality standards.
2. **Conveyance from the source:** Water supply; intake structures, Functions; Pipes and conduits for water, Pipe materials, Hydraulics of flow in pipes, Transmission main design, Laying, jointing and testing of pipes, appurtenances, Types and capacity of pumps, Selection of pumps and pipe materials.
3. **Water distribution and supply:** Requirements of water distribution Components, Selection of pipe material, Service reservoirs Functions, Network design Economics, Analysis of distribution networks, Computer applications, Appurtenances for Leak detection
4. **Principles of design of water supply in buildings:** House service connection, Fixtures and fittings, systems of plumbing and types of plumbing.
5. **Principles of sedimentation:** Types of settling and settling equations, design criteria and design of settling tanks.
6. **Principles of Coagulation and Flocculation**: Types of coagulants, coagulant aids, coagulation theory, and optimum dose of coagulant, design criteria and numerical examples

Laboratory Practice: students must perform optimum coagulant dosage, optimum chlorine dosage and any other important experiments selected by instructor

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, laboratory practice = 20% and Final examination = 40%

References

- Garg. S.K., (2001), “Water Supply Engineering”, Khanna Publishers, Delhi, September
- Punmia B.C, Arun K. Jain, Ashok K. Jain, (1998), “Water supply Engineering” Lakshmi publication private limited, New Delhi,
- Birdie.G.S., (1991), “Water Supply and Sanitary Engineering”, Dhanpat Rai and sons,
- Fair. G.M., Geyer.J.C.(1954), “Water Supply and Wastewater Disposal”, John Wiley and Sons,

- Babbit.H.E. E, and Donald. J, (1984), “Water Supply Engineering”, McGraw Hill book Co,
- Steel. E.W.et al., (1984) “Water Supply Engineering”, Mc Graw Hill International book Co,
- Duggal. K.N. (1998), “Elements of public Health Engineering”, S. Chand and Company Ltd, New Delhi,
- Mark J. Hammer & Mark J. Hammer Jr., (2008), “Water and Waste Water Technology”, Prentice Hall of India Pvt. Ltd., New Delhi,

19.2 Course Title: Wastewater & Solid Waste Management (WSEE-4152)

Pre-requisite: Water Supply & Treatment

Objective: The objectives of this course are to help students develop the ability to apply a basic understanding of physical, chemical, and biological phenomena for a successful design, operation and maintenance of sewage treatment plants.

Learning outcomes: Upon successful completion of this course, students will be able to understand;

- The concept of a unit operation and a unit process.
- The fundamental scientific processes underlying the design and operation of wastewater treatment plant.
- The management of residuals from water and wastewater treatment.
- The methods that are used for the design of a water and wastewater treatment plant.

Course Description/ Contents;

1. **Introduction:-** Scope of sanitary engineering, systems of sanitation, Conservancy and water carriage system, Sewage systems, Quantity of sanitary and storm sewage, determination,
2. **Designs of sewers:** sewer joints Sewer appurtenances, Manholes Types, flushing tanks, Construction and Maintenance of Sewage,
3. **Characteristics and Examination of sewage:** physical chemical, biological- Biochemical Oxygen demand, chemical oxygen demand, sewage disposal methods and choice, oxygen balance.
4. **Sewage treatment process:** types, screaming and skimming, Sedimentation, Chemical precipitation, Biological treatment, activated sludge processes oxidation pond, septic tank, pit privy cesspool,
5. **Solid waste management:** Hydraulics of sludge filtration. Solid waste sources, composition, characteristics, Solid waste quantity, collection systems, Transportation, Solid waste processing and resource recovery.

Laboratory practice: The students carry out tests on Biological oxygen demand (BOD), Chemical oxygen demand (COD)

20. MODULE 16: IRRIGATION ENGINEERING

Provide students with the basic principles of irrigation design, selection of irrigation systems, determination of the quality and quality of water for irrigation and finally assessment of the feasibility of irrigation schemes. Further, the module has the objective of introducing the students Methods of estimating crop water requirement, Methods of application of irrigation water such as sprinkler and drip irrigation systems. The module has only one course; Irrigation engineering with 2, 2 and 1 of lectures, tutorial and practical time respectively.

Course Title: Irrigation Engineering (WRIE-3161)

Pre-requisite: Introduction to hydrology

Objectives: Students will gain from the module expertise of the design, construction operation and management of the various types of irrigation systems, Drainage systems and irrigation structures. The module discusses different methods of irrigation, drainage system components and irrigation structures; the concepts of open channel flow and water conveyance are dealt in detail. It is also important to identify different methods of surface and pressurized irrigation method and drainage; design layout at the field and apply skills required in operation and maintenances.

Learning outcomes Students will be able

- To choose the appropriate irrigation scheme
- Determine crop-water requirement
- Design various types of irrigation schemes
- Estimate field and scheme water supply as net irrigation requirement for surface irrigation
- Identify different methods of surface irrigating method and their design, layout, evaluation and operation at the field
- Acquire underlying principles, theories and practices pertaining to sprinkler and drip Irrigation system.

Course Description/Contents:

1. **Introduction:** Definition, Necessity, Scope of irrigation scheme, Benefits, ill- effects, & types of irrigation, History of irrigation development of Ethiopia.
2. **Soil-plant-water system:** Introduction; General description of soil water; Soil moisture characteristics; Soil water retention; Basic concepts of soil water dynamics; Methods of determining soil water contents; Water infiltration.
3. **Irrigation water requirement:** Introduction; Consumptive use and its estimation; Dependable and effective rainfall; Net and gross irrigation requirement; Field and scheme water supply; Irrigation scheduling.

4. **Surface irrigation methods:** Introduction; Classification and System selection; Basic concepts of surface irrigation (hydraulic phases of surface irrigation); Surface irrigation models and Irrigation efficiencies; Surface irrigation system design and field layout.
5. **Drip (trickle) irrigation system;** Definition and development of drip irrigation; Components of Trickle System; Crop Water Requirement for Trickle System; Water distribution in the soil related to trickle system; Design of Trickle Irrigation System; Emitter Hydraulics, Pipe line Hydraulics; Capacity of Trickle System; Performance measurement of Trickle system; Filtration and chemical treatment for Trickle system; Automation in trickle system; Economics of trickle irrigation system.

Field work: Students will go to demo farm and identify different irrigation systems and layouts. In addition, they will use CROPWAT 8.0 and analyse irrigation water requirements.

Mode of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, Field practice = 10 % and Final examination = 40%

References

1. Merkley, G.P.and Allen, R.G. (2004). Sprinkle & Trickle Irrigation Lectures. Biological and Irrigation Engineering Department, Utah State University, Logan, Utah, USA.
1. Arora, (2002). Irrigation, Water Power and Water Resources Engineering, A.K.Jain, New Delhi.
2. Hansen, V.E. Israelson and Stringham, (1979), Irrigation Principles and methods, 4th Edition, John Wiley & Sons, New York.
3. Michael A.M. (1978) Irrigation, Theory and Practice, Vikas Publishing house ltd, New Delhi.
4. Richard H.Cuenca (1989). Irrigation System Design: An Engineering Approach. Prentice Hall, Enlewood Cliff, New Jersey 07632
5. Sahasrabudhe, S.R., (1994). Irrigation Engineering and Hydraulic structures, 6th Edition, Nai Sarak, Delhi.

21. MODULE 17: WATER RESOURCES MANAGEMENT

This module introduces students to basic elements and design of river engineering works. They will understand physical processes and natural phenomena in river basin systems, the effect of human interference in river basins, such as river structures and training works. They will apply science, mathematics, and modern engineering tools to identify, prevent, analyze and solve environmental and water resources problems. This module is sub-divided in to five courses and described in Table 21-1.

Table 21-1 Water Resources Management module

Code	Course Name	Status	CrH	L	T	LP	HS	ECTS
HWRE-5171	Water Resources Planning and Management	Compulsory	3	2	2	1	3	5
HWRE-5172	River Engineering and Sediment Transport	Compulsory	3	2	2	1	3	5
WSEE-5173	Environmental Impact Assessment	Compulsory	2	2	1	0	2	3
HWRE-5174	Watershed Management	Compulsory	3	2	2	1	3	5
HWRE-5175	Water Law and Hydro Politics	Compulsory	2	2	2	0	2	4
	Total		13	10	9	3	13	22

21.1 Course Title: Water Resources Planning & Management (HWRE-5171)

***Pre-requisite*:** Engineering Economics

Course objectives: The subject water resources planning is too broad and has too many methodological options to be covered completely in a semester and therefore the course is well designed with various topics to give thorough knowledge on the engineering and economic planning aspects of water resources studies, that should be understood by all students.

Learning outcomes: Students will be able

- Know the water budget and surfaces water resources of Ethiopia and existing and water resources potential and percent coverage in various sectors like water supply& sanitation, Irrigation and Hydropower etc.
- Know the various demands, variations in demand and their assessment for water supply projects, fixation of the Reservoir capacity under various demand conditions - mass curve and sequent peak algorithm techniques, etc. Understand the definition of system, factors governing a system, system analysis, typical problems associated with system and detailed study of techniques (optimization) used to solve the typical hydrological /water resources system problems.
- Understands the basic principles of model, modeling and various types of models. How a reservoir may be modeled using deterministic inputs – model formulation for two important aspects of reservoir modeling namely reservoir sizing and reservoir operation
- Selection of various alternative designs and economic analysis of various alternatives. Calculation of capital and maintenance costs of each alternatives and selection of best alternatives and feasibility studies of various projects

Course Description/Course Syllabus/Contents:

1. **Systems planning and management:** Concepts of systems and systems analysis; Systems components planning and management; need for planning and management; planning and management approaches; planning and management aspects; challenges in water sector; allocation of available water resources; water resources project formulation evaluation; feasibility study and final design; some common pitfalls in water resources planning.
2. **Optimization and simulation:** Modeling techniques; optimization; classification of optimization techniques; simulation; steps in simulation; classification of simulation models; comparison between optimization and simulation.
3. **Optimization with methods using calculus:** functions of single and multiple variables; optimization of functions of single and multiple variables; constrained and unconstrained optimization; Kuhn Tucker conditions.
4. **Linear and nonlinear programming:** Nonlinear programing; linear programming; Optimization using graphical method; Optimization using Simplex Method-I and II; Linear programming and applications; Reservoir operation and sizing.
5. **Dynamic programming:** Introduction and preliminaries; water allocation problems; reservoir operation problems; capacity expansion and shortest route problems.

Laboratory practice: Recent modeling tools: ANN; Fuzzy inference systems; Genetic algorithms

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%**,** Laboratory practice = 10% and Final examination = 40%

References

1. Loucks, D.P. and Eelco van Beek (2005). Water resources systems planning and management: An introduction to methods, models and applications, UNESCO.
2. Vedula, S. and Mujumdar, P.P. (2005). Water resources systems: Modeling techniques and analysis., Tata McGraw Hill, New Delhi.
3. Mays, L.W. and Tung, Y.K. (1992). Hydro systems engineering and management., McGraw Hill, USA.
4. Simonovic, S.P. (2009). Managing water resources: Methods and tools for a systems approach, UNESCO publishing, France.
5. Jain, S.K. and Singh V. P. (2003) Water Resources Systems Planning and Management, Elsevier. Chaturvedi M C (1987) Water Resources Systems Planning and Management, Tata McGraw Hill, New Delhi.
6. Bhave, P. R., (2011) Water Resources Systems, Narosa Publishing House, New Delhi.
7. Hiller, F.S. and Lieberman, G.J. (2005) Introduction to Operations Research, The McGraw Hill Companies, Inc., New York.

21.2 Course Title: River Engineering and Sediment Transport (HWRE-5172)

Pre-Requisite: Open Channel Hydraulics; Engineering Hydrology

Course Objectives: This course examines the processes of sediment entrainment, transport, and deposition and the interaction of flow and transport in shaping river channels. The course introduces the students about boundary layer flow; physical properties of sediment; incipient, bed-load, and suspended-load motion; bed forms; hydraulic roughness; velocity and stress fields in open channels; scour and deposition of bed material, and migration of river channels. In addition, the course develops techniques of laboratory, theoretical, and numerical modeling and applies them to problems of channel design, restoration, and maintenance.

Learning outcomes: Up on the completion of this course, the students will able to:

- Understand Fluid and Sediment transport in open channels.
- Undertake the detail design of stable channel and River development and training works.

Course Description/Course Syllabus/Contents:

1. **Introduction:** River characteristics; River hydraulics and River morphology and regime.
2. **Sediment transport**: Origin and properties of sediment; Limitations of particle motion and Transportation mechanisms, bed load, suspended load and total load calculation, bed forms, Numerical Modeling of Sediment Transport in Rivers using tools.
3. **Fluid and Sediment properties**: fluid properties: fluid density, viscosity; sediment properties density and porosity, shapes, size, particle fall velocity, Angle of (natural) repose
4. **Initiation of motion**: initiation of motion in currents: critical bed shear stress, critical depth averaged velocity, design of stable channel; Initiation of motion in waves: critical velocity, critical bed shear stress; initiation of motion in combined currents and waves: critical bed shear stress; initiation of suspension in currents: Critical beds shear stress, critical depth averaged velocity.
5. **Bed forms**: Bed forms in unidirectional currents: Classification, shape and dimensions of bed forms; bed forms in non-steady currents: Non steady river flow, tidal flow; Bed forms in waves: Classification, dimensions of bed forms; Bed forms in currents and waves: Classification, shape and dimensions of bed forms.
6. **Sediment load sampler:** Introduction, Bed load sampler, trap sampling, suspended load sampler: classification of samplers, instruments for concentration, point-integrating measurements (bottle and trap samplers, pump-samplers, optical and acoustical sampling methods)

Laboratory practice: *Students will go to Hydraulics laboratory and observe artificially made river morphology, initiation of motion**,** bed forms and others*

Modes of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 50%**,** Laboratory practice = 10% and Final examination = 40%

References:

1. Van Rijn, L. C. (1993). Principles of sediment transport in rivers, estuaries and coastal seas (Vol. 1006, pp. 11-3). Amsterdam: Aqua publications.
2. Calow, P. P., & Petts, G. E. (Eds.). (2009). The rivers handbook: hydrological and ecological principles. John Wiley & Sons.

21.3 Course Title: Environmental Impact Assessment (WSEE-5173)

Pre-Requisite: None

Objective: The course provides a detailed insight into the Ethiopian environmental legislation aspects including National Environmental Policy, legal framework, various Acts related to environmental pollution, Prevention and control. The course also deliberates on carrying capacity concepts, objectives, scope and types of impact assessment. Explains the process of impact assessment; and deals with various methodologies. Distinguishes between EMP and DMP. It reviews few case studies on EIA.

Learning outcomes Students will be able

- To know the basic concepts of environment,
- The need for environmental assessment,
- EIA process, identifies major impacts of water related projects, and review eia report.
- To know mitigation measure for environment

Course Syllabus/Contents/descriptions:

1. **Environmental Legislation:** Introduction & need, National Environmental Policy, Environmental Legal Framework, Legislative act, rules, regulations notification and amendments
2. **Sustainable development and Environmental regulations**
3. **Environmental Impact Assessment:** Carrying capacity concept and Environmental Impact Assessment – Objectives, Types - Rapid and Comprehensive EIA, EIS. Step-by-step procedure for conducting EIA and Limitations of EIA, Prevention of Significant Deterioration Programme. Frame work of Impact assessment, scope and contents of EIA, methodologies and techniques of EIA, Public participation in EIA. Attributes, Standards and Value functions. Impact prediction models for various attributes.
4. **Environmental monitoring and Auditing:** Environmental Management Plan (EMP) and Disaster Management Plan (DMP).
5. **EIA Case Studies** – Dam and reservoir, Hydro Power Plants, Mining, Construction Projects, Airports and Environmental Projects – Water and Wastewater Treatment Plants.

Modes of assessment: Continues Assessment (Assignment, quiz, case study and test) = 50%, Final exam = 50%

References

1. Canter L., (1995), “Environmental Impact Assessment”, McGraw Hill.
2. Jain R.K., Urban L.V., Stacey G.S., (1977), “Environmental Impact Analysis – A New Dimension in Decision Making", Van Nostrand Reinhold Co. 12
3. Clark B.C. Bisett and Tomlinsan P, (1985), “Perspective on Environmental Impact Assessment”, Allied Publishers.
4. Morgan, R (1999). Environmental impact Assessment. Amethodological perspective. Great Britain
5. Therrivel, R and Morris, P (2001). Methods of Environmental Impact Assessment. 2nd ed. Spon press. Great Britain
6. Petts, J (1999). Handbook of Environmental Impact Assessment, Vol 2. Blackwell publisher. London

21.4 Course Title: Watershed Management (HWRE-5174)

Pre-Requisite: None

Objective: This course will introduce students to the foundations of watershed hydrology and management. It also provides the tools to students for effective catchment management and decentralized management of water resources. Moreover, it enables students with watershed management plans and management skills, understand process & organization design of water user groups; comprehend water user conflicts, principles and options.

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

- Have concepts on watershed management system
- Have knowledge on how to delineate watershed boundary

1. **Introduction and basic concepts:** Definitions; watershed management and stakeholder’s analysis; watershed management policies.
2. **Sustainable watershed approach and watershed management practices:** Sustainable watershed management; agricultural practices and watershed management; soil erosion and conservation
3. **Integrated watershed management:** Integrated water resources management; conjunctive use of water resources; rain water harvesting system; rain water harvesting and roof catchment system
4. **Social aspects of watershed management:** Social and community aspects of watershed management; socio-economy, private sector participation and gender issue; integrated development, water legislation and implementation issue.
5. **Use of modern techniques in watershed management:** GIS and remote sensing applications in watershed management; Application of knowledge based models in watershed management
6. **Water conservation and recycling:** Water conservation; water recycling; Water reclamation and re-use.

Modes of assessment: Continues Assessment (Assignment, quiz, case study and test) = 50%, Final exam = 50%

References

1. Hydrology and the management of watersheds" kenneth n. Brooks, et. Al., third edition, iowa state university press.
2. Integrated watershed management: principles and practice (by isobel w. Heathcote)
3. Watersheds: processes, assessment and management by paul a. Debarry
4. Linsley, Franzini, Freyberg, Tchobanoglous. Water resources engineering. Fourth edition. MCGRAW-HILL international editions. Civil Engineering series.

21.5 Course Title: Water Law and Hydro politics (HWRE-5175)

Pre-requisite: Water Resources Planning & Management

Course Objectives: This course will focus on the theories and historical/empirical evidence on the linkages between water resources and conflict or cooperation. Our primary interest will be directed to transboundary water issues, broadly defined. Conceptual issues related to water scarcity, and theories of natural resource conflict, hydro politics, hydro hegemony and water security will be discussed. The role of multiple and diverse stakeholders, and the spatial scale of disputes or agreements over water will also be considered. International water resource problems will also be linked to a broader literature on the management of public goods and economic externalities as they relate to the environment and health.

Students will read about contemporary research on the patterns of water and resource conflict and cooperation, learn about the norms and laws for mediating water conflict at different jurisdictional levels, and relate these to current events related to water.

Learning outcomes At the end of the course, a student is able to:

- Interpret the theories and concepts underlying multiple levels of water governance and contemporary global water debates.
- Use these to analyses processes of socio-technical change in hydro-social cycles and legal regulation of water resources as well as the definitions of water rights.
- Apply concepts of socio-technical change, legal regulation and water rights in urban water supply, sanitation, irrigation systems, ground water subtraction or river basin management in both Northern (upstream) and Southern (downstream) contexts.

Course Description/Course Syllabus/Contents:

1. **Water Law:** Introduction to water law; water and scarcity: definitions and dimensions of depletion
2. **Introduction to water governance:** Evolution of international water law; paradigm shifts in water governance; international water law today; multinational corporations and global water governance; water governance and water rights

3. **International water law:** Introductions to water law; sources of water law; environmental and resources use principles; international legal frameworks for dealing with water and institutional perspectives; national legal frame work of water resources; ownership of water in different legal systems (existing water laws)
4. **National and international water policy:** National water policy; international water policy; boundary demarcation; navigational uses of rivers; non-navigational use of water
5. **Water and security:** Hydro politics and securitization; the effects of water variability and disasters
6. **Conflict and cooperation in transboundary river basin:** Types of dispute; modes of dispute resolution; understanding socio-technical systems and agency
7. **Negotiations for a Nile-cooperative framework agreement:** Geopolitical setup; negotiations on Nile River

Mode of Assessment: Final exam will represent 40% of a student's total grade. Midterm or/and paper report are worth the final 25%. The scores on homework assignments and review report constitute 15% and 20%, respectively. For writing based assignments, emphasis is placed on assisting the students to develop clear, organized, on-topic writing (as opposed to focusing on grammar and other style issues).

References:

- Caponera, D.A., Principles of Water Low and Administration; National and International, Balkema, Rotterdam etc., 19
- Giddens, A. 1990. The consequences of modernity. Cambridge: Polity Press.
- Gleick, P. H. 2000. The World's Water, 2000-2001: Biennial Report on Freshwater Resources. Washington DC: Island Press.
- LeMarquand, DSi, Inremational Rivers; The Policies of Cooperation, Wastewater Research Centre, Vancouver, 1977.
- Wolf, A.T., International Water Dispute Resolution: The Middle East Multilateral Working Group on Water Resources, Wafer fnremational, Vol. 20. No 3, 1995, pp. 141-150.
- Yacob Arsano Institutional Development and Water Management in Ethiopia in Terje Tvedt (ed. 2010) The River Nile in the Post-Colonial Age: Conflict and Cooperation Among the Nile Basin Countries, I.B. Tauris, London & New York. ISBN: 9781845119706.

22. MODULE 18: ROAD AND BRIDGE HYDRAULICS

As we know Hydraulic and water resources engineer may engage with the construction of hydropower project, the site of the project most of the time they are far from human residents therefore there should be the construction of new access road in to the site. To accomplish this task, the knowledge of road and bridge hydraulics is important. The objective of the module is to equip students with the concepts and Applications of geometric design for rural and urban highways. The module will also make students

acquainted with the principles of Bridge and culvert design and analysis also help them acquire basic knowledge and practical prospective of highway materials, and construction practice.

Table 22-1 Road and bridge hydraulics

Code	Course Name	Status	Cr. H	L	T	L/P	HS	ECTS
CEng-5181	Road Engineering	Compulsory	2	2	2	0	2	4
HWRE - 5182	Bridge & Culvert hydraulics	Compulsory	3	2	1	1	2	4
	Total		5	4	3	1	4	8

22.1 Course Title: Road Engineering [CEng-5181]

Pre-requisite: Surveying II and Soil mechanics I

Objectives: As Hydraulic and water resources engineers should construct the access road to the site of the water resources structure this course is introduced The objective of the course is to exposes students to the fields of highway engineering. Students will demonstrate ability to develop and apply concepts of geometric design for rural and urban roads and highways.

Course Syllabus/Contents:

1. **Highway route selection:** factors to be considered in highway route selection, steps in highway route surveys. Functional classification systems of highways.
2. **Geometric design of highways:** Design controls and criteria; Highway cross-section elements – lane and shoulders, sidewalks, medians, and pedestrian crossings; Elements of geometric design – sight distance,
3. **Alignments:** horizontal alignment: design of circular and transition curves; vertical alignment: grade selection and design of vertical curves; combinations of horizontal and vertical alignment; Intersections and Interchanges.
4. Drainage and drainage structures: surface and subsurface drainage facilities.
5. Earthwork:

Modes of assessment: Continuous Assessment (Assignment, quiz, case study and test) = 50%, Final exam = 50%

References:

1. Wright, P. H. and Karen, D. (2003), Highway Engineering, 7th edition, Wiley.
2. Rogers, M. (2003), Highway Engineering, Blackwell Science Ltd. Mannering, F. L., Kilareski, W. P., & Washburn, S. S. (2004), Principles of Highway Engineering and Traffic Analysis, 3rd edition, Wiley.

22.2 Bridge & Culvert Hydraulics [HWRE - 5182]

Pre-requisite: Road engineering

Objectives: To engage students in selecting appropriate site for bridges and culverts. Plan, design and constructional view of bridges and culverts will be dealt under this course. Moreover, it helps students to model bridges and culverts on natural rivers using HEC-RAS and other.

Learning outcomes The student shall:

1. learn to select the appropriate site for bridges and culverts
2. plan design and constructional view of bridges and culverts
3. be able to model bridges and culverts on natural rivers using HECRAS

1. **Introduction:** Why you study culvert and bridge hydraulics? Hydraulic causes of culvert and bridge failure; site selection and span determination for bridges types of bridges: Reinforced concrete (slab, girder, frame), arch, cable stayed and suspension. Selection of bridge type. Geometry of bridges (length, cross-section).
2. **Culvert Hydraulics:** Introduction; Classification of flow types at culvert; Culvert flow controls (inlet and outlet control); Principles and criteria of culvert design; Hydraulic design of culverts
3. **Bridge Hydraulics:** Introduction; The effect of bridge on river flow; Hydraulic performance of bridge; Types of flow in bridge waterway; Hydraulic design of bridges
4. **Design of Reinforced Concrete and Steel girder bridges**:
5. **Bearings and railings.**
6. **Culverts and low level water crossings.**

Modes of assessment: Continuous assessment (Assignment, quiz, case study and test) = 50%, Final exam = 50%

References:

23. MODULE 19: COMPUTER APPLICATIONS IN HYDRAULIC ENGINEERING

Computer Application in Hydraulic Engineering plays an important role in linking hydraulic theory with real-world applications and computer modeling by focusing on problem solving skills that will help the student to become a better engineer. This module introduces appropriate models and software for hydraulic Engineering analysis and design. In addition to this, students will have Basic understanding of a spatial phenomenon and they will have basic knowledge how to use GIS and RS for assessing, monitoring and predictions of factors in water resources.

The objective of the module is to give the student a comprehensive theoretical and practical knowledge on software and models related with hydraulic engineering. Upon successful completion students will be able to use effectively the recent GIS and RS tools to solve real world problems related to water resources management. The course catalogue in this module is given in Table-1.

Table 23-1 Computer Application in Hydraulic Engineering Module

Code	Course Name	Status	Cr. H	L	T	L/P	HS	ECTS
HWRE-4191	Software Applications in HE	Compulsory	3	2	0	3	3	5
HWRE-5192	GIS and Remote Sensing	Compulsory	3	2	0	3	3	5
HWRE-5193	Hydrological models	Compulsory	2	1	0	2	2	4
		Sum	8	5	0	8	8	14

23.1 Course Title: Software Applications in Hydraulic Engineering (HWRE-4191)

Pre-requisites: Computer Programming, Hydraulic Structures I

Course Objectives: This course is designed to introduce appropriate software and models related to hydraulic engineering and water resources management, system design and process analysis.

Outcome: After completion of this course students will be able to

- Select the appropriate model for hydraulic Engineering analysis and design.
- Know the general procedure of solving physical problems using computers programs and software.
- Solve hydraulic problems such as, pipe flow for water supply, channel design, drainage; storm ditches; sanitary sewerage, culverts & reservoirs using software.
- Apply spreadsheet application in appropriate engineering problems
- Use Global mapper and Eagle point for generating contour and canal aligning respectively.

Course Description/Course Syllabus/Contents

1. Spreadsheet application for solving engineering problems: Flow duration and power duration curve; Reservoir routing; Rating curve; River cross section through channel; GVF profile, Fill missing data by regression, arranging data by VLookup; Optimization by using solver
2. CAD Softwares**:** StormCAD for design and analyzes storm systems; WaterCAD/ for Design and analyzes water distribution systems; SewerCAD/ SewerGEMS to design and analyze sewer system; Introduction to AutoCAD
3. Global mapper, Surfer, Eagle Point, Google earth

Modes of assessment: Continues Assessment (Assignment, quiz, case study and test) = 30%, Practical work = 70%

References

- T. Walski, T. Barnard, R. Durrans, M. Meadows, S Lowry, B. Whitman (2013). Computer Applications in Hydraulic Engineering. 8th Edition, Bentley Institute Press.
- Lecture Notes, Software's manual if any or Any reference material related to the topics

23.2 Course Title: GIS and Remote Sensing (HWRE-5192)

Pre-requisites: Computer Application in Hydraulic Engineering and Surveying II

Course Objectives & Competences to be acquired

Objective: After completion of this course students will be able to

- Develop the basic understanding of spatial phenomena and fundamentals of GIS,
- Gain theoretical knowledge and practical skill on how to capture, store, import, analyze and present geographical data
- Understand the possibilities and constrains related to GIS & RS
- Use effectively GIS and RS tools to solve real world problems related to water resources management through quantitative and qualitative approaches.

Course Description/Course Syllabus/Contents:

Defining GIS and RS: Components of GIS, Application of RS and GIS in Water Resources Management, Cartography, Understanding Map Projection and Map Digitalization, Effects of Projection on Shape, Area…

Data Structures and Database: Vector Data Structures, Raster Data Structures, Defining a Database, Types of Database, How a Database Works, Data Capturing, Data Capturing Methods, Comparison of Data Capturing Methods

Application of GIS in Water Resources Modeling: Vector Analysis, Raster Analysis, Interpolation, Digital Elevation Model Generation, Area/Volume Estimation, Watershed Delineation, Surface Analysis in GIS like Contour, Slope, view shed, hill shed…….

Remote Sensing: Introduction to Remote Sensing, Types of Remote Sensing Electromagnetic energy principles; Energy interaction in the atmosphere and the earth surface features, Application of Remote Sensing, Introduction to Image Analysis, Global positioning system (GPS)

Tasks to be done in the Laboratory/Field:

a) Basic concept and operation of ArcCatalog
b) The basics of map creation: Basic concept and operation of ArcMap; Query and Select
c) Data edition: Attribute data editing, Vector data editing; Raster data editing
d) Thematic map creation
e) Topography map creation from DEM; length, area and volume calculation
f) Contour map generation: Interpolation
g) Hydrology Analysis: River route delineation; River basin delineation, Watershed delineation
h) Introduction to Google Earth; Digital image processing
i) Collecting ground control points using GPS

Modes of assessment: Continuous Assessment (Assignment, quiz, case study and test) = 30%, Practical work = 70%

References

1. Burrough, P. A. & McDonnel, R. A. (2015): Principles of Geographical Information Systems. 3rd Edition, Oxford University Press
2. Maribeth H. Price (2016): Mastering ArcGIS, 7th edition, McGraw-Hill Education.
3. Lyenn E. Johnson (2009): Geographical Information Systems in Water Resources Engineering, CRC press
4. Laurini, R. and Thompson, D. (1996): Fundamentals of spatial information systems. Academic Press Limited.
5. MacEachren, A. M. and Taylor, D. R. F. (Ed.) (1994): Visualization in modern Cartography. Elsevier Science Inc.
6. Mather, P. M. (1999): Computer processing of remotely sensed images – An introduction. 2nd edition. JohnWiley.
7. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind (2006) Geographic Information Science and Systems, 4th Edition, John Wiley & Sons, Inc.
8. Ullman, J. and Widom, J. (1998): A first course in database systems. Prentice-Hall.
9. I. Mesey (2007): Integration of GIS and Remote Sensing. Florida State University: John Wiley & Sons, Inc.

23.1 Course Title: Hydrological models (HWRE-5193)

Pre-requisites: GIS and Remote Sensing

Course Objectives: This course is designed to introduce appropriate software and models related to hydrology and water resources management, system design and process analysis.

Outcome: After completion of this course students will be able to

- Select the appropriate model for hydrological analysis and system design.
- Know the general procedure of solving physical problems using hydrological models.
- Effectively model rainfall and runoff from urban and rural watersheds to design detention and retention facilities, outlet structures, and channels as well as hydraulic characteristic of rivers for various hydrological phenomenon using modeling tools.

Course Description/Course Syllabus/Contents

1. Introduction to hydrological models: General, types of surface water and ground water modeling tools, merits and demerits of modeling tools, Modeling software selection criteria, Applications of modeling tools.
2. Modeling stream flow of a catchment using HEC-HMS and SWAT: HEC-HMS Watershed delineation using HEC-GEOHMS, Modeling stream flow using HEC-HMS, SWAT Modeling stream flow using SWAT, modeling watershed using SWAT
3. Hydraulic modeling using HEC RAS: Introduction to HEC-GeoRAS Hydraulic modeling of One-dimensional steady flow, one and two-dimensional unsteady flow calculations

Modes of assessment: Continues Assessment (Assignment, quiz, case study and test) = 30%, Practical work = 70%

References

- Vernon R. Bonner (1996). Bridge Hydraulic Analysis with HEC-RAS: Technical paper. US Army Corps of Engineers.
- T. Walski, T. Barnard, R. Durrans, M. Meadows, S Lowry, B. Whitman (2013). Computer Applications in Hydraulic Engineering. 8th Edition, Bentley Institute Press.
- SWAT manuals
- HEC RAS manuals
- Lecture Notes, Software's manual if any or Any reference material related to the topics

24. MODULE 20: INTERNSHIP AND FIELD PRACTICE

The primary objective of this module is to make students all the courses taken during the previous six semesters. The students shall proof their ability to address and solve more complex and practice-relevant problems by combining the application of a number of skills and abilities they have gained while attending classes during the six semesters. Moreover, it is intended to deepen the practical understanding of students by providing extended exposure to "real" working conditions of different construction site and design offices. For the purpose of evaluation, this module is divided in to five courses as described in table 24-1.

Table 24-1 Internship and field practice

Code	*Course Name*	*Status*	*Cr. H*	*L*	*T*	*L/P*	*HS*	*ECTS*
HWRE-4211	Holistic Examination	Compulsory	1	0	0	2	4	2
HWRE-4212	Internship Mentors Evaluation	Compulsory	4	0	0	7	3	7
HWRE-4213	Internship Report Evaluation	Compulsory	4	0	0	7	3	7
HWRE-4214	Internship Presentation and Defense	Compulsory	6	0	0	9	3	9
HWRE-5215	Educational Field Practice	Compulsory	P/F	0	0	3	4	P/F
	Sum		15	0	0	28	17	25

24.1 Course Title: Holistic Examination (HWRE-4211)

Pre-requisite: *All major courses*

Objective: To evaluate the capacity of the students on how they understand scientific theories and basic principles studied during the previous semesters and ready to convert in to practical knowledge before they depart for internship.

Learning outcomes After the holistic exam, students can evaluate themselves before they go to internship and how shall be ready to tackle any difficulty during the practical work.

Course Description/Course Syllabus/Contents

- Module with examples and exercises for major courses shall be prepared so that students can read, understand and practice during semester break.

Mode of Assessment and guideline for instructors

- Aptitude type of exam based on major courses of the department shall be taken (100%). The exam may include subjective type, work out problems and laboratory or practical problems.
- The FHWRE establishes Holistic Examination preparation, processing and evaluation committee. For this particular task, the committee members will earn 2 EqLHs credit exemption per semester.

References

1. All important books and lecture notes of previous semester courses including modules and others

24.2 Course Title: Internship Mentors Evaluation (HWRE-4212)

Pre-requisite: Holistic Examination

Objective: To assess students' overall performance throughout the internship process by the company or organization and university assigned mentor to understand how much practical knowledge they gained.

Learning outcomes

- It helps students gain knowledge about the industry and develop a career path by learning from industry mentors
- The experience from the program will help transition from student's academic life to the workforce
- The programme will also a valuable resource for industry leaders to meet and recruit upcoming graduates that have interest in mentor organization

Course Description/Course Syllabus/Contents

- Companies assign students to perform different practical tasks related to their background including**;** document revision, redesigning existing projects, participating in construction, research and others.

Mode of Assesment and guideline for instructors

- The company supervisory team evaluates an internee based on his or her performance and skill gained from the programme in the company out of 60%, and an internee in this process acquires feedback from the company.
- The university assigns a mentor for each student who will visit the respective company twice during the entire internship period and evaluates the performance of each student assigned to him/her out of 40%.
- The assigned mentor should stay a minimum of five (5) working days in the company with the students and evaluate them based on the guidelines prepared by IIL & TT Directorate Office.
- For this particular service, the mentor will get 0.15ELHs credit exemption per each student.

References: Any supportive materials provided by the company, important books and lecture notes of previous semester courses including modules and others.

24.3 Course Title: Internship Report Evaluation (HWRE-4213)

Objective: Students capacity of converting field works to standardized paper will be evaluated by this course. The overall report organization of their practical work; layout, editing and capability to use standardized reporting format of the university.

Learning outcomes:

- They could get enough experience in writing skills which will be supportive for final project
- Advance the way of elaborating the field work by preparing report
- Develop the way of connecting theoretical knowledge with field experience in form of report

Course Description/Course Syllabus/Contents

- Writing different practical tasks in a report form. These may include document revision, redesigning existing projects, participating in report writing of new projects, project auditing, research writing and others.

Mode of Assessment and guideline for instructors

- The internees prepare a monthly report and send to their advisors (2 advisors) via email, telegram or others for comment and acquire feedback. Finally, the approved document by their respective advisor will be submitted to the examiner.
- Guidelines prepared by IIL & TT directorate office in collaboration with the FHWRE will be used to evaluate internees report.
- The assigned advisors evaluate the report out of 100% based on their monthly report and final report document to be submitted to the examiners.
- For this particular service, each advisor will get 0.15ELHs credit exemption per each student.

References: Any supportive materials provided by the company, important books and lecture notes of previous semester courses including modules and others.

24.4 Course Title: Internship presentation and Defense (HWRE-4214)

Objectives: Students present the actual practical work during the field stay and evaluated based on how well they understood the theoretical and practical knowledge.

Learning outcomes

- Students obtain knowledge on how to present their report to the audience.
- To get experience on how they correct, edit and compile paper after presentation.

Course Description/Course Syllabus/Contents

- Students present their practical tasks to the audience and understand materials to be presented.

Mode of Assesment and guidelines for instructors:

- The students prepare slide and present to the assigned examiners (Minimum of 2). Evaluation can be done based on the quality of their slide and ability of the student to express the practical works done. Moreover, the ability of the student will be assessed depending on how much he she is capable of correlating theories with practical world. Quantitative/qualitative type format to evaluate the students' performance will be prepared by IIL and TT and the respective faculties.
- The assigned examiners evaluate the students based on reports presented and capacity of the students defending their work. The maximum mark of evaluation is 100%.
- For this particular service, each examiner will get 0.15ELHs credit exemption per each student.

References: Any supportive materials provided by the company, important books and lecture notes of previous semester courses including modules and others.

24.5 Course Title: Educational Field Practice (HWRE-5215)

Pre-requisite: All major courses

Objectives: This course enables students better understand different water structures via site visit/tour.

Learning outcomes

- Students expose themselves to different water related structures and understand them.
- Students identify the on spot problems of each structures and write a proposal for their final year project.

Course Description/Course Syllabus/Contents

- Students visit different water related structures in our country and make notes on them (Minimum of 15 days)

Mode of Assesment: The students prepare visit report and present to the examiners (Minimum of 2) at the end. Based on the quality of the slide prepared, ability of the student to express the practical works done, and finally, his ability to respond to questions raised by examiners and audience. Quantitative type format for assessment of the course will be prepared by the departments.

References: Any supportive materials provided by the company, important books and lecture notes of previous semester courses including modules and others.

25. MODULE 21: RESEARCH AND REPORTING

An integrated project will assist the students in consolidating their Knowledge acquired in various previous modules. The students will apply their knowledge in solving practical and real-time projects in due time. The main aim of this module will let students to acquire knowledge and skills of planning and management of hydraulic and water resources engineering projects. In addition to this The Integrated Project is a comprehensive design project using a team approach requiring interaction with practitioners, development of a team project report and a formal presentation to practitioners.

Table 25-1 Research and reporting

Code	*Course Name*	*Status*	*Cr. H*	*L*	*T*	*L/P*	*HS*	*ECTS*
HWRE-4211	Research Methods and Technical Report Writing	Compulsory	2	3	0	0	2	3
HWRE-5212	Bachelor Thesis	Compulsory	4	0	0	0	7	7
		Sum	6	3	0	0	9	10

25.1 Research Methods and Technical Report Writing (HWRE-4211)

Pre-requisite: None

Objectives: The objectives of the course are to provide students information on research methods: their use, analyses and applications, how to write and develop professional reports.

Learning outcomes Successful students in this course will be able to understand different steps of research methods and understand how they write professional report.

- Historical development. General features of a report.
- Editing and style in technical Report Writing. Creating Effective documents.
- Technical report as a specialized branch of communication. Types of reports. Visual displays and presentations.
- The nature of research. Research methods. Data Collection. Analysis and interpretation of data.

Course Description/Course Syllabus/Contents

1. Research: Components of proposal and research; General features of a report.
2. Composition of scientific research proposals,
3. Data collection, analysis and evaluation;
4. Styles of thesis and scientific paper writing, including paper organization, style, grammar and appearance in addition to technical content;
5. Seminar preparation and presentation.

Mode of assessment: Continuous assessment (quizzes, tests, mid exam, assignments, projects, etc.) = 40%, Practical work = 20% and Final examination = 40%

Practical task: Students will write some professional reports and they will present for their instructor in the form of seminar.

References

1. Davies J.W. Communication for Engineering Students (Longman 1996).
2. Finkelstein, L. Technical Writing for Engineers and Scientists: McGraw-Hill 2001.
3. Sandra E.Lamb: How to Write it: Complete Guide to Powerful writing for every situation, , May 31, 2006.
4. Emden J.: Effective communication for Science and Technology, (Palgrave 2001) Engineers 2nd ed. (Macmillan 1998).
5. Daniel G. Riordan, Steven E. Pauley: Technical Report Writing Today, Houghton Mifflin Company; 9 editions (July 15, 2004).

25.2 Bachelor Thesis (HWRE-5212)