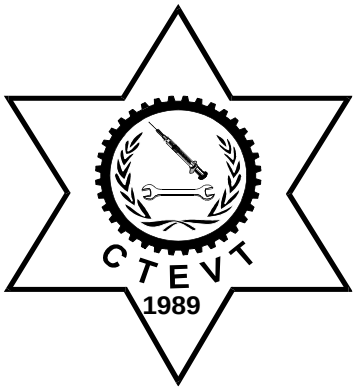
CURRICULUM

Diploma
in
Refrigeration and Air-Conditioning

(Three years program-semester system)



Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

2015

Table of Content

1. Background:

This curriculum for "Diploma in Refrigeration and Air-conditioning Engineering" has been developed by taking care of the course currently phased out by the Institute of Engineering (IOE-TU). This field has been helping the world for the all-round physical infrastructure development and it has been creating wage and self employment opportunities both in public and private sectors. This curriculum is designed with the purpose of producing middle level technical workforce equipped with knowledge and skills related to the field of Refrigeration and Air-conditioning Engineering so as to meet the demand of such workforce in the country to contribute in the national economic development of Nepal. The knowledge and skills incorporated in this curriculum will be helpful to deliver the individual needs as well as national needs in the field of Refrigeration and Air-conditioning Engineering.

2. Introduction:

This curriculum is of three years duration with six semesters based on the semester system. It is designed to produce middle level competent technical workforce equipped with knowledge and skills related to the areas of Refrigeration and Air-conditioning engineering under Mechanical Engineering.

3. Course title:

Diploma in Refrigeration and Air-conditioning Engineering (DRAE).

4. Objectives:

This curriculum has following objectives:

4.1 To produce middle level competent technical workforce/human resource (Technical and Supervisory staffs) in Refrigeration and Air-conditioning Engineering with focus on the following areas;

- Refrigeration equipment and system installation
- Repair and Maintenance of refrigeration components
- Air-conditioning system installation
- Repair and maintenance of Air-conditioning components

4.2. To prepare such technicians who are able to work in the industrial settings of the country.

4.3. To prepare such technical workforce who will demonstrate positive attitude and respect for the profession and socio-cultural values.

4.4. To help meet the demand of such technical workforce for the industries.

5. Duration:

The total duration of this curricular program is three years. Each year consists of two semesters of six months each.

6. Target group:

Individuals who have passed SLC or equivalent with English, Science, and Mathematics or related Technical SLC (TSLC)

7. Group size:

The group size will be maximum of 48 (Forty eight) in each batch.

8. Location of Institutions:

The target location of institutions will be all over Nepal.

9. Entry criteria:

- SLC or equivalent with English, Science, and Mathematics or related Technical SLC
- Should pass entrance examination.
- Physically fit for the program.
- Individuals of lower economic status preferred.

10. Selection:

Applicants fulfilling the entry criteria will be selected for admission on the basis of merit.

11. Medium of instruction:

The medium of instruction will be in English and/or Nepali.

12. Pattern of attendance:

Minimum of 90% attendance in each subject is required to appear in the respective final examination.

13. Teacher and student ratio:

- For theory: As per the nature of the course.
- For practical / demonstration: 1:10.
- For bench work: 1:5.
- 75 % of the teachers must be full timer.

14. Lecturers and Instructors:

- The Lecturers should have a minimum of Bachelor degree in the related area with at least two years experience in the related field.
- The Instructor should have a minimum of Bachelor degree in the related area or have a minimum of Diploma in the related area with five years experiences in related activities.

15. Mode of education:

There will be inductive and deductive mode of education in MMP.

16. Instruction methods:

- Lecture will be the method of instruction supported by tutorials and practical works.
- Practical classes will be used in the form of laboratory works, project works and industrial visits.

17. Teaching learning methodologies:

The methods of teachings for this curricular program will be a combination of several approaches. Such as Illustrated Lecture, Tutorial, Group Discussion, Demonstration, Simulation, Guided practice, Hands-on Practices, Fieldwork and Other Independent learning.

- Theory: Lecture, Discussion, Assignment, Group work.
- Practical: Demonstration, Observation, Guided practice and Self-practice.

18. Examination and marking scheme:

- The subject teacher will internally assess the students' achievement in each subject during the course followed by a final examination at the end of each semester.
- A weightage of 20% for the internal assessment and 80% for the semester final examination will be allocated for theoretical components of a subject.
- The final semester examinations of all theory components will be conducted through written tests.
- Generally the method of continuous assessment will be adopted for practical components.
- In some cases semester final examinations are also conducted for practical components as per the needs.
- Student who fails in the internal assessment will not be allowed to sit in the semester final examination and will also not be allowed to continue the following semester study.

19. Provision of back paper:

There will be the provision of back paper but a student must pass all the subjects of all six semesters within six years from the enrolment.

20. Certification:

- Students who have passed all the components of all the subjects of all semesters will be considered to have successfully completed the course.
- Students who have successfully completed the course will be awarded with Diploma in Refrigeration and Air-conditioning Engineering.

21. Disciplinary and ethical requirements:

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by review by the disciplinary review committee of the Institute.

- Dishonesty in any academic activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in Institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

22. Pass marks:

The students must secure 40%marks in the internal assessment and 40% in the semester final examination of each subject to pass the subject.

23. Curriculum and credits:

In this curriculum each subject has its code; full marks; and credit hours divided into lecture hours, tutorial hours, and practical hours.

24. Grading system:

The overall achievement of each student will be measured by a final aggregate percentage of all final semester examinations and graded as follows: -

Marks division:

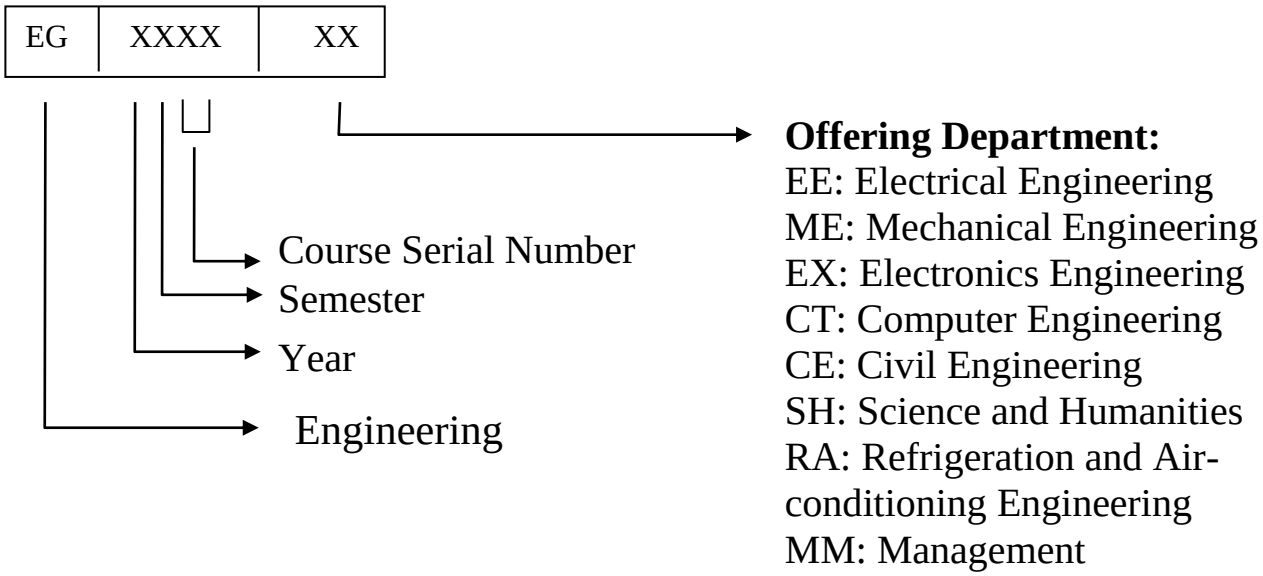
- Distinction : > or =80 %
- First division : 65 % to < 80 %
- Second division : 50 % to < 65 %
- Pass : 40 % to < 50 %

25. Course description:

This course is based on the job required to be performed by a Refrigeration and Air-conditioning technician at different related industries and organizations in Nepal. The Diploma in Refrigeration and Air-conditioning Engineering program extends over three years. Each year is divided into two semesters. There are six semesters in total within the period of three years. This curriculum includes the core subjects like physics, chemistry, and mathematics applicable in the field of Refrigeration and Air-conditioning Engineering. It also includes

language subjects like Nepali and English applicable for the communication in the field of Refrigeration and Air-conditioning technology. It also has provision of focus in the specific areas of Refrigeration and Air-conditioning Engineering. The course structure and the subject wise contents reflect the details of this curriculum.

26. Subjects Codes



27. Elective courses:

There will be elective courses in the following areas: -

- Cold-storage and food preservation
- Renewable energy
- Heating, Ventilation and Air-conditioning

28. Career path:

The graduates will be eligible for the position equivalent to Non-gazetted 1st class (technical) as Refrigeration and Air-conditioning Technician or as prescribed by the Public Service Commission of Nepal.

Course Structure

Detail Breakdown of the composition of subject, marks and credit hours of **REFRIGERATION AND AIR-CONDITIONING (RAC)**

YEAR: I **SEMESTER: I**

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 1101 SH	Communication Nepali	2	-	-	-	2	10	40	1.5	-	-	-	50	
2	EG 1102 SH	Communication English	2	-	-	-	2	10	40	1.5	-	-	-	50	
3	EG 1103 SH	Engineering Mathematics-I	4	1	-	-	5	20	80	3	-	-	-	100	
4	EG 1104 SH	Engineering Physics-I	3	1	-	2	6	20	60	3	10	10	1.5	100	
5	EG 1105 SH	Engineering Chemistry-I	3	1	-	2	6	20	60	3	10	10	1.5	100	
6	EG 1106 ME	Engineering Drawing-I	1	-	4	-	5	0	0	-	60	40	4.0	100	
7	EG 1107 RA	Workshop Technology	3		6		9	20	80	3	80	20	4.0	200	
TOTAL			**18**	**3**	**10**	**4**	**35**	**100**	**360**		**160**	**80**		**700**	

YEAR: I **SEMESTER: II**

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 1201 SH	Engineering Mathematics-II	3	1	0	-	4	20	80	3	0	0	-	100	
2	EG 1202 SH	Engineering Physics-II	3	1	0	2	6	20	60	3	10	10	1.5	100	
3	EG 1203 SH	Engineering Chemistry-II	3	1	0	2	6	20	60	3	10	10	1.5	100	
4	EG 1204 ME	Engineering Drawing-II	0	0	4		4	0	0	-	60	40	4.0	100	
5	EG 1205 RA	Thermodynamics-I	3	1		1.5	5.5	20	60	3	10	10	1.0	100	
6	EG 1206 RA	Refrigeration-I	3	-	6	-	9	20	80	3	60	40	4.0	200	
7	EG 1207 EE	Basic Electrical Engineering	4		3	-	7	20	60	3	10	10	2.0	100	
TOTAL			**19**	**4**	**13**	**5.5**	**41.5**	**120**	**400**		**160**	**120**		**800**	

YEAR: II SEMESTER: III

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 2101 EX	Basic Electronics Engineering	4	-	-	3	7	20	60	3	10	10	1.0	100	
2	EG 2102 EE	Electrical Machines and Control	4	-	-	3	7	20	60	3	10	10	1.0	100	
3	EG 2103 RA	Thermodynamics-II	3	1		1.5	5.5	20	60	3	10	10	1.0	100	
4	EG 2104 EE	Electrical Drawing - I	-	-	4	-	4	0	0	-	60	40	4.0	100	
5	EG 2105 RA	HVAC-I	3	1	3	-	7	20	60	3	10	10	1.0	100	
6	EG 2106 RA	Refrigeration-II	3	1	6	-	10	20	60	3	10	10	1.0	100	
TOTAL			**17**	**3**	**13**	**7.5**	**40.5**	**100**	**300**		**110**	**90**		**600**	

YEAR: II SEMESTER: IV

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 2201 EX	Applied Electronics	4	-	-	3	7	20	60	3	10	10	2.0	100	
2	EG 2202 RA	Fluid Mechanics and Machines	3	1	-	1.5	5.5	20	60	3	10	10	1.0	100	
3	EG 2203 RA	HVAC-II	3	1	3	-	7	20	60	3	10	10	2.0	100	
4	EG 2204 **EE**	Electrical Drawing-II	-	-	4	-	4	0	0	-	60	40	4.0	100	
5	EG 2205 **CT**	Computer Aided Drawing	2	-	-	3	5	0	0	-	60	40	2.0	100	
6	EG 2206 RA	Refrigeration-III	3	1	6	-	10	20	60	3	10	10	4.0	100	
TOTAL			**15**	**3**	**13**	**7.5**	**38.5**	**80**	**240**		**160**	**120**		**600**	

YEAR: III SEMESTER: V

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 3101 MM	Engineering Economics	3	1	-	-	4	20	80	3	----	----		100	
2	EG 3102 MM	Organization and Management	3	-	-	-	3	20	80	3	-----	----		100	
3	EG 3103 RA	HVAC - III	3	1	3	-	7	20	60	3	10	10	1.0	100	
4	EG 3104 RA	Troubleshooting & Maintenance	1	-	6	-	7	0	0	-	60	40	4.0	100	
5	EG 3105 RA	Estimation and Costing	2	2	-	-	4	10	40	1.5	0	0		50	
6	EG 3106 RA	Project – I	-	-	9	-	9	0	0	----	30	120	4.0	150	
7		Elective - I	3	1	1.5	-	5.5	20	60	3	10	10	1.0	100	
TOTAL			**15**	**5**	**19.5**	**-**	**39.5**	**90**	**320**		**110**	**180**		**700**	

YEAR: III SEMESTER: VI

S.N.	Code No.	Subject	Mode				Total Hours	DISTRIBUTION OF MARKS						Total Marks	Remarks
								Theory			Practical				
			L	T	P	Lab		Assmt. Marks	Final Marks	Time Hours	Assmt. Marks	Final Marks	Time Hours		
1	EG 3201 MM	Entrepreneurship Development	3	-	-	-	3	20	80	3	----	----		100	
2	EG 3202 RA	Safety Engineering	2	-	-	-	2	10	40	1.5	----	----		50	
3	EG 3203 MM	Eng. Professional Practice	2	-	-	-	2	10	40	1.5	----	----		50	
4	EG 3204 RA	Technology, Environment and Society	3	1	-	-	4	20	80	3	----	----		100	
5	EG 3205 ME	Applied Mechanics	3	1	--	1	5	20	80	3	----	----		100	
6	EG 3206 RA	Project - II	-	-	12	-	12	----	----	----	40	160	1.0	200	
7	EG 3207 RA	Elective - II	3	1	1.5	-	5.5	20	60	3	10	10	1.0	100	
TOTAL			**16**	**3**	**13.5**	**1**	**33.5**	**100**	**380**		**50**	**170**		**700**	

Electives:

Elective - I

1. Cold Storage and Food Preservation (EG 3107 RA)
2. Heating System EG 3108 RA)
3. Renewable Energy Technology (EG 3109 RA)

Elective - II

4. Transport Refrigeration and air-conditioning (EG 3207 RA)
5. Refrigerant Management (EG 3208 RA)
6. Energy Auditing and Management (EG 3209 RA)

*** Elective: Maximum of two subjects will be offered as an elective if there are only 24 students**

*** Maximum of three subjects will be offered as an elective if there are 48 students**

*** Other electives may also be offered as per the requirements after due approval.**

First Year

(First and Second Semesters)

First Year First Semester

Subjects:

1. EG 1101 SH Communication Nepali
2. EG 1102 SH Communication English
3. EG 1103 SH Engineering Mathematics-I
4. EG 1104 SH Engineering Physics-I
5. EG 1105 SH Engineering Chemistry-I
6. EG 1106 ME Engineering Drawing-I
7. EG 1107 RA Workshop Technology

कम्युनिकेसन नेपाली
ई.जी. ११०१ एस.एच.

वर्ष : प्रथम **जम्मा : २ घण्टा/ हप्ता**
सेमेष्टर :प्रथम **प्रवचन : २ घण्टा/ हप्ताः**
विशेष : घण्टा/ हप्ताः
प्रयोगात्मक : घण्टा/ हप्ताः
प्रयोगशाला : घण्टा/ हप्ताः

कोर्षको परिचय

यस विषयमा विद्यार्थीहरूले भावी व्यवसायमा प्रभावकारी ढङ्गले सञ्चार गर्नका लागि आवश्यक पर्ने ज्ञान र सीपसँग सम्बन्धित नेपाली सञ्चारात्मक भाषा, लेखन सीप, र कृति परिचयको ढाँचा गरी जम्मा ३ वटा एकाईहरू सभावेश गरिएका छन् ।

कोर्षको उद्देश्य :

यस पाठ्यांशको अध्ययनबाट विद्यार्थीहरूले निम्नलिखित भाषिक क्षमता विकास गर्न सक्नेछन्:-

१ आफ्नो व्यावसायिक कार्य क्षेत्रमा प्रभावकारी सञ्चार गर्न
२ आफ्नो व्यवसायसँग सम्बन्धित विविध लेखन सीप प्रदर्शन गर्न
३ कार्य सम्पादनमा आवश्यक परिस्थितिजन्य संवाद गर्न ।

पाठचांशको विषयवस्तु

एकाइः १ संचारात्मक नेपाली भाषा ***[७ घण्टा]***

१.१ भाषिक भेदको परिचय

- मौखिक र लिखित
- औपचारिक र अनौपचारिक
- अमानक र मानक
- सामान्य र प्रयोजनपरक (विशिष्ट) भेदको सोदाहरण परिचय

१.२ दैनिक कार्यमा प्रयोग हुने भाषाको ज्ञान र प्रयोग

- अनुरोध तथा आदेश/निर्देशन गर्ने भाषाको ज्ञान र प्रयोग
- सोझै गरिने कामहरूमा प्रयोग हुने भाषाको ज्ञान र प्रयोग
- प्रश्नात्मक र वर्णनात्मक भाषाको ज्ञान र प्रयोग

एकाइ २ लेखन सीप ***[१८घण्टा]***

२.१ बोध, बुंदाटिपोट, सङ्क्षेपीकरण र शब्दभण्डारको ज्ञान र अभ्यास

- अनुच्छेद लेखन
- संवाद लेखन
- बुँदा लेखन
- सारांश लेखन
- पत्र लेखन (निमन्त्रणा पत्र, सूचना, सम्पादकलाई चिट्ठी र निवेदन आदि)
- निबन्ध लेखन
- प्राविधिक तथा पारिभाषिक शब्दहरूको ज्ञान र प्रयोग

२.२ शब्द निर्माणको अभ्यास

- उपसर्ग
- प्रत्यय, (कृत् तथा तद्धित)
- समास

२.३ प्राविधिक/पारिभाषिक शब्दहरूको शब्दस्रोत,

- वर्णविन्यास (प्राविधिक शब्दका सन्दर्भमा आवश्यक मात्र)
- अर्थ र व्युत्पत्तिका लागि शब्दकोशको प्रयोगको अभ्यास

२.४ प्रतिवेदन लेखन

एकाइ ३ कृति परिचय *[५घण्टा]*

निम्न लिखित ढाँचामा तलका कृतिको परिचय लेख्ने अभ्यास

३.१ कृतिहरू:

- सौर्य उर्जा
- ट्रेड कोर्ष (कालिगढ तालिम) : एक परिचय : इ.अ.सं. पश्चिमाञ्चल क्याम्पस पोखरा ।
- भुकम्पबाट सुरक्षित रहन गर्नु पूर्व तयारी: भूकम्प प्रविधि राष्ट्रिय समाज नेपाल ।
- इन्जिनियरिङ नेपाली: लालानाथ सुवेदी ।
- सिंचाई प्रविधि ज्ञान : भोजराज रेग्मी, त्रि. वि. पाठ्यक्रम विकास केन्द्र

३.२ कृति परिचयको ढांचा

- कृतिको नाम:
- कृतिकारको नाम:
- कृतिका मुख्य विषय: (एक अनुच्छेद)
- कृतिको महत्व: (एक अनुच्छेद)
- कृतिले आफूलाई पारेको प्रभाव : (छोटो एक अनुच्छेद)
- कृतिको भाषा शैली: (छोटो एक अनुच्छेद)
- कृतिको कमी, कमजोरी र सुझाव: (छोटो एक अनुच्छेद)

सन्दर्भ सामग्रीहरू

- त्रि. वि. पाठ्यक्रम विकास केन्द्र, अनिवार्य नेपाली शिक्षण निर्देशन, काठमाण्डौं
- इन्जिनीयरिङ नेपाली, श्री लालानाथ सुवेदी, विद्यार्थी पुस्तक भण्डार, भोटाहिटी, काठमाण्डौं ।
- नेपाली व्याकरण, बोध/रचना (सम्बन्धित अंश मात्र), श्री लालानाथ सुवेदी, विद्यार्थी पुस्तक भण्डार, भोटाहिटी, काठमाण्डौं ।
- पत्र पत्रिकाका सम्पादकीय, टिप्पणी र लेखहरू ।
- प्रशिक्षकहरूले आफ्नो पुस्तक तयार गर्न वा बजारमा पाइने सामग्री छानेर पढाउन सक्ने, तर परीक्षा महाशाखालाई यसको पूर्व जानकारी दिनुपर्ने ।

Communication English

EG 1102 SH

Total: 2 hour /week

Year: I **Lecture: 2 hours/week**

Semester: I **Tutorial: hours/week**

Practical: hours/week

Lab: hours/week

Course description:

This subject consists of four units related to communicative English; writing skills in English; English sounds and structures; and English conversation practices so as to equip the students with the skills and knowledge of communication in English language in order to have an effective and efficient job performance through occupational communication in the workplace.

Course objectives:

After the completion of this subject, students will be able to:

1. Communicate in English language at work/job environment;
2. Define and use trade related technical terminologies;
3. Demonstrate various writing skills related to the job and
4. Demonstrate situational/structural conversation essential for job performance.

Course Contents:

Unit 1. Communicative English: [3 Hr]

1.1. The structure of English:

- Introduction
- Grammatical units:
  - The word
  - The phrase
  - The clause
  - The sentence
- The grammatical structures:
  - The structure of the phrase

- The structure of the clause
- The structure of sentence (functions)
- The structure of sentence (realizations)

1.2. Everyday functions.
1.3. Requests and offers.
1.4. Direct functions.
1.5. Asking about / expressing.
1.6. Asking about / stating.
1.7. Functions of English.
1.8. Using dictionary
1.9. Reading comprehension
1.10. Collection and definitions of trade related terminologies

Writing skills in English: [15 Hr]

2.1 Writing paragraphs
2.2 Writing dialogues
2.3 Writing Précis
2.4 Writing summaries
2.5 Writing letters:
- Applications
- Official letters
- Business letters
- Invitation letters

2.6 Writing essays
2.7 Writing reports:
- General reports
- Technical reports
- Needs assessment reports
- Review reports

2.8 Writing resumes
2.9 Writing bibliographies
2.10 Writing minutes
2.11 Writing notes

2.12 Writing proposals:
- Technical proposals
- Academic proposals

2.13 Writing for action
2.14 Writing for job
2.15 Writing technical articles:
2.16 Using technical journals/articles
2.17 Writing instructions
2.18 Introduction to writing technical manuals
2.19 Writing memos

Unit 2. English Sounds and Structures: [4 Hr]

3.1 Definitions of phonology, sounds of English, morphology, lexicology, syntax, and semantics

3.2 Sounds of English:
- The vowels
- The consonants
- Consonant clusters
- Vowel sequences
- Syllable structure
- Stress
- Intonation

Unit 3. English Conversation Practices and Guidance: [8 Hr]

4.1. Situational conversation

4.2. Structural conversation

4.3. Familiarization with English spoken skills for employment during the stage of visa application to workstation in abroad.

4.4. Guidance for:

- TOEFL preparation
- IELTS preparation
- Group discussion and presentation
- Seminar conduction

References:

1. Poudel, R.C., A Manual to Communicative English, K.P.Pustak Bhandar, Kathmandu, 1956/57.
2. Shah ,B.L.,Atext book of writing skills in English, First edition Hira Books Enterprises, Kathmandu,
3. Fruehling, R. T. and Oldham N. B., Write to the point, McGraw- Hill, Inc. New York NY 10020
4. Tayior, G., English conversation practice, 1975.
5. Maharjan L. B..A textbook of English sounds and Structures, Vidyarthi Pustak Bhandar, Kathmandu, 2000.
6. Todd, LAN introduction to Linguistics, Longman York press, 1991.
7. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.
8. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject.

Engineering Mathematics I

EG 1103 SH

Total: 5 hours /week

Year: I **Lecture: 4 hours/week**

Semester: I **Tutorial: 1 hour/week**

Course description:

This subject consists of four units related to trigonometry; coordinate geometry; algebra; and calculus necessary to develop mathematical background helpful for the understanding and practicing the related engineering works.

Course objectives:

After the completion of this course, students will be able to explain the concepts of the followings and apply them in the field of related engineering area

1. Trigonometric ratios and equations, inverse circular functions and properties of triangles;
2. Straight lines, angle between lines, circle and parabola;
3. The progressions, permutations and combinations, binomial theorem, exponential and logarithmic series as well as the quadratic and polygonal equations and
4. Sets, limit and continuity, derivatives, integration and integrals.

Course Contents:

Unit 1: Trigonometry: [16 Hr]

1.1. Review of trigonometric ratios:
- Basic trigonometric formulae
- Identities and conditional identities.

1.2. Trigonometric equations:
- Periodicity of trigonometric functions
- General solutions of the following equations:

- Sin x = k , cos x = k and Tan x = k and using trigonometric equations.

1.3. Inverse circular functions:
- Domain and their graphs
- Formulae involving inverse circular functions
- Simple identities and equations involving circular functions

1.4. Properties of triangles:
- The sin law
- The cosine law
- The projection law
- The half angle formulae
- The area of a triangle
- The encircles and ex-circles of a triangle

Unit 2: Coordinate Geometry: [16 Hr]

2.1 Straight lines:
- The three standard forms of equations of a line.
- The linear equation: ax + by + c = 0.
- Any line through the intersection of two lines.
- Concurrency of lines.

2.2 Angle between two lines:
- Bisectors of angles between two lines
- Pair of lines
- Homogeneous equation of second degree
- General equation of second degree representing two lines
- Angle between a pair of lines
- Bisectors of the angles for a line pair
- Lines joining the origin to the points of intersection of a curve and a line

2.3. Circle:
- Standard equation
- General form
- Tangents and normal

2.4. Parabola:
- Standard equation
- Tangents and normal

Unit 3: Algebra: [8 Hr]

3.1. Progressions:
- A.P., G.P. and H.P.

3.2. Permutations and combinations

3.3. The binomial theorem for any index

3.4. Series:
- Exponential & logarithmic

3.4. Equations:
- Quadratic & polynomial

Unit 4: Calculus: [20 Hr]

4.1 Idea of set, set notations, set operations,

4.2. Venn diagram,

4.3. The set of real members and its subsets.

4.4. The absolute value of a real number.

4.5. Functions- algebraic and transcendental.

4.6. Graphs of simple function.

4.7. Limit of community.

4.8. Derivatives from definition of simple functions like:
- xn, (ax+b)n, sin (ax +b), eax, ax , and log x.

4.9. Derivatives of sum, difference, product and quotient of functions, chain rule, parametric and implicit functions

4.10. Integration, Rules for finding integrals.

4.11. Standard integrals and their uses.

4.12. Definite integrals- definition and evaluation.

4.13. Definite integral as limit of sum.

References:

1. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.
2. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject.

Engineering Physics I

EG 1104 SH

Total: 6 hours /week

Year: I **Lecture: 3 hours/week**

Semester: I **Tutorial: 1 hour/week**

Lab: 2 hours/week

Course description:

This subject consists of four units related to mechanics, heat and thermodynamics, optics, and magnetism necessary to develop background in physics that supports for the understanding and practicing the related engineering works.

Course objectives:

After the completion of this course, students will be able to explain the basic concepts related to the followings and apply them in the field of the related engineering area.

1. Mechanics.
2. Heat and thermodynamics.
3. Optics.
4. Magnetism.

Course Contents:

Unit 1: Mechanics [14 Hr]

1.1 Basic units and measurements:

- Measurement of physical quantities
- Introductory ideas about dimensions of physical quantities.
- Scalar and Vector: definitions and examples, dot and cross product of two vectors
- Composition and resolution of vectors.

1.2 Newton's laws of motion:

- Newton’s laws of motion (First, second and third laws)
- Principle of conservation of linear momentum
- Solid friction: Dynamic and rolling friction, laws of solid friction and its verification

1.3. Uniform circular motion:
- Angular displacement and velocity.
- Centripetal force and acceleration.
- Motion of bicycle rider and banked track

1.4. Gravitation:
- Newton’s law of universal gravitation.
- Gravitational attraction of earth:
- Acceleration due to gravity.
- Variation of acceleration due to gravity with height, depth, and latitude.
- Motion of satellites:
  - Orbital velocity,
  - Geostationary satellites.
- Weightlessness.

1.5. Work, energy, and power:
- Definition and units of work, energy and power.
- Potential and kinetic energy.
- Conservation of energy.
- Conservative forces.
- Transformation of energy.
- Power efficiency.

1.6. Simple harmonic motion (SHM):
- Simple harmonic motion and its characteristics.
- Period, frequency, and amplitude of simple harmonic motion.
- Speed and acceleration in simple harmonic motion.
- Energy of simple harmonic motion.
- Simple pendulum.

1.7. Rotation of rigid bodies:

- Forces in equilibrium, torque, couple, C.G. and center of mass.
- Moment of inertia.
- Angular momentum and
- Its conservation.
- Work done by torque.

Unit 2: Heat and Thermodynamics: [11 Hr]

2.1 Heat Phenomena and Quantity of Heat:

- Concept of temperature and thermal equilibrium.
- Temperature scales.
- Quantity of heat gain or heat loss.
- Specific heat capacity.
- Determination of heat capacity by the method of mixtures.
- Newton's law of cooling.

2.2 Change of Phase:

- States of matter.
- Fusion and vaporization.
- Evaporation and boiling.
- Specific latent heats of fusion and vaporization.
- Melting and boiling points.
- Saturated and unsaturated vapors.
- Variation of melting and boiling points with pressure.
- Triple point and critical point.
- Dew point and humidity.

2.3 Thermal Expansion:

- Coefficients of linear, superficial and cubical expansions of solid and relation between them.
- Cubical expansion of liquids.
- Real and apparent expansions.
- Variation of density due to expansion.
- Barometric height correction.

2.4 Heat Transfer:

- Thermal conduction conductivity and determination of the coefficient of thermal conductivity.
- Convection and convection coefficient.
- Radiation.
- Perfectly black body.
- Stefan-Boltzman's law of black body radiation.

2.5 Gas Laws:

- Boyle's law,
- Charles law and ideal gas equation.
- Universal gas constant,
- Avogadro number and Boltzman constant.
- Volume and pressure coefficients of ideal gas.

2.6 Kinetic Theory of Gases:

- Pressure in an ideal gas from molecular point of view.
- RMS speed, mean energy of a molecule of an ideal gas.

2.7 Thermodynamics:

- First law of thermodynamics.
- Different thermodynamic process:
  - Adiabatic,
  - isothermal and
  - Isobaric.
- Specific and molar heat capacities for different thermodynamic processes, $C_p - C_v = R$.
- Second law of thermodynamics.
- Carnot engine, Otto cycle and their efficiencies.

Unit 3: Optics [10 Hr]

3.1 Light and Illumination:

- Nature of light, sources of light, rays.
- Luminous s flux.
- Luminous intensity of a point source.

3.2 Reflection and Refraction by plane Surfaces:

- Review of reflection and refraction by plane surfaces.
- Speed of light in different media.
- Deviation due to reflection and refraction.
- Phenomenon of total internal reflection, critical angle.
- Real and apparent depth.
- Determination of reflective index.

3.3 Reflection by Spherical Surfaces:

- Review of reflection by spherical surfaces.
- Method of construction pf image by ray diagrams.
- Real and virtual images.
- Nature of images formed by spherical mirrors.
- Spherical aberration: parabolic mirror.
- Uses of Mirrors: driving mirror of a car, field of view.

3.4 Refraction through Prisms and Lenses:

- Deviation due to prism and minimum deviation.
- Refraction through lenses.
- Lens maker equation.
- Converging lens, diverging lens and thin lens equation.
- Formation of images by lenses.
- Combination of lenses.
- Magnification,
- Power of a lens.
- Uses of lenses:
  - simple microscope,
  - compound microscope and
  - Telescope
- Human eye.

Unit 4: Magnetism [10 Hr]

4.1 Magnets and Magnetic fields:

- Magnetic poles, magnetic moment, magnetic axis, and magnetic meridian.

- Magnetic field.
- Coulomb's law for magnetism.
- Magnetic field due to magnetic poles and bar magnets.
- Intensity and flux density of magnetic field.
- Neutral point.
- Tangent law.
- Deflection and oscillation magnetometer.

4.2. Earth's Magnetism:

- Horizontal and vertical components of earth's magnetic field.
- Declination and angle of dip.

4.3. Magnetic properties of materials;

- Molecular and modern theory of magnetism.
- Para magnetism and diamagnetism:
  - Permeability and
  - Susceptibility.
- Intensity of magnetization.
- Domain theory of ferromagnetism.
- Hysterisis

Practical (Laboratory)

1. Determine volume of hallow cylinder by using vernier calipers.
2. Determine density of a steel / glass ball by using screw gauge.
3. Determine thickness of glass plate using spherometer and calculate the area by using millimeter graph paper.
4. Determine the acceleration due to gravity by using simple pendulum.
5. Determine the magnetic movement of a bar magnet by using deflection magnetometer.
6. Determine the refractive index of the material of prism.
7. Determine specific heat capacity of solid by the method of mixtures.
8. Determine specific latent heat of ice by the method of mixtures.
9. Determine specific gravity of different solids by up thrust method.
10. Determine focal length of a converging lens by displacement method.

References:

1. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.
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Engineering Chemistry I

EG 1105 SH

Total: 6 hours /week

Year: I **Lecture: 3 hours/week**

Semester: I **Tutorial: 1 hour/week**

Practical: hours/week

Lab: 2 hours/week

Course description:

This subject consists of three units related to general chemistry, language of chemistry, and system of classification necessary to develop background in chemistry that supports for the understanding and practicing related engineering works.

Course objectives:

After the completion of this subject, students will be able to explain the basic concepts related to the followings and apply them in the field of related engineering works:

1. General chemistry;
2. Language of chemistry and
3. System of classification.

Course Contents:

Unit: 1: General Chemistry [8 Hr]

1.1 Atom and molecule:
- Definition
- Dalton's atomic theory and modern position of the theory

1.2 Atomic weight:
- Definition
- Determination of atomic weight by Dulong and Petit's method and
  Related numerical problems

1.3 Molecular Weight:

- Definition
- Avogadro's hypothesis
- Application of Avogadro's hypotheses (Mol. Wt=2×V.D., in the deduction of atomicity of elementary gases H_2 , Cl_2, O_2, and N_2)
- Molecular weight determination by Victor Meyer's method and

  Related numerical problems

1.4 Equivalent weight:

- Definition
- Equivalent weight of element, acid, base and salt
- Equivalent weight determination by hydrogen displacement method and oxide method.
- Numerical relation between equivalent weight, atomic weight and valency
- Some related problems of equivalent wt. (From Hydrogen displacement method and oxide method)

1.5 Simple mole concept:

- Mole of an atom
- Mole of a molecule
- Molar volume and
- Simple calculation on mole concept

Unit: 2: Language of Chemistry [4 Hr]

2.1 Symbol:

- Definition
- Significance (qualitative and quantitative)

2.2 Formula:

- Definition
- Significance (qualitative and quantitative)
- Concept of valency in terms of combining capacity with H_2, O_2, and Cl_2

- Variable valency (ref. Fe, Sn, Pb, Cu, Hg, S and N)
- Radicals (electro- positive and electro - negative)
- Writing a formula

2.3 Chemical equation:

- Definition
- Types requisites
- Significance and limitation
- Balancing of chemical equation by hit and trial method and Partial equation method

Unit: 3: System of Classification: [33 Hr]

3.1 Atomic structure:

- Subatomic particles (electron, proton and neutron)
- Classical α - rays scattering experiment
- Rutherford's atomic model and its drawbacks
- Bohr's atomic model (postulates only)
- Composition of nucleus
- Mass number and atomic number
- Arrangement of electron (Bohr - Bury Scheme)
- Concept of shell and sub shell,
- Electronic Configuration and atomic structure of Some elements (Atomic no. 1 to 30)
- Hund's rule
- General idea of quantum number and Pauli's exclusion principle

3.2 Electronic theory valency:

- Assumptions
- Types
- Electrovalency eg. NaCl, MgO, CaS
- Covalency eg. H_2, O_2, N_2, CH_4, H_2O, NH_3, C_2H_2
- Coordinate co-valency eg.H_2O_2, SO_2, O_3, SO_3)
- Electronic dot structure of some compounds eg.H_2SO_4, $CaCO_3$, K_2SO_3

3.3 Oxidation and reduction:

- Classical definition
- Electronic interpretation
- Oxidizing agent: Definition and eg O_2, O_3, oxyacids, halogens, $K_2Cr_2O_7$, $KMnO_4$
- Reducing agent: Definition and eg. H_2, H_2S with some examples,
- auto-oxidation eg.H_2O_2, HNO_2, SO_2
- Idea of oxidation number
- Balancing chemical equation by oxidation number method

3.4 Periodic table:

- Mendeleef's periodic law
- Mendeleef's periodic table
- Characteristics of groups and periods in the table
- Advantages and anomalies of the periodic table
- Modern periodic law

3.5 Electrolysis:

- Definition of electrolyte, non-electrolyte and electrolysis
- Faraday laws of electrolysis,
- Application of electrolysis (electroplating and electro refining)
- Electrolysis of acidulated water

3.6 Activity and electrochemical series:

- Definition,
- Action of water, acid and oxygen on metals.

3.7 Corrosion:

- Definition
- Types
- Direct and indirect method and prevention against corrosion

3.8 Acid, Base and Salt:

- Arrhenius concept of acid and base
- Lowry and Bronsted concept of acid and base
- Conjugate acid and base

- Amphoteric nature of water
- Lewis concept of acid and base
- Preparation of acid and base (at least 2 -methods).
- Properties of acid and base.
- Definition of Salt
- Types of salt (normal, acidic and basic)
- Preparation of salt (at least 3 - methods)
- Concept of hydrogen ion concentration, pH value and pH Scale
- Buffer solution.

3.9 Volumetric analysis:

- Definition of titration (acidimetry and alkalimetry),
- Indicator
- End-point (neutralization point)
- Standard solution (primary and secondary standard solution), Normal, Decinormal, Molar, Molal solution
- Requisites of primary standard substance
- Volumetric equation,
- Express the strength of solution Normality, Molarity, Molality, gram per litre and percentage and related numerical problems

Practical (Laboratory):

1. Simple Glass Working

a. to cut the glass tube into three equal parts and round up their shape edges

b. to bore a hole through a cork

c. to bend the glass tubing into acute, obtuse and right angle

d. to draw a jet and capillary tube

e. to fit up a wash bottle

2. To separate sand and copper sulphate crystals in pure and dry state from the mixture of sand and copper sulphate
3. To separate sand and calcium carbonate in pure and dry state from the mixture of sand and calcium carbonate
4. To prepare pure water from supplied impure water by distillation and o test the purity of the sample prepared
5. To neutralize dilute sulphuric acid with sodium carbonate solution, and to recover crystals of sodium sulphate
6. To obtain pure and dry precipitate of barium sulphate by treating excess of dilute sulphuric acid with barium chloride solution
7. To investigate the composition of water by electrolysis by using Hofmann's apparatus
8. To determine the equivalent weight of reactive metal by hydrogen displacement method.
9. To determine the pH of different unknown solution and using pH paper and universal indicator
10. To prepare primary standard solution of sodium carbonate and to use it to standardize an approximate decinormal acid solution
11. To standardize given unknown acid (Approx N/10) solution by preparing standard alkali solution. (Expression of strength in different ways)
12. To standardize given unknown alkali (approximately N/10) solution with the help of by preparing standard acid solution. (Expression of strength in different ways)
13. To carry out conductivity experiments on solids and liquids (CuSO4, Zn, Mg, Al, Fe, CCl_4, C_6H_6, C_2H_5OH)

Textbooks:

1. A Text book of Chemistry, Jha and Guglani
2. Foundations of Chemistry, Vol. 1, M.K. Sthpit and R.R. Pradhananga

References:

1. Fundamentals of Chemistry, K.R. Palak
2. Inorganic Chemistry, Bahl and Tuli
3. A Text book of Engineering Chemistry, R.S. Sharma
4. A Textbook of Inorganic Chemistry, L.M. Mitra
5. Elementary practical chemistry, M.K Sthapit

Other learning materials:

1. Other references to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject

Engineering Drawing I

EG 1106 ME

Year: I **Total 4 hours/week**
Semester: I **Practical : 4 hours/week**

Course Description:

This course deals with geometrical construction, orthographic projections and basic techniques of freehand sketch.

Course Objectives:

After completing this course the students will be able to

1. represent different shapes accurately by applying geometrical constructions,
2. project point, line, plane and geometrical solids,
3. represent three dimensional objects in orthographic from and dimension them,
4. use freehand techniques to sketch different shapes.

Course content:

Unit 1: Introduction [4 Hr]

1.1 Engineering drawing as graphic language
1.2 Drawing instruments
1.3 Scale: Reduced scale, enlarged scale, full size scale
1.4 Conventional line types
1.5 Sheet size and sheet layout
1.6 Exercise on drawing horizontal, vertical and inclined lines and conventional line types [*Sheet 1*]

Unit 2: Technical Lettering [4 Hr]

2.1 General procedure for freehand technical lettering: letter stroke, letter proportion, use of pencil and pens, uniformity of letters
2.2 Single stroke vertical capital letters, Single stroke inclined capital letters, Single stroke vertical lowercase letters, Single stroke

inclined lowercase letters, vertical and inclined numerals, vertical and inclined fractions

2.3 Lettering using templates

2.4 Exercise on freehand technical lettering and lettering using templates [Sheet 2]

Unit 3: Geometrical Construction [12 Hr]

3.1 Construction on straight lines and angles

Bisection and trisection of a straight line, Bisection and trisection of an angle, To draw perpendicular lines, To draw parallel lines, To divide a straight line into any number of equal parts, To divide a straight line proportionately, To draw an angle equal to given angle

3.2 Construction of polygons

To draw triangles, To inscribe a circle of a triangle and circumscribe a circle about a given circle, To draw squares, To draw a regular polygon, To draw a regular hexagon, To draw a regular octagon, To draw a regular polygon (general method)

3.3 Exercise on construction on straight lines and angles and construction of polygons [*Sheet 3*]

3.4 Construction on circular arcs and circles

To determine center of a given arc, To draw a circle passing through three given points, To draw an arc tangent to given two straight lines, To draw an arc tangent to given straight line and a given circle or circular arc, To draw an arc tangent to given two circles or circular arcs, To draw open belt and cross belt tangents, To draw an ogee curve between two parallel lines

3.5 Exercise on construction on circular arcs and circles [Sheet 4]

3.6 Construction of standard curves

Construction of parabola, ellipse, hyperbola, cycloid, helix, spiral, involute

3.7 Exercise on construction of standard curves [Sheet 5]

Unit 4: Dimensioning [4 Hr]

4.1 Dimensioning terms and notations

4.2 Techniques of dimensioning: Size and location dimensioning

4.3 Placement of dimensions: Aligned and Unidirectional system

4.4 Rules for dimensioning and conventions
4.5 Exercise on dimensioning of two dimensional figures including straight line, angles, circles, circular arcs [Sheet 6]

Unit 5: Projection of Points, Lines and Planes [8 Hr]

5.1 Principle of projection
5.2 Principle planes of projections, Four quadrants
5.3 Projection of point

Projection of point on two planes of projection, Projection of point on three planes of projection

5.4 Projection of line

Projection of line perpendicular to VP, Projection of line perpendicular to HP, Projection of line parallel to both VP and HP, Projection of line parallel to VP and inclined to HP, Projection of line parallel to HP and inclined to VP, Projection of line inclined to both VP and HP

5.5 Exercise on projection of point and line [Sheet 7]
5.6 Projection of plane

Projection of plane parallel to VP, Projection of plane parallel to HP, Projection of plane perpendicular to both VP and HP, Projection of plane perpendicular to VP and inclined to HP, Projection of plane perpendicular to HP and inclined to VP

5.7 True Length of an Oblique Line
5.8 True shape of an Oblique Plane
5.9 Exercise on projection of plane; true length of an oblique line; true shape of an oblique plane [Sheet 8]

Unit 6: Projection of Geometrical Solids [4 Hr]

6.1 Types of Solids: Polyhedra and Solids of revolution
6.2 Projection of geometrical solids: Prism, Cylinder, Pyramid and Cone
6.3 Projection of points on the surfaces solids
6.4 Exercise on projection of cylinder, prism, cone and pyramid; Projection of points on the surfaces of these solids [Sheet 9]

Unit 7: Orthographic Projection [20 Hr]

7.1 Principle of Orthographic Projection

7.2 Systems of Orthographic Projection: First Angle and Third Angle
7.3 Making an Orthographic Drawing
7.4 Analysis in Three Views
7.5 Exercise on orthographic projection of rectangular objects with horizontal and vertical plane surfaces [Sheet 10]

Exercise on orthographic projection of rectangular objects with inclined plane surfaces [Sheet 11]

Exercise on orthographic projection of objects with cylindrical surfaces [Sheet 12 &13]

Exercise on orthographic projection and dimensioning [Sheet 14]

Unit 8 Freehand Sketching [4 Hr]

8.1 Techniques of Sketching: Pencil hardness, paper with grid or lines
8.2 Techniques for horizontal and vertical lines; arcs and circles
8.3 Exercise on freehand sketches of different shapes with lines, arcs, and circles [Sheet 15]

References:

1. Luzadder, W.J., Fundamental of Engineering Drawing, Prentice-Hall of India Pvt-Ltd., New Delhi, Latest edition.
2. Bhatt N. D. and PanchalV.M., Engineering Drawing, Charotar Publishing House, 2001.
3. Gill P.S, Engineering Drawing, S. K. Kataraia & Sons, New Delhi, 2004/2005

Workshop Technology

EG 1107 RA

Total: 9 hours /week

Year: I **Lecture: 3 hours/week**

Semester: I **Practical: 6 hours/week**

Course Description:

This course deals with basic fitting work and copper tubing practices pertaining to Refrigeration and Air conditioning. The intention of course is also to train the student carefully and safely handle tools and equipment applicable in work. During the course student will be acquainted with various methods of laying out Refrigeration piping utilizing appropriate soldering process.

Course objectives:

After the completion of this course, student will be able to

1. Explain mandatory safety rules
2. Explain applications of various materials
3. Explain fitting tools and machines
4. Explain about the basic plumbing processes
5. Carry out copper piping works
6. Explain about simple electric wiring

Course content:

Unit 1: Mechanical workshop **[3 Hr]**

- 1.1 Introduction
- 1.2 Scope and application
- 1.3 Safety
  - 1.3.1 Personal Safety
  - 1.3.2 Machine Safety
  - 1.3.3 Work Safety
  - 1.3.4 General Safety

Unit 2: Engineering Materials [4 Hr]

2.1 Metals and Non-metals
2.2 Ferrous and Non-ferrous
2.3 Iron and Steels
2.3.1Irons
2.3.2 Carbon Steel
2.3.3 Alloy Steel
2.3.4 Cutting materials

Unit 3: Important Mechanical properties [2 Hr]

4.1 Tenacity 4.2 Stiffness 4.3 Elasticity 4.4 Plasticity
4.5 Ductility 4.6 Malleability 4.7 Toughness 4.8 Brittleness
4.9 Hardness 4.10 cohesion

Unit 4. Bench tools and Basic fitting Work [15 Hr]

4.1 Bench work
4.2 Fitting tools (types, construction and application)
4.2.1 Holding tools
4.2.2 Striking tools
4.2.3 Cutting tools
4.3 Basic fitting Works (Methods and application)
4.3.1 Filing
4.3.2 Sawing
4.3.3 Chiseling
4.3.4 Punching
4.3.5 Scraping
4.3.6 Drilling
4.3.7 Countersinking
4.3.8 Counter boring
4.3.9 Thread cutting

Unit 5: Sheet Metal Works [3 Hr]

5.1 Introduction
5.2 Tools and equipment (Hammers, Stakes, Mandrels, Shears, Groovers etc.)
5.3 Heming, Seaming, Edge preparation, Stamping, Embossing and other forming

Unit 6: Measuring Instruments and Gauges [3 Hr]

6.1 measuring instruments
- 6.1.1 Steel Rule
- 6.1.2 Vernier caliper
- 6.1.3 Angle Protractor
- 6.1.4 Micrometer
- 6.1.5 Combination set

6.2 Gauges
- 6.2.1 Radius Gauge
- 6.2.2 Filler gauge
- 6.2.3 Screw pitch gauge
- 6.2.4 Telescopic Gauge
- 6.2.5 Slip Gauge
- 6.2.6 Angle Gauge
- 6.2.7 Surface Gauge
- 6.2.8 Depth gauge

Unit 7: Marking tools [1 Hr]

7.1 Soft scribers
7.2 Steel scribers

Unit 8: Laying out tools [3 Hr]

8.1 Steel Square
8.2 Calipers (Simple, Odd leg)
8.3 Surface plate
8.4 Angle plate
8.5 Straight edge
8.6 Surface Anvil
8.7 Dividers
8.8 Trammels
8.9 Punches

Unit 9: Plumbing [3 Hr]

9.1 G.I. pipes and fittings (Water Supply)
9.2 HD Polythene pipes and PVC pipes (Drainage)
9.3 Hygiene and Safety Rule in Plumbing

Unit 10: Refrigeration piping [5 Hr]

10.1 Soft copper and Rigid copper
10.2 Copper tubes and fittings
10.3 Bending, swaging, flaring and expanding of copper tubes
10.4 Joining of copper tubes and fittings with silver-phosphorus soldering material
10.5 joining of copper/copper and copper/ polythene without flame
10.6 Care, repair and maintenance of copper pipe lines

Unit 11: Electricity for Refrigeration [3 Hr]

11.1 Basic Electrical Principles
11.2 Hand tools for Electrical Work
11.3 Types of wires, electrical accessories and fixtures
11.4 Wiring principles (house wiring)
11.5 Wiring lay out testing method and procedures
11.6 Safety devices and their applications

Practical Work

1. **Basic fitting works [30 Hr]**
   1.1 Safety rules demonstration (General and HVAC)
   1.2 Familiarization with measuring tools and gauges
   1.3 Familiarization with marking and laying out tools
   1.4 Familiarization with basic fitting tools
   1.5 Assignment: -Making of fitting work piece incorporated with different fitting work

2. **Sheet metal work [40 Hr]**
   2.1 Marking out
   2.2 Shearing (using suitable snips)
   2.3 Preparing edges
   2.4 Preparing seams
   2.5 Sheet metal bending and forming
   2.6 Soft soldering practice
   2.7 Use of fluxes and solders
   2.7 Assignment: -Making of sheet metal articles with hems and seam

3. Plumbing [20 Hr]

3.1 G.I. Pipes and fittings (Water Supply)
3.2 Tools and equipment for G.I. piping
3.3 HD Polythene pipe, PPVC, CPVC, PPR and PVC pipes lay out (drainage)
3.4 Tools and equipment for sno.3.2
3.5 Hygiene and safety rules in plumbing
3.6 Assignment: -Water supply and drainage disposal lay out exercise

4. Refrigeration Piping [30 Hr]

4.1 Familiarization with soft copper and rigid copper
4.2 Familiarization with Copper tubes and fittings
4.3 Bending and flaring of copper tubes
4.4 Oxy-acetylene and propane gas for hard soldering
4.5 Filler materials and fluxes used in brazing
4.6 Use of silver solder for joining copper tubes and fittings
4.7 Checking and testing of joints for air tightness
4.8 Assignment: -Copper tube bending and joining (hard soldering) exercise

5. Electricity [15 Hr]

5.1 Safety rules in electrical work (demonstration)
5.2 Hand tools used in electrical work
5.3 Familiarization with electrical accessories and fixtures
5.4 Wire connection (house wiring) practice
5.5 Assignment:
5.5.1 One light and two pin socket with one way switch
5.5.2 One light and two pin socket with two way switch
5.5.3 Two lights points with one way control
5.5.4 Three pin switch socket with two way control

References:

1. *Elements of Workshop Technology Vol. 1,* S.K Hajara Chaudhary, A.K. Hajara Chaudhary, Nirjhar Roy
2. *General Electrical Drawing Part I*, Surjit Singh, S.K. Kataria

First Year/Second Semester

Subjects:

1. EG 1201 SH Engineering Mathematics-II
2. EG 1202 SH Engineering Physics-II
3. EG 1203 SH Engineering Chemistry-II
4. EG 1204 ME Engineering Drawing-II
5. EG 1205 RA Thermodynamics-I
6. EG 1206 RA Refrigeration-I
7. EG 1207 EE Basic Electrical Engineering

Engineering Mathematics II

EG 1201 SH

Total: 4 hours /week

Year: I **Lecture: 3 hours/week**

Semester: II **Tutorial: 1 hour/week**

Course description:

This subject consists of five units related to vectors; algebra; calculus; geometry; and statistics necessary to develop mathematical background helpful for the understanding and practicing the related engineering works.

Course objectives:

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

1. Explain the concepts of vectors in plain and vectors in space and apply them in the field of the related engineering area;
2. Explain the concepts of the complex numbers, linear inequalities and programming apply them in the field of the related engineering area;
3. Explain the concepts of determinants and matrices and apply them in the field of the related engineering area;
4. Explain the concepts of determinants and matrices and apply them in the field of the related engineering area;
5. Explain the concepts of applications of derivatives and areas of curves and apply them in the field of the related engineering;
6. Explain the concepts of coordinates in space and planes and apply them in the field of the related engineering area and
7. Explain the concepts of statistics and apply them in the field of the related engineering area.

Course Contents:

Unit 1. Vectors: [5 Hr]

1.1. Vectors in plane, addition and subtraction.
1.2. Composition and decomposition of vectors.
1.3. Vectors in space.
1.4. The unit vectors i, j, k

1.5. Product of two vectors-
- dot product,
- cross product,

1.6. Simple applications.

Unit 2. Algebra: [15 Hr]

2.1. Complex number in the from A+ ib.
2.2. Algebra of complex numbers.
2.3. Polar representation of complex numbers.
2.4. De Moivre's theorem and its applications
2.5. Linear inequalities and their graphs.
2.6. System of linear inequalities in two variables,
2.7. System of linear inequalities in two variables,
2.8. Linear programming: Problems involving two variables under given linear constraints
2.9. Determinants and matrices,
2.10 Algebra of matrices,
2.11 Properties of determinants,
2.12. Ad joint and inverse of matrices.
2.13. Solution of linear equations using cramers' rule
2.14. Row equivalent matrices
2.15. Idea of polynomial equations

Unit 3. Calculus: [12 Hr]

3.1. Applications of derivatives-
- Tangents and normal to a curve taking slope as derivative
- Maxima and minima of a function
- Derivative as rate of change

3.2 Areas under curves:
- Use of definite integral as limit of a sum to find area under curves
- Areas of closed curves and
- Areas between curves.

3.3 Antiderivatives:
- Curve tracing, maxima and minima
- Rieman sums & integral
- Application of fundamental theorem

Unit 4. Geometry: **[4 Hr]**

4.1. Coordinates in space,

4.2. Coordinates in planes.

Unit 5. Statistics: **[9 Hr]**

5.1. Statistics:

- Introduction to statistics
- Measures of Central Tendency
- Measures of Dispersion
- Moments, Skewness and Kurtosis
- Correlation and Regression

5.2. Probability:

- Concept of Probability
- Concept of conditioned probability
- Concept of independent and dependent events
- Concept of mutually exclusive events
- Concept of theoretical probability distribution

5.3 Concept of normal curve and normal distribution

5.4. Concept of sampling, estimation and tests of significance

References:

1. A Text book of Statistics – B.C. Bajracharya
2. Elementary Statistics – H. C. Saxena
3. Statistical Methods – Mrigendralal Singh
4. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.
5. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject

Engineering Physics II

EG 1202 SH

Total: 6 hours/week

Year: I **Lecture: 3 hours/week**

Semester: II **Tutorial: 1 hour/week**

Lab: 2 hours/week

Course description:

This subject consists of four units related to electricity, waves, properties of matter, and modern physics necessary to develop background in physics that supports for the understanding and practicing the related engineering works.

Course objectives:

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

1. Explain the basic concepts related to the electricity and apply it in the field of the related engineering area;
2. Explain the basic concepts related to the waves and apply it in the field of the related engineering area;
3. Explain the basic concepts related to the properties of matter and apply it in the field of the related engineering area and
4. Explain the basic concepts related to the modern physics and apply it in the field of the related engineering area.

Course Contents:

Unit: Electricity: [16 Hr]

1.1. Electrostatics:

- Elementary charge, charging and induction.
- Faraday's ice-pail experiment.
- Idea of electric field
- Lines of forces.
- Coulomb's law.

- Intensity of electric field.
- Electrostatic potential, equipotential.
- Surfaces.
- Potential and field strength.
- Potential gradient.
- Action of point.
- Van de Graff generator.
- Capacitors.
- Different types of arrangement of capacitors.
- Energy storage.
- Action of dielectrics

1.2. Current electricity:

- Basics:
- D.C. Current.
- Strength of Current.
- Potential difference across a conductor.
- Ohm's law and its verification.
- Resistance and resistivity.
- Mechanical measurements:
- Galvanometer.
- Ammeter and voltmeter
- Potentiometer and measurement of emf.
- Whitestone bridge
- Kirchhoff's law and their use to analyze simple circuits.
- Heating effect of current:
- Joule's law
- The rate of heating from the concept of p.d.
- Thermoelectricity:
- See-beck effect
- Peltier effect
- Thomson effect.

- Chemical effect of current:
- Faraday's law of electrolysis.
- Accumulator.

1.3. Magnetic effect of current and electromagnetism:

- Magnetic forces and magnetic field of current:
- Force experienced by charge moving in magnetic field.
- Maxwell's crockscrew rule.
- Force applied by magnetic field on current carrying conductor.
- Torque on current carrying coil in magnetic field.
- Theory of moving coil galvanometer.
- Biot-Savart's Law
  - Field due to a long straight conductor and due to circular coil.
  - Force between two parallel conductors carrying current.
- Ampere’s law
  - Magic field due to the solenoid or toroid and long straight conductor.
- Electromagnetic induction:
- Faraday's law of electromagnetic induction and Lenz’s law.
- Phenomenon of self-induction.
- A.C. generator.
- D.C. generator.
- Transformer.

1.4 Alternating current:

- Instantaneous and effective values of current and voltage.
- Phase between current and voltage across different elements of circuit.
- Capacitive and inductive reactance.
- Impedance.
- Resonance.
- Power in a.c. circuit

Unit 2: Waves: [9 Hr]

2.1. Wave motion:

- Wave motion.
- Types of wave motion
- Characteristics of wave motion
- Wavelength, frequency and speed of waves
- Speed of waves in different media.
- Velocity of sound in air.

2.2. Wave phenomena:

- Sound waves.
- Reflection of sound waves.
- Interference of sound waves.
- Diffraction of sound waves.
- Beats and their formation.
- Progressive waves.
- Stationary waves.
- Waves in strings and pipes: fundamental vibrations and overtones.
- Intensity of sound.
- Intensity level.
- Inverse square law.

2.3. Physical optics:

- Interference of light waves and coherent sources.
- Phase difference and path difference. Young's double slit experiment.
- Distraction of light waves.
- Huygen's principle.
- Polarization and un polarized lights, polarization by reflection (Brewster's law)

Unit 3: Properties of Matter: [10 Hr]

3.1 Elasticity:

- Elasticity, Hook's law, Young's modulus, Bulk modulus.
- Elasticity of shear.

3.2 Surface tension:

- Intermolecular attraction in liquid, surface tension.
- Cohesion and adhesion, angle of contract.
- Coefficient of surface tension and surface energy (Introduction only).

3.3 Viscosity:

- Stream line and turbulent flows.
- Idea of liquid layer, Velocity gradient, Viscosity and its coefficient.
- Comparison of viscosity with solid friction, Viscous forces, Stoke's law, Terminal velocity, determination of coefficient of viscosity, viscous forces at higher relative velocities (qualitative).
- Temperature dependence of the coefficient of viscosity of liquid and gases.

Unit 4: Modern Physics: [10 Hr]

4.1 Atomic physics:

- Photons, Photoelectric effect, Einstein's photoelectric equation and stopping potential for photoelectrons.
- Motion of charged particles in simultaneously applied electric and magnetic fields, e/m for electron, Milliken's oil drop experiment. Bohr model for hydrogen atom. Energy level diagrams and spectral series.
- X-rays: Production, nature and uses.
- Laser (introduction only)

4.2 Semiconductors:

- Energy states of valent electrons in solids, energy bands.
- Semiconductors, intrinsic and doped, p-type and n-type semiconductors.
- Majority and minority carries.
- Acceptors and donors, p-n junction, diode and depletion layer, forward and reverse bias.
- Rectifying property of diode, Transistor, transistor action and uses of npn transistor

4.3 Nuclear physics:

- Laws of radioactive disintegration: half life, mean life, and decay constant.
- Stable and radioactive nuclei.
- Binding energy.
- Fission and fusion.

Practical (Laboratory): [30 Hr]

1. Determine specific resistance of a wire.
2. Determine the frequency of A.C. mains.
3. Study current voltage characteristics of a junction diode.
4. Determine speed of sound by resonance air column method.
5. Determine Young Modulus.
6. Verify Ohm's law.
7. Determine force constant of a helical spring oscillation method.
8. Compare Emfs of two cells by using potentiometer.
9. Study characteristic curves of npn transistor.
10. Determine unknown resistance by Wheatstone bridge method.

References:

Text books (For Both Parts I and II):

1. Advanced level physics by Nelkon and Parker Vth and later editions
2. A textbook of physics, part I and part II by Gupta and Pradhan

Supplementary text:

1. College Physics by sears, Zemansky and Young, Fourth edition 1985

Textbooks for laboratory work:

1. Physics Practical Guide by U.P. Shrestha, RPB

Textbooks for numerical problems:

1. Numerical exercise in physics volume I and volume II -
   Prepared by Physics Dept., Pulchowk Campus, and published by Institute of Engineering.

Other learning materials:

1. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject
2. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject.

Engineering Chemistry II

EG 1203 SH

Total: 6 hours/week

Year: I **Lecture: 3 hours/week**

Semester: II **Tutorial: 1 hour/week**

Lab: 2 hours/week

Course description:

This subject consists of three units related to nonmetals and their compounds; metals and their compounds; and organic compounds and synthetic materials necessary to develop background in chemistry that supports for the understanding and practicing related engineering works.

Course objectives:

After the completion of this subject, students will be able to explain the basic concepts related to the followings and apply them in the field of related engineering works:

1. Nonmetals and their compounds;
2. Metals and their compounds and
3. Organic compounds and synthetic materials.

Course Contents:

Unit 1: Non-metals and their Compounds: [20 Hr]

1.1 Water:

- Source of water
- Hard and soft water
- Removal of temporary and permanent hardness of water
- Water treatment of domestic and industrial purpose

1.2 Ammonia:

- Lab preparation
- Manufacture by Haber's process
- Properties and uses

1.3 Nitric acid:
- Manufacture by Ostwald's process
- Properties and uses.
- Nitrogen cycle
- Fixation of Nitrogen
- Chemical fertilizers
- Oxides of nitrogen as pollutant (general concept)
- Acid rain (due to oxides of nitrogen and oxide of Sulphur "Sulpher dioxide")

1.4 Halogens (Chlorine):
- Lab preparation
- Properties and uses

1.5 Hydrochloric acid:
- Lab preparation
- Properties and uses

1.6 Hydrogen Sulphide:
- Lab preparation
- Properties and uses

1.7 Sulphuric acid:
- Manufacture by contact process)
- Properties and uses

1.8 Carbon and its compounds:
- Allotropes of carbon (reference of diamond & graphite & their structure).
- Oxides of carbon (Ref. carbon dioxide & carbon mono oxide as pollutants)- general idea only

Unit 2: Metals and their Compounds: [15 Hr]

2.1 General study of metals and their components:
- Combined & free state of metals
- Chemistry of Metallic Carbonates, Sulphates, Chlorides and Nitrates

2.2 Alkali metals:

- General characteristics of Alkali metals
- Properties & uses of sodium

2.3 Alkaline earth metals:

- General characteristics of the Alkaline earth metals
- Properties & uses of calcium

2.4 Aluminum:

- Properties and uses

2.5 Coinage metals:

- General properties of coinage metals
- Properties and uses

2.6 Zinc:

- Properties & uses

2.7 Iron:

- Properties & uses

2.8 Lead:

- Properties & uses

2.9 Alloys:

- Definition
- Purpose of making alloys
- Composition,
- Properties and uses of alloys of steel, aluminum, copper and zinc

Unit 3: Organic Compounds and Synthetic Materials: [10 Hr]

3.1. Organic compounds

- Organic compounds:
  - Historical background, classification, and nomenclature
  - Functional groups and homologous series
- Comparison of aliphatic and aromatic compounds
- Saturated hydrocarbon: Properties of Methane
- Unsaturated hydrocarbon: Properties of Ethylene and Acetylene
- Aromatic compounds: Properties of Benzene

3.2. **Synthetic materials:**

- Polymer and polymerization
  - Definition
  - Types of polymer
- Rubber:
  - Types (Natural and Synthetic)
  - Preparation and uses.
- Polyvinyl chloride (PVC):
  - Preparation and uses
- Polythene:
  - Preparation and uses

Practical (Laboratory)

1. To compare the hardness of different types of water
2. To prepare Bakelite (resin) in the laboratory
3. To determine the condition in which corrosion takes place
4. To investigate the action of acids on some metals (Zn, Mg, Fe, Al, Sn & Cu)(acids:- HCl, H_2SO_4(dil.)& HNO_3 (dil)
5. To prepare and study the properties of hydrogen gas
6. To prepare and study the properties of ammonia gas
7. To prepare and study the properties of hydrogen Sulphide gas. (This gas should not be prepared individually in Woulf bottle but in Kipp's apparatus commonly)
8. To detect the acid radicals (Cl^-, NO_3^{--}, SO_4^{---}, CO_3^{--}) by dry and wet
9. To detect the basic radicals (Cu^{++}, Al^{+++}, Fe^{+++}, Zn^{++}, CO^{++}, Ni^{++}, Ca^{++}, Ba^{++}, Mg^{++}) by wet ways
10. To detect the acid and basic radicals (complete salt analysis)

Textbooks:

1. Foundations of chemistry, Vol-2, M.K. Sthapit and R.R. Pradhananga
2. A text Book of chemistry, Jha & Guglani
3. A text Book of Organic Chemistry, B.S. Bahl & Arun Bahl
4. Elementary qualitative analysis, M.K.Sthapit and C.B.Tuladhar
5. Elementary practical chemistry, MK.Sthapit

References:

1. Inorganic chemistry, Bahl & Tuli
2. Elementary Organic Chemistry, P.N. Bargava
3. Fundamentals of chemistry, K.R. Palak
4. A text Book of Inorganic Chemistry, L.M. Mitra

Engineering Drawing II

EG1204 ME

Total: 4 hours /week

Year: I **Lecture: hours/week**

Semester: II **Tutorial: hours/week**

Practical: hours/week

Lab: 4 hours/week

Course Description:

This course deals with sectional view, pictorial projections, development of surfaces and intersection of solids.

Course Objectives:

After completing this course the students will be able to

1. draw sectional view of the given three dimensional solid,
2. draw pictorial projections from the given orthographic views,
3. develop the surfaces of the geometrical solids, and,
4. draw interpenetration line/curve for the given intersecting solids.

Course content:

Unit 1: Sectional Views **[8 Hr]**

1.1 Use of sectional views
1.2 Cutting plane line and hatching lines
1.3 Types of Section: Full section and Half Section
1.4 Exercise on Full Section [Sheet 1]
Exercise on Half Section [*Sheet 2]*

Unit 2: Pictorial Projection: Isometric Drawing **[12 Hr]**

2.1 Introduction to Axonometric projection
2.2 Isometric projection and isometric drawing
2.3 Procedure of Making an Isometric Drawing
2.4 Non isometric Lines and Non isometric surfaces
2.5 Box and coordinate construction method
2.6 Angles in isometric
2.7 Circles and circular arcs in isometric
2.8 Orientation of object in isometric drawing

2.9 Exercise on isometric drawing of rectangular objects with horizontal and vertical planes [Sheet 3]
Exercise on isometric drawing of rectangular objects with inclined planes [Sheet 4]
Exercise on isometric drawing of objects with cylindrical surfaces and cylindrical holes [*Sheet 5*]

Unit 3: Oblique Drawing [4 Hr]

3.1 Oblique projection and Oblique drawing
3.2 Procedure of Making an Oblique Drawing
3.3 Rules for Placing Object in Oblique
3.4 Angles, Circles and Circular Arcs in Oblique
3.5 Cavalier and Cabinet Projection
3.6 Exercise on oblique drawing of objects with plane and curved surfaces [Sheet 6]

Unit 4: Surface Development [16 Hr]

4.1 General concepts and practical considerations
4.2 Development of Right solids: Cylinder, Prism, Cone and Pyramid
4.3 Development of Oblique solids: Cylinder, Prism, Cone and Pyramid

4.4 Development of Truncated solids
4.5 Exercise on development of truncated right prism and cylinder [Sheet 7]
Exercise on development of truncated right pyramid [Sheet 8]
Exercise on development of truncated right cone [Sheet 9]
Exercise on development of oblique solids [Sheet 10]

Unit 5: Intersection of solids [12 Hr]

5.1 Lines of intersection of geometric surfaces
5.2 Intersection of two cylinders
5.3 Intersection of two prisms
5.4 Intersection of a prism and a cylinder
5.5 Intersection of a prism and a pyramid
5.6 Intersection of a prism and a cone
5.7 Intersection of a cylinder and a cone
5.8 Intersection of a cylinder and a pyramid
5.9 Exercise on intersection of two cylinders, intersection of two prisms, intersection of a prism and a cylinder [*Sheet 11*]
Exercise on intersection of a prism and a pyramid, intersection of a prism and a cone [*Sheet 12*]

Exercise on intersection of a cylinder and a cone, intersection of a cylinder and a pyramid [Sheet 13]

Unit 6: Pattern Making [8 Hr]

6.1 Pattern of three dimensional solids
6.2 Pattern of geometrical solids
6.3 Pattern of intersecting solids
6.4 Exercise on patterns of any two solid objects from Sheet 1 and 2 [*Sheet 14*]
6.5 Exercise on patterns of any two solid objects from Sheet 7, 8, 9 and 10 [*Sheet 15*]

References:

1. Luzadder, W.J., Fundamental of Engineering Drawing, Prentice-Hall of India Pvt-Ltd., New Delhi, Latest edition.
2. Bhatt N. D. and PanchalV.M., Engineering Drawing, Charotar Publishing House, 2001.
3. Gill P.S, Engineering Drawing, S. K. Kataraia & Sons, New Delhi, 2004/2005

Thermodynamics - I

EG 1205 ME

Total: 5.5 hours /week

Year: I **Lecture: 3 hours/week**

Semester: II **Tutorial: 1 hours/week**

Lab: 1.5 hours/week

Course Description:

This course deals with basic concept of thermodynamic system and the fundamental laws of thermodynamics.

Course Objectives:

After completion of this course the students will be able to understand and analyze

1. Various type of thermodynamic system
2. Energy and energy transfer
3. Properties of common substances
4. Laws of thermodynamics

Course Content:

Unit 1: Introduction [8 Hr]

- 1.1 Definition and scope of Engineering Thermodynamics
- 1.2 Thermodynamic system, surroundings and boundary
- 1.3 Thermodynamic properties
- 1.4 Thermodynamic equilibrium
- 1.5 Thermodynamic state and processes

Unit 2: Energy and Energy Transfer [6 Hr]

- 2.1 Energy and its meaning
- 2.2 Stored Energies: Internal energy, Potential energy, Kinetic energy, Total energy
- 2.3 Transient Energies: Heat Transfer, Work Transfer

Unit 3: Pressure [4 Hr]

- 3.1 Unit of pressure in different system of units and conversion from one to another

3.2 Atmospheric pressure, Vacuum, Gauge pressure and Total pressure

3.3 Types of pressure gauges, its construction and operation

Unit 4: Heat and Temperature [3 Hr]

4.1 Unit of heat and temperature in different system of measurement

4.2 Conversion of unit of heat and temperature from one system to another

4.3 Relation among molecular movement, heat, temperature and pressure

4.4 Difference among sensible, latent and specific heat

4.5 Calculation of heat added or rejected to change from one phase to another or temperature level

Unit 5: Boiling and Evaporation [2 Hr]

5.1 Difference between boiling and evaporation

5.2 Cooling effect of evaporation

5.3 Factors affecting the rate of evaporation

Unit 6: Properties of Common Substances [7 Hr]

6.1 Simple compressible substances: sub cooled liquid, saturated liquid, saturated vapor, wet vapor and super-heated vapor

6.2 Gas Laws: Boyles law, Charles law, Universal gas constant, Specific heats

6.3 Quality of steam (dryness factor)

6.4 Phase changes, P-v, T-s and P-h diagrams

Unit 7: Zeroth law of thermodynamics [1 Hr]

7.1 Equality of Temperature

7.2 Zeroth law of Thermodynamics

Unit 8: First law of thermodynamics [7 Hr]

8.1 First law of Thermodynamics for control mass system

8.2 First law of Thermodynamics for control mass system under going cyclic process

8.3 First law of Thermodynamics for control volume system

Unit 9: Second law of thermodynamics [7 Hr]

9.1 Limitation of first law and necessity of formulation of the second law
9.2 Second law of thermodynamics for an isolated system
9.3 Reversible and irreversible processes
9.4 Second law of thermodynamics for control mass system
9.5 Carnot cycle and its efficiency
9.6 Classical statements of the Second law of thermodynamics
9.7 Consequences of second law.

References:

1. C.P. Arora, Thermodynamics, Tata McGraw-Hill, India
2. D.S. Kumar, Thermal Science Engineering, S.K. Kotaria& Sons, India
3. E. Rathakrishanan E, Fundamental of Engineering Thermodynamics, Prentice Hall India
4. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications, India

Practical:

1 Mechanical Equivalent of Heat
2 Verification of first law of thermodynamics for control mass system
3 Verification of first law of thermodynamics for control volume system
4 Study of performance of Air and water heat pump
5 Study of performance of vapor compression refrigeration system

Refrigeration– I

EG 1206 RA

Total: 9 hours /week

Year: I **Lecture: 3 hours/week**

Semester: II **Practical: 6 hours/week**

Course Description:

This course has been designed to introduce the students with the world of refrigeration. This course will help the students to develop basic concepts about refrigeration, its systems, identify basic components of the systems and confirm their use.

Course Objectives:

After completion of this course, the students will be able to;

1. explain refrigeration process,
2. handle basic refrigeration tools,
3. use basic measuring instruments regarding refrigeration field,
4. join copper tubes,
5. identify various components of refrigeration system,
6. complete the wiring of simple domestic refrigerators,
7. charge the refrigerant in a domestic refrigerator.

Course Contents;

Unit 1: Basic Concepts: [10 Hr]

1.1 History of Refrigeration

1.2 Units of Refrigeration

1.3 Types of Refrigeration

1.3.1 Ice Refrigeration

1.3.2 Air Refrigeration

1.3.3 Thermo-electric Refrigeration

1.3.4 Evaporative Refrigeration

1.3.5 Absorption Refrigeration

1.3.6 Liquid Nitrogen Refrigeration

1.3.7 Vapor Compression Refrigeration

Unit 2: Components of Vapor Compression Refrigeration systems: Their Construction, Types, and Functions [13 Hr]

2.1 Compressor
2.2 Condenser
2.3 Evaporator
2.4 Liquid receiver
2.5 Accumulator
2.6 Sight glass
2.7 Oil separator
2.8 Filter drier
2.9 Vibration eliminator
2.10 Service valve
2.11 Check Valve
2.12 Pressure Relief valve (PRV)

Unit 3: Types, Construction and Operation of Flow control devices [8 Hr]

3.1 Capillary Tube
3.2 Hand Expansion Valve
3.3 Automatic Expansion Valve (AEV)
3.3 Thermostatic Expansion Valve (TEV/TXV)
3.5 Thermal-electric Expansion Valve
3.6 High-side Float
3.7 Low-side Float

Unit 4: Refrigerants [4 Hr]

4.1 Classification
4.2 Identification of Refrigerants by numbers
4.3 Properties of an ideal refrigerant
4.4 Properties and pressure-temperature charts of various refrigerants (CFC, HCFC, HFC, Hydro carbon and Natural gases)
4.5 Ozone depletion issues and alternate refrigerants

Unit 5: Lubrication [3 Hr]

5.1 Definition of lubrication
5.2 Properties of Lubricant
5.3 Types of lubricant (Natural and Synthetic poly oil)
5.4 Methods of lubrication

Unit 6: Domestic Refrigerator [7 Hr]

6.1 Refrigeration piping for Single Door/Double Door Refrigerator

6.2 Starting Relays

- 6.2.1 Current Relay
- 6.2.2 Potential Relay
- 6.2.3 Hot-wire Relay
- 6.2.4 PTC (Solid State) Relay

6.3 Permanent Split Capacitor

6.4 Overload Protector

6.5 Types, function and use of Thermostat

6.6 Construction and operation of frost free refrigerator

6.7 Condensate drainage system

6.8 Various systems of piping in a domestic refrigerator (Oil –cooling, door perimeter heating)

6.9 Important points for the smooth and efficient running of refrigerator

Reference Books;

1. Principle of Refrigeration Dossat, R.J. John Wiley & Sons Ltd.
2. Basic Refrigeration and Air-conditioning Ananthnarayan, P.N. TMH
3. A course in refrigeration and Air-conditioning: Domkundwar, Arora, S.C. Dhanpat rai & Sons

Practical

1. Distinguish between Tubes and Pipe
2. Measure copper tubes using various scales
3. Cut copper tubes using various tools (Hacksaw, Tube cutter, Triangular file)
4. Perform Reaming and Cleaning of tube ends
5. Swage the tube ends using proper tools
6. Flare the tube ends using Flaring Tools

7. Join copper tubes Using various methods and appropriate tools and equipment
   7.1 Swaging and Brazing
   7.2 Flaring
8. Bend the copper tubes using various tools (Inside/Outside Spring, Bending Tools)
9. Complete tubing projects on the basis of given measurement
10. Measure cabinet temperature using thermometers
11. Identify the tubing and different components of domestic refrigerator/freezer and draw the mechanical system diagram
12. Identify compressor terminals by measuring resistance
13. Trace and prepare free hand sketch of electrical circuit of domestic refrigerators
14. Complete electrical circuit of a simple domestic refrigerator using necessary components
    (Current / Hot-wire / PTC Relay, Door switch, Cabinet light, Over-load protector, Thermostat, Start capacitor)
15. Trace and Draw electrical circuit of a frost free refrigerator
16. Check the performance of frost-free Refrigerator
17. Charge the refrigerant in a domestic refrigerator using appropriate process and tools
    (Measure Pressure, Evacuation, Leak testing, Charging by different methods)

Basic Electrical Engineering

EG 1207 EE

Total: 7 hours /week

Year: I **Lecture: 4 hours/week**

Semester: II **Practical: 3 hours/week**

Course Description:

This course provides knowledge and understanding on the basics of theory of fundamentals of electrical engineering and helps the students to develop the skills on different laboratory works related to the subject.

Course Objectives:

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

1. Understand and explain the basic laws of electrostatics, electrolysis, electric circuits, electrical power and energy, magnetism and electromagnetism.
2. Understand and calculate the basic units of voltage, current resistance, power, energy, inductance and capacitance and the application of each.

Course content:

Unit 1: Modern Electron Theory and Basic Concept of Electricity [3 Hr]

1.1. Fundamentals of electricity, matter, molecule and atom, structure of atoms- electrons, protons and neutrons, free electrons

1.2. Electric charge and current, movement of electrons in a conductor, electric current and its units, conventional direction of electric current, electricity and its uses.

1.3. Electric field, potential and potential difference, potential gradient, electromotive force, voltage and its units.

Unit 2: Fundamentals of Electric Circuits [8 Hr]

2.1 Definition of an electric circuit and its elements – sources of energy, Resistor, Inductor, and Capacitor

2.2 Voltage and current sources - Independent and dependent

2.3 Resistance – physical meaning and its role in electric circuits, units, conductors, insulators and semiconductors with regard to their resistance value.

2.3 Factors affecting the value of resistance, effect of temperature on resistance.

2.4 Connection of resistance in series and parallel, calculation of equivalent resistance

2.5 Explanation of Ohm's law, definition and practical application. Analogy with water flow system.

2.6 Explanation of Kirchhoff's laws, definition and practical application

Unit 3: Electrical Power and energy [2 Hr]

3.1 Electrical power, its units and practical application

3.2 Electrical energy, its units and practical application

Unit 4: Electrostatics and capacitance [8 Hr]

4.1 Laws of electric forces, Electric field and electric field intensity, Electric flux and flux density

4.2 Dielectrics, permittivity and relative permittivity

4.3 Electrostatic induction phenomenon

4.4 Definition of Capacitors and capacitance, units, factors affecting the capacitance of a capacitor, parallel plate capacitor, type and application

4.5 Connection of capacitance in series and parallel, calculation of equivalent capacitance

4.6 Energy stored in charged capacitor

4.7 Charging and discharging of capacitor, time constant for charging/discharging

Unit 5: Magnetism and inductance [7 Hr]

5.1 Definition of permanent magnet and electro magnets, magnetic and non magnetic material, magnetic field ,field intensity, magnetic flux, flux density

5.2 Permeability and relative permeability of magnetic material

5.3 Definition of inductors and Self inductance, coefficient of self inductance (L), Mutual inductance, coefficient of mutual inductance (M), coefficient of coupling.

5.5.Factors affecting the inductance of a coil, Energy stored in a current carrying inductor

5.6. Connection of inductance in series and parallel, calculation of equivalent inductance

Unit 6: Magnetic Circuit and Electromagnetism [8 Hr]

6.1 Magnetic circuit, Magneto Motive Force(MMF), magnetizing force,(Ampere Turns), permeability, reluctance, analogy to electric circuit

6.2 Relation between electricity and magnetism, application of magnetic effect of current, principle of electromagnetism, magnetic induction, faraday's law of electromagnetic induction, production of induced emf & current, magnitude and direction of induced emf & current

6.3 Statistically & Dynamically induced emf, Lenz's law,

6.4 Explanation of magnitude and direction of force on a conductor carrying current in a magnetic field, Fleming's Left Hand Rule

Unit 7: Fundamentals of alternating current and single phase circuits [9 Hr]

7.1 definition and comparison of direct and alternating current and voltage, definitions of ac terms – frequency, time period, phase and phase difference, basic idea of generation of alternating emf (a sine wave), in-phase and out of phase quantities

7.2 Definition of instantaneous, average and RMS values of alternating current and voltage

7.3 Current, voltage and power equations and waveforms in pure a resistive, inductive and capacitive circuit

7.4 Current, voltage and power equations and waveforms in a series R-L, R-C and R-L-C circuits, definition and derivation of reactance, impedance and power factor in such circuits, industrial importance of power factor

7.5 power in ac circuit – active, reactive and apparent power

7.6 Introduction of parallel ac circuits

Unit 8: Three - Phase circuits [9 Hr]

8.1 Definition of three-phase system, phase sequence, numbering of phases, advantages of 3-phase over 1-phase, general idea on the generation of 3-phase emf

8.2 Star connection of 3-phase windings, neutral point, relationship between line voltage/current and phase voltage/current, power consumed by a star connected load

8.3 Delta connection of 3-phase windings, relationship between line voltage/current and phase voltage/current, power consumed by a delta connected load

8.4 Concept of balanced and unbalanced loads, idea of neutral current

Unit 9: Distribution and Supply system [6 Hr]

9.1 Introduction to Generation, Transmission and distribution system of Nepal

9.2 Supply system for residential (1-phase) and commercial establishment (3-phase)

9.3 Control system for distribution arrangement – MCB, MCCB, relays, circuit breaker, panels, single phase preventer, ELCB

9.4 Cables – HV and LV cables

9.5 Earthing and its types - system and equipment

Practical

1. Perform the correct connection of voltmeter, ammeter, fixed and variable resistors in an electric circuit and hence observe the correct handling and application of the equipment
2. Use of Ammeter and Voltmeter to measure current, voltage and resistance and specific resistance of a resistor. Identify scale and range settings of such meters.
3. Verification of Ohm's law .
4. Connection of resistors in series and parallel with ammeters and voltmeters to calculate equivalent resistance and to verify Kirchhoff's laws.
5. Connect a circuit with a voltmeter, ammeter and resistor to calculate the power and energy consumed by the resistor in 5 minutes.

6. Charging and discharging of capacitor and hence calculate the time constant.
7. Connect capacitors in series and parallel, charge them and hence calculate the equivalent capacitance and voltage.
8. B-H Curve for hard and soft magnetic materials.
9. Connect a circuit with 4 batteries in series and parallel and hence find the equivalent emf.
10. Measurement of internal resistance of batteries.
11. Verify the existence of a magnetic field around a conductor carrying current and measure its direction and magnitude.
12. Verify that a force is experienced by a current carrying conductor in a magnetic field and measure its direction and magnitude.
13. Use oscilloscope and be familiar with its operation to measure dc/ac quantities.
14. Use oscilloscope to measure frequency, time period, phase and phase difference of an alternating voltage.
15. Measurement of current and voltage in an R-L, R-C and R-L-C series circuits and hence verify the results.
16. Measurement of current and voltage in an R-L, R-C and R-L-C parallel circuits and hence verify the results.
17. To be familiar with 3-phase supply and 3-phase load.
18. To be familiar wit star and delta connections.
19. Connect the loads in star and delta to measure phase and line currents and voltages.
20. To be familiar with 3-phase electrical circuit along with necessary measuring instruments to determine
    (a) Active Power
    (b) Reactive Power
    (c) Apparent Power
    (d) Power Factor

REFERENCES

1. A textbook of Electrical Technology by B.L Theraja
2. A Course in Electrical technology by J. B. Gupta
3. Principles of Electrical Engineering by Vincent Del Toro

Second Year
(Third and Fourth Semesters)

Second Year/Third Semester

Subjects:

1. EG 2101 EX Basic Electronics Engineering
2. EG 2102 EE Electrical Machines and Control
3. EG 2103 RA Thermodynamics-II
4. EG 2104 EE Electrical Drawing - I
5. EG 2105 RA HVAC-I
6. EG 2106 RA Refrigeration-II

Basic Electronics Engineering

EG 2101 EX

Total: 7 hour /week

Year: II **Lecture: 4 hours/week**

Semester: III **Lab: 3 hours/week**

Course Description:

This course is designed to provide practical and essential theory about modern electronics components

Course Objective:

After completion of this course the students will be able to;

1. explain practical and essential theory on modern electronic components.
2. explain technical and analytical skills required by Refrigeration and Air Conditioning Engineers, Technicians to use different Electronics Controls.

Course Content:

Unit 1: Introduction : [2 Hr]

1.1 Importance of electronics in modern society.

1.2 Use of electronics in Electro Mechanical Control system and automation.

Unit 2: Introduction to electronic passive components [10 Hr]

2.1 Resistors and potentiometers

- Introduction, Classification and Demonstration of various types of Fixed Resistors and Variable
- Resistors, Resistor Color Codes.
- Resistor Circuits. Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.
- Characteristics, Application and Demonstration of Thermistors, LDR.

2.2. Inductive components

- Introduction, Classification and Demonstration of various type of Inductive Components and basic construction.
- Types of Inductors used in electric & electronic circuit.
- Inductance Circuits, Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.

2.4 Capacitors

- Introduction, Classification and Demonstration of Capacitance and Capacitor and basic construction and units.
- Types of Capacitors and their application in Electrical & Electronic circuit.
- Capacitor Circuits: Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.

Unit 3: Principles of semiconductors [6 Hr]

3.1 Introduction to Semiconductor: Atomic structure, Semi-conductor Crystals and their characteristics.

3.2 Adding impurities to semiconductors, Donor and Acceptor impurity in intrinsic Germanium.

3.3 N Type and P Type Semiconductor.

Unit 4: Semiconductor diode [8 Hr]

4.1 PN Junction Diode

- Basic construction, Junction barrier & barrier potential.
- Forward and Reverse Bias Characteristics of Junction Diode.
- Point contact diode (Signal Diode).
- Application of Diode. Half Wave Rectifier, Full Wave Center Tapped and Bridge Rectifier circuit.
- Rectifier Filter Circuits. Principles of operation of Capacitor filter, RC and LC Filter Circuit
- Clipping and Clamping Circuits
- Checking of Diode using Ohm Meter.

4.2 Zener Diode

- Basic construction and operation of a Zener diode.
- Forward and reverse bias Characteristics of a Zener diode.
- Application of Zener Diode as a Voltage Regulator.

Unit 5: Introduction to Bi-Polar Junction Transistor (BJT). [8 Hr]

5.1 Basic structure of BJ: PNP and NPN type.

5.2 Biasing of PNP and NPN Transistor, principles of operation.

5.3 Voltage and Current Characteristics: Input and Output Characteristics, Collector current as a function of base current (Family of Collector characteristics curve), Cutoff, Saturation and DC Load line.

5.4 Basic Configuration of Transistor Circuits: Common Emitter (CE), Common Base (CB) and Common Collector (CC)

5.5 Demonstration various types of Transistors, Transistor Rating and interpretation of Transistor Data sheet.

5.6 Testing of Transistor by using Ohm-meter

Unit 6: Transistor amplifiers circuits [10 Hr]

6.1 Introduction, Principles of operation and characteristics to Common Emitter (CE) Amplifier, Common Collector (CC) Amplifier and Common Base (CB) Amplifier circuit.

6.2 Transistor Leakage current (I_{CBO}, I_{CES}, & I_{CEO}) & Temperature stability Transistor circuit, use of Heat sink to prevent the Transistor from over heating

Unit 7: RC coupled small signal common emitter amplifier [6 Hr]

7.1 Introduction and principles of operation Class of operation (Class A, Class B and Class C) of RC coupled Amplifier, Transformer coupled Amplifier and Direct coupled Amplifier circuit.

7.2 Introduction to feedback. Positive and Negative feedback in Transistor Amplifier.

Unit 8: Special semiconductor devices [10 Hr]

8.1 Silicon Controlled Rectifier (SCR)

- Basic construction & physical features of SCR
- Voltage - current characteristics.
- Application of SCRs

8.2 Uni-junction Transistor (UJT)

- Basic construction & physical features of UJT
- Voltage - current characteristics.
- Application of UJT. (Relaxation Oscillator and Relay control circuit)

8.3 Junction Field Effect Transistor (JFET)
- Basic construction & physical features of JFET
- Voltage - current characteristics of JFET.
- Application of JFET.

8.4 Metal Oxide Semiconductor (MOSFET)
- Basic construction & physical features of MOSFET
- Voltage - current characteristics.
- Application of MOSFET.

8.5 Photo Diode and Opto Coupler
- Basic construction & physical features and operation of Photo diode.
- Application of Photo Diode and Opto Coupler.

8.6 Capacitance Diode (Varactor Diode)
- Basic construction & physical features and operation of Varactor diode.
- Application of Varactor diode.

LIST OF LABORATORY EXPERIMENTS:

1. Introduction to Laboratory Equipment.
2. Measurement of Voltage, Current , Resistance and Series & Parallel Resistance Circuit
3. PN Junction Diode and Zener Diode Characteristics.
4. HW and FW rectifier – waveforms and characteristics
5. BJT characteristics – C.E. input and output characteristics
6. Transistor Small Signal CE Amplifier Circuit.
7. FET characteristics – C.S. input and output characteristics
8. SCR characteristics – V and I characteristics
9. Tunnel diode characteristics – V and I characteristics
10. Photo diode characteristics – V and I characteristics

References:

1. Basic Electronics by Bernard Grob
2. Electronics Principles by Malvino
3. Electronic Devices by Floyd
4. Basic Electronics Solid State - B.L. Theraja
5. Electronic Principles - Sanjay Sharma
6. Basic Radio Vol 1 to Vol 6 - Marvin Tepper

Electrical Machines and Control

EG 2102 EE

Total: 7 hours /week

Year: II **Lecture: 4 hours/week**

Semester: III **Practical: 3 hours/week**

Course Description:

This course provides knowledge and understanding on the construction and working principle of electrical machines. It also provides knowledge of control of machines using different parameters.

Course Objective:

After completion of this course the students will be able to;

1. compare between magnetic and electrical circuit
2. explain the operation and application of different types of transformer
3. explain the principles of operation and working of DC generator, DC motor and induction motors
4. explain the principles of operation and working of Three Phase Synchronous Generator and Fractional Kilowatt Motors

Course Content:

Unit 1: Magnetic Circuit [6 Hr]

- 1.1 Comparison between Magnetic circuit and electrical circuit, Magnetic circuits and Ampere's law
- 1.2 Types of magnetic circuit
- 1.3 Ferromagnetic materials
- 1.4 Hysteresis curve
- 1.5 Hysteresis & Eddy current losses
- 1.6 Faraday's Laws of electromagnetic induction, Sell & mutual inductances
- 1.7 Magnetically coupled circuits.

Unit 2: Transformer [8 Hr]

- 2.1 Transformer-Construction, working principle

2.2 Transformer on load, Real transformer and equivalent circuit.
2.3 Losses in transformer, open circuit and short circuit loss.
2.4 Efficiency and voltage regulation
2.5 Auto-transformer and Instrument transformer.
2.6 Three phase transformer, advantages and disadvantages of single unit three phase transformer .
2.7 Different types of transformer connection.(Y/Y, Y/Δ, Δ/Y, Δ/Δ and V/V (or open Δ) connections
2.8 Choice between star and delta connection, choice of transformer connection.
2.9 Parallel operation of single phase and three phase Transformers

Unit 3: D.C Generator [8 Hr]

3.1 Construction and Operating principle of dc generator
3.2 EME equation of DC generator
3.3 Types of DC generator
3.4 Armature reaction and commutation.
3.5 Characteristics of DC generator
3.6 Application of DC generator

Unit 4: D.C Motor [8 Hr]

4.1 Construction and working principle of DC motor
4.2 Torque equation of DC motor
4.3 Types of DC motor
4.4 Characteristics of DC motor
4.5 DC motor starters:- Three point and four point starters
4.6 Speed control of DC motor
4.7 Application of DC motor

Unit 5: Induction motor [10 Hr]

5.1 Introduction and construction of three phase induction motor
5.2 Operating principle and generation of rotating magnetic field.
5.3 Starting and Running torque
5.4 Torque slip characteristics
5.5 Speed control of Induction motor
5.6 Energy stages, Losses and efficiency
5.7 Induction motor starter
5.8 Application of Induction motor

Unit 6: Three Phase Synchronous Generator [10 Hr)

6.1 Constructional Details, Types of Rotor, Exciter
6.2 Working Principle, Rotating Magnetic Field
6.3 EMF equation, distribution factor, pitch factor
6.4 Armature Reaction and its effects
6.5 Alternator with load and its phasor diagram
6.6 Voltage Regulations
6.7 Parallel Operation and Synchronization

Unit 7: Fractional Kilowatt Motors [10 Hr)

7.1 Single phase Induction Motors: Construction and Characteristics
7.2 Double Field Revolving Theory
7.3 Split phase Induction Motor
    7.3.1 Capacitor start motor
    7.3.1 Capacitors start and run motor
    7.3.3 Shaded pole motor
    7.4 Reluctance start motor
7.5 Universal motors
7.6 Special Purpose Machines: Stepper motor, Schrage motor and Servo motor

Practical

1. To draw B-H curve for two different sample of Iron Core
2. To perform turn ratio test of a transformer
3. To perform open circuit (OC) and short circuit (SC) test to determine equivalent circuit parameter of a transformer and hence to determine the regulation and efficiency at full load
4. To examine exciting current harmonics
5. To draw open circuit characteristic (OCC) of a DC shunt generator and to calculate: (a)Maximum voltage built up (a)Critical resistance and critical speed of the machine
6. To draw load characteristic of shunt generator
7. Speed control of DC Shunt motor by (a) armature control method (b) field control method
8. To draw torque-speed characteristics and to observe the effect of rotor resistance on torque-speed characteristics

9. To perform no load and blocked rotor test to evaluate equivalent circuit parameters.
10. To study No-load characteristics of a 3-phase synchronous generator
11. To study load characteristics of synchronous generator with (a) resistive load (b) inductive load and (c) capacitive load
12. To study the effect of a capacitor on the starting and running of a single-phase induction motor

Reference Books:

1. I.J. Nagrath & D.P. Kothari, *Electric Machines*, Tata McGraw Hill, India.
2. E. Fitzgeral, C. Kinsley & S. Dumans, *Electric Machinery*, Tata MvGraw Hill, India Ltd. 1984.
3. P.S. Bhimra, *Electrical Machinery*, Khanna Publisher, India.
4. M.G. Say, *AC Machnies.*
5. Dr. Kohli, *A Laboratory Course in Electrical Machnie*, Nemchand & Bros. Roorkee.
6. Electrical Technology (Electrical Machines) J.B Gupta S.K Kataria & Sons.

Thermodynamics II

EG 2103 ME

Total: 5.5 hours /week

Year: II **Lecture: 3 hours/week**

Semester: III **Tutorial: 1 hours/week**

Practical: 1.5 hours/week

Course Description:

This course deals with the application of laws of thermodynamics, types and functions of heat engines and refrigeration cycles, boilers, air compressors and internal combustion engines.

Course Objectives:

After completing this course the students will be able to;

1. explain the working of Heat engines and refrigeration cycles
2. explain the working of various types of boilers.
3. explain the working of various types of air compressors.
4. explain the working of various types of internal combustion engines.

Course Content:

Unit 1: Thermodynamic Cycles **[10 Hr]**

- 1.1 Carnot cycle and its efficiency
- 1.2 Classification of Thermodynamic cycles
- 1.3 Gas Powered Heat Engine cycles:
  (Air standard Otto, Diesel and Brayton cycles)
- 1.4 Vapor powered cycle :
  - 1.4.1 Simple Rankin Cycle
  - 1.4.2 Modified Rankin Cycle
- 1.5 Refrigeration Cycle:
  - 1.5.1 Simple vapor compression refrigeration cycle
  - 1.5.2 Modified vapor compression refrigeration cycle

Unit 2: Boilers **[11 Hr]**

- 2.1 Introduction and applications
- 2.2 Classifications of boilers and comparison between fire tube and water boilers

2.3 Cochrane Boiler: construction, operation, and special features
2.4 Lancashire Boiler: construction, operation, and special features
2.5 Locomotive Boiler: construction, operation, and special features
2.6 Bob cock and Wilcox Boiler: construction, operation, and special features
2.7 Requirements of an ideal boiler
2.8 Boiler mountings and accessories: Water level indicator, feed check valve, blow off valve, safety valves, air pre-heater, super heater and economizer

Unit 3: Air compressors [12 Hr]

3.1 Introduction and applications
3.2 Classifications of air compressors
3.3 Construction and operation of : Reciprocating, Rotary, Centrifugal, Axial, Screw and Scroll Compressor.
3.4 Comparison of various compressors.

Unit 4: Internal Combustion Engines [12 Hr]

4.1 Introduction and applications
4.2 Classifications of Internal Combustion Engines
4.3 Construction and operation: Two Stroke, Four Stroke, Diesel and Petrol Engines
4.4 Comparison between two stroke and four stroke engines
4.5 Comparison between Diesel and Petrol Engines

Practical:

1. Study performance of vapor compression refrigeration system
2. Study performance of Boilers
3. Study performance of air compressor
4. Study performance of Diesel engines
5. Study performance of Petrol engines

References:

1. C.P. Arora, Thermodynamics, Tata McGraw-Hill, India
2. D.S. Kumar, Thermal Science Engineering, S.K. Kotaria& Sons, India
3. E. Radhakrishanan, Fundamental of Engineering Thermodynamics, Prentice Hall India
4. P.K. Nag, Basic and Applied Thermodynamics, Tata McGraw-Hill, India
5. R.K. Rajput, Thermal Engineering, Laxmi Publications, India

Electrical Drawing – I

EG 2104 EE

Total: 4 hours /week

Year: II **Lecture: hours/week**

Semester: III **Practical: 4 hours/week**

Course Description:

Refrigeration and Air-conditioning engineering being one of the branches of Electro-mechanical engineering, the knowledge of electrical drawing is essential. The drives and control systems basically utilizes electricity and this course delivers the knowledge of Electrical Drawing.

Course Objective:

After completion of this subject, the students will be able to;

1. Identify different symbols of electrical components
2. Identify different types of electrical drawing,
3. Follow different typed of drawing,
4. Draw the control system of refrigeration and Air-conditioning system

Course Content:

Unit 1: Electrical symbols (layout and wiring) and conventions [8 Hr]

Unit 2: Basic information about types of wiring and Circuit [4 Hr]

(open, closed and short)

(a) Installation wiring diagram

(b) Layout or line wiring diagram

(c) Schematic wiring diagram

(d) Complete wiring or connection diagram

Unit 3: Different types of Switches [4 Hr]

Unit 4: Circuit diagram for domestic Lighting Circuit [10 Hr]

4.1 Circuit with one-way switches for lightings and sockets with MCB and DP Switch.

4.2 Circuit with one way/two-way switches to control light / lights/fan/tube light with MCB and DP Switch.

Unit 5: Drawing & Interpretation of Typical Line and Schematic Circuit [34 Hr]

5.1 Simple domestic refrigerator with different type of relays (Current, Hot-wire, Potential and Electronic)

5.2 Domestic refrigerator with Food Compartment light operated by door switch, Condenser fan, door heater and thermostat,

5.3 Electrical circuit of a frost free refrigerator involving time delay relay, LP cut out, HP cut out, differential oil pressure switch for frost free operation.

5.4 Electrical circuit of commercial refrigerators/Deep freezers and walk-in coolers

References:

1. *General Electrical Drawing,* PartI, Surjit Singh, S.K. Kataria

2. *A Course in Electrical Engineering ,* J.B. Gupta, S.K. Kataria

3. *Principle of Refrigeration ,* R.J. Dossat, John Wiley & Sons Ltd.

4. *Basic Refrigeration and Air-condition ,* P.N. Ananthnarayan

Heating, Ventilation & Air-Conditioning (HVAC) - I

EG 2105 RA

Total: 7 hours /week

Year: II **Lecture: 3 hours/week**

Semester: III **Tutorial: 1 hours/week**

Practical: 3 hours/week

Course Description:

This course deals with the study of various properties of air, psychrometric chart and various psychrometric processes, working of main components, and functions of conventional refrigeration and air-conditioning systems. It also describes the uses of and types of refrigeration and air-conditioning applications and incorporates the study of refrigerants and psychrometry.

Course Objectives:

After this course the students will be able to:

1. Describe the uses of various kinds of RAC machines
2. Explain the operation of components of conventional RAC machines
3. Install, check and carry out servicing of these components and system as a whole

Course Content:

Unit 1: Introduction [2 Hr]

1.1. Definition and scope of Air-conditioning

1.2 History of Air-conditioning

1.3 Parameters of Air-conditioning System(Temperature, Humidity, Air quality and Air velocity)

Unit 2: Psychrometry [10 Hr]

2.1. Psychrometry and psychrometric properties

2.2 Psychrometric relation: Dalton's law of partial pressure

2.3 Measurement of dry bulb temperature, wet bulb temperature and relative humidity

2.4 Psychrometric chart and its uses

2.5 Psychrometric processes: Sensible heating, sensible cooling, humidification, dehumidification, cooling with dehumidification, cooling with adiabatic humidification, chemical adiabatic

dehumidification , heating with humidification, mixing of two air streams and their representation on Psychrometric chart.

Unit 3: Air-conditioning (AC) system [10 Hr]

3.1 Classification of air-conditioning system
3.2 Direct expansion (DX) air-conditioning system
3.3 All water Air-conditioning system
3.4 All air Air-conditioning system
3.5 Air Water- Air-conditioning system
3.6 Heat pump type air-conditioning system

Unit 4: Air Conditioning system type [8 Hr]

4.1 Window
4.2 Split
4.3 Package
4.4 Central

Unit 5: Air distribution systems [12 Hr]

5.1 Introduction
5.2 Classification of duct
5.3 Construction of duct
5.4 Components of Air distribution system: fan, air filter, eliminator, heating coil, cooling coil, humidifier, dehumidifier, dampers, Grill, diffuser

Unit 6: Evaporative cooler [3 Hr]

6.1 Principle of operation
6.2 Construction and operation of Evaporative fan and Desert cooler

References:

1. Domkundwar & Arora, A course in Refrigeration and air conditioning, Dhanpat Rai and sons, 1682, Nai Sarak, Delhi – 110006, India
2. E. RathaKrishanan, 2002 Fundamental of Engineering Thermodynamics, Prentice Hall India Pvt. Ltd, New Delhi – 110001, India
3. R.K. Rajput, Refrigeration and Air-conditioning, S.K. Kataria & Sons, India

Practical :

1. Study of various psychrometric process
2. Dismantling, Assembling, Repair and Maintenance of non-inverter type single split air-conditioning unit
3. Dismantling, Assembling, Repair and Maintenance of inverter type single split air-conditioning unit
4. Dismantling, Assembling, Repair and Maintenance of VRF multi split air-conditioning system
5. Dismantling, Assembling, Repair and Maintenance of ductable type air-conditioning system

Refrigeration – II

EG 2106 RA

Total: 10 hours /week

Year: II **Lecture: 3 hours/week**

Semester: III **Tutorial: 1 hours/week**

Practical: 6 hours/week

Course Description:

This course has been designed to impart the knowledge regarding commercial refrigeration systems and various refrigeration devices. This course will also develop the skills for setting controlling devices as well as analyzing performance of the systems.

Course Objectives:

After completion of this course, the students will be able to;

1. install and operate commercial systems
2. handle refrigerator having absorption system
3. analyze vapor compression system
4. identify various insulating materials
5. calculate heat transfer and
6. handle ice manufacturing plants

Course Contents;

Unit 1: Commercial refrigeration system and equipment [6 Hrs]

1.1 Function and working of display/storage cases/Deep-freezers

1.2 Construction and operation of

1.2.1 Low-pressure Cut-out (LPC)

1.2.2 High-pressure Cut-out (HPC)

1.2.3 Differential Pressure Cut-out

1.2.4 Oil Pressure Differential Switch

1.3 Construction and operation of Pump-down system

Unit 2: Absorption Refrigeration System [6 Hr]

2.1 Introduction
2.2 Principles of absorption system
2.3 Practical absorption system using Ammonia and Water
2.4 Absorption system using Ammonia, Water and Hydrogen (Electrolux System)
2.5 Absorption System using Lithium Bromide Solution
2.6 Vapor absorption verses vapor compression system

Unit 3: Vapor Compression System [6 Hr]

3.1 Analysis of vapor compression cycle on pressure-enthalpy diagram. Wet compression, Vapor dry at suction of compressor, Vapor superheated at suction of compressor and liquid sub-cooled before throttling
3.2 Wet verses dry compression. Sources of superheating and its effects and the effects of foreign material on the performance of refrigeration cycle
3.3 Deviation of actual cycle from theoretical vapor compression cycle
3.4 Calculation of Coefficient of performance (COP) of a vapor compression Refrigeration System

Unit 4: Heat Transfer [11 Hr]

4.1 Modes of heat transfer
4.2 Fourier's law and conduction through slab and pipes
4.3 Conduction through composite walls and pipes. Numerical exercises
4.4 Expression for heat transfer by convection, combined conduction and convection
4.5 Nature of thermal radiation
4.6 Stefan – Boltzmann law, Absorptivity, Reflectivity and Transmitivity
4.7 Construction and principal of operation of hear exchanger

4.8 Temperature distribution of fluids in parallel flow heat exchanger. The equation of heat transfer and the meaning of log mean temperature difference

4.9 Cooling load determination exercises involving wall gain load and product load

Unit 5: Thermal Insulation [4 Hr]

5.1 Properties of an ideal insulating material

5.2 Types of Insulating Material

5.3 Critical thickness of insulation

Unit 6: Production of Low Temperature [4 Hr]

6.1 Limitations of Vapor Compression system for the production of low temperature

6.2 Multi-stage refrigeration system and its limitation

6.3 Cascade System

6.4 Application of low temperature

Unit 7: Liquefaction of air [4 Hr]

7.1 Joule Thompson Effect

7.2 Claude System

Unit 8: Water Coolers and Ice Making [4 Hr]

8.1 Construction and working of Water Coolers

8.2 Construction and working of portable ice making machines

8.3 Principles of Ice production in a commercial scale

8.4 Different commercial system of ice manufacture

References:

1. Principle of Refrigeration, Dossat, R.J., John Wiley & Sons Ltd.

2. Basic Refrigeration and Air-conditioning, Ananthnarayan, P.N., TMH

3. A course in Refrigeration and Air-conditioning: Domkundwar, Arora, S.C Dhanpat rai and Sons

Practical:

1. Assemble AEV, TXV and Thermo-Electric Expansion Valve in a system
2. Adjust superheating in the system having above listed device
3. Check the performance of a walk-in cooler
4. Check the performance of different deep-freezer
5. Check the performance of a commercial cold-storage
6. Install LPC, HPC and adjust the differential pressure
7. Install Oil Pressure differential switch and Solenoid Valve: Adjust and check the performance
8. Carryout the maintenance of the burner/Heater and check the performance of a refrigerator having Absorption Refrigeration System
9. Identify different types of Insulating materials
10. Check the performance of Water cooler and draw the mechanical and electrical system diagram
11. Check the performance of Ice making machine and draw the mechanical and electrical system diagram

Second Year/Fourth Semester

Subjects:

1. EG 2201 EX Applied Electronics
2. EG 2202 RA Fluid Mechanics and Machines
3. EG 2203 RA HVAC-II
4. EG 2204 **EE** Electrical Drawing-II
5. EG 2205 **CT** Computer Aided Drawing
6. EG 2206 RA Refrigeration-III

Applied Electronics

EG 2201 EX

Total: 7 hours /week

Year: II **Lecture: 4 hours/week**

Semester: IV **Lab: 3 hours/week**

Course Description:

This course deals with various theories and applications related to digital electronic components and logic devices.

Course Objectives:

After completing this course the student will be able to;

5. explain the concept of integrated circuit, digital electronics, combinational logic devices, logic families
6. explain basic characteristics, sequential logic devices, analog and digital conversion as well as memory and addressing
7. explain the basic concept regarding assembly language programming

Course content:

Unit 1: Introduction to integrated circuit [2 Hr]

1.1 Introduction to IC, basic construction of IC chip
1.2 Monolithic Integrated circuit.
1.3 Large scale Integrated circuit (LSI).
1.4 General classification of Integrated Circuits based on application. (Linear and Digital ICs).
1.5 Illustration of some Linear ICs. Voltage regulator IC, Timer IC, OP Amplifier etc

Unit 2: Introduction to digital electronics [2 Hr]

2.1 Introduction to Analogue and Digital Signal
2.2 Two state operation and its advantages
2.4 Transistor Switch and Relay operation.

Unit 3: Introduction to number system [8 Hr]

3.1 Decimal Number System
3.2 Binary Number System

3.3 Octal Number System
3.4 Hexa -Decimal Number System
3.5 Conversion of Number system
3.6 Addition, Subtraction, Multiplication, Division.
3.7 Signed and Unsigned Binary Numbers.
3.8 Binary Coded Decimal Numbers and ASCII Codes.

Unit 4: Fundamentals of digital electronics [8 Hr]

4.1 Principles of operations of two state operation and its advantages.
4.2 Operation of Transistor as a Switch and Relay Control.
4.3 Introduction to Logic Gates (NOT, AND, OR, NAND, NOR XOR). Symbols, Truth Tables, Boolean Algebra and Associate Rules.
4.4 Boolean Algebra and Associate Rules.
4.5 De-Morgan's Theorem.
4.6 Universal Gate conversion.
4.7 Minimization of Logical Expressions using Boolean Algebra.
4.8 Application of Karnaugh's Map (K-Map) for minimization of Logical expressions.

Unit 5: Introduction to combinational logic devices [6 Hr]

5.1 Encoder / Decoder – Decimal to Binary, Binary to Gray Code, Priority Encoder.
5.2 Seven Segment Display Decoder.
5.3 Multiplexer and De-Multiplexer.
5.4 Parity Generator and Checker.
5.5 Half Adder, Full Adder and Subtractor.
5.6 Nibble and Bite Adder and Subtractor.

Unit 6: Introduction to logic families and basic characteristics [6 Hr]

6.1 TTL Family and Devices.
6.2 CMOS Family and Devices.
6.3 ECL Family and Devices.
6.4 Comparison of above mentioned Logic families in terms of Input/Output Voltage, Current, Supply Voltage, Operation temperature, Fan-in, Speed and Noise Margin.
6.5 Standard available Devices in different families and Compatibility.
6.6 External Driving Devices. Opto-Coupler, LED, Relays.

Unit 7: Introduction to sequential logic devices [13 Hr]

7.1 Mono-stable , Bi-stable and Astable Devices.
7.2 Latches and Filp-flop.
7.3 Triggering of Flip-flop.
7.4 SR and D Flip-flop.
7.5 Clocked Flip-flop.
7.6 JK, T Flip-flop.
7.7 Master –Slave Flip-flop.
7.8 Synchronous and asynchronous Counter.
7.9 Binary Counters, BCE Counters and Mode N counters.
7.10 Shift Registers – Shift left and Shift Right.
7.11 Serial and Parallel registers.
7.12 Ring Counters.
7.13 Application of counters – Digital clock, Frequency Counter.

Unit 8: Introduction to analog and digital conversion [5 Hr]

8.1 Analogue to Digital Conversion.
8.2 Digital to Analogue Conversion.
8.4 Basic characteristics of Converters – accuracy and speed

Unit 9: Introduction to memory and addressing [4 Hr]

9.1 Functions of Flip-flop as Memory.
9.2 Types of Memory : ROM , RAM , PROM , EPROM, EEROM, UVPROM.
9.3 Static and dynamic Memory.
9.4 Memory addressing and address decoding logic

Unit 10: Fundamental to microprocessor [3 Hr]

10.1 History of Microprocessor
10.2 Basic Architecture of 8085 Microprocessor and its operation

Unit 11: Introduction to assembly language programming [3 Hr]

11.1 Basic programming of 8085 using instructions available in 8085.
11.2 Data Transfer and logical instructions.

LIST OF LABORATORY EXPERIMENTS:

1. Transistor Switch and Relay Control
2. Function and Operation of Logic Gates and Verification of Truth Table. NOT, AND, OR, NAND , NOR, XOR
2. Multiple (Three and Four) Input Gates.
3. Verification of De-Morgan's Theorem.
4. Construction and verification of Encoder and Decoder.
5. Construction and verification of Flip-Flops
6. Construction of Mono stable, Bi- Stable, Astable Multi-vibrators using 555 IC
7. Analogue to Digital (A/D) conversion using R- 2R Ladder Circuit.

References:

1. Digital Computer Electronics by Albert Paul Malvino,
2. Digital Principles and Applications by Malvino, A.P and Leach, D.P.
3. ELECTRONIC DEVICES and CIRCUITS by J.B. Gupta

Fluid Mechanics and Fluid Machines

EG 2202 ME

Total: 5.5 hours /week

Year: II **Lecture: 3 hours/week**

Semester: IV **Tutorial: 1 hours/week**

Lab: 1.5 hours/week

Course Description:

This course deals with the general theories and equations of fluid mechanics. It also describes various applications of theories including water turbines and pumps.

Course Objectives:

After completing this course the student will be able to explain:

1. General properties of fluids
2. Various characteristics of fluid at static and kinematics conditions
3. Basic theories and equations of fluid mechanics with their applications
4. Various phenomena of viscous flow
5. Dynamic action of fluid
6. Theories and working principles of fluid machines

Course content:

Unit 1: Properties of fluid [3 Hr]

1.1 General introduction of fluid
1.2 Density, specific volume, specific weight and specific gravity
1.3 Fluid viscosity
1.4 Surface tension and capillary action
1.5 Compressibility

Unit 2: Fluid static [5 Hr]

2.1 Fluid pressure, fundamental equation of fluid static and pressure head
2.2 Absolute pressure, gauge pressure and atmospheric pressure
2.3 Pressure measuring devices and manometer
2.4 Buoyancy, flotation and stability

Unit 3: Kinematics of fluid **[2 Hr]**

3.1 Description of fluid motion, path line and stream line
3.2 Types of fluid displacement
3.3 General types of fluid flow

Unit 4: Basic equations of fluid flow **[7 Hr]**

4.1 Continuity equation
4.2 Bernoulli's equation
4.3 Momentum equation
4.4 Applications of basic equations of fluid flow

Unit 5: Viscous flow **[7 Hr]**

5.1 Laminar and turbulent flow
5.2 Reynold's number
5.3 Velocity distribution
5.4 Boundary layer concept
5.5 Lift and drag on immersed body
5.6 Introduction to head losses in close conduits
5.7 Flow over rectangular and triangular notches or weirs, co-efficient of discharge

Unit 6: Dynamic action of fluid **[5 Hr]**

6.1 Dynamic force and power
6.2 Force exerted by fluid jet on stationary and moving flat/ curved plates

Unit 7: Water turbines **[9 Hr]**

7.1 Introduction of hydraulic machines
7.2 History of development of water turbines
7.3 Types of water turbines
7.4 Working principles of impulse and reaction turbines
7.5 General characteristics curve of water turbines
7.6 Introduction of water turbine governor

Unit 8: Pumps **[7 Hr]**

8.1 Classification (positive displacement and roto-dynamic pumps)
8.2 Working of centrifugal, axial and piston pumps
8.3 Selection of pump
8.4 Hydraulic ram

Lab/Practical:

1. Study of properties of fluid
2. Validity of Bernoulli's theorem
3. Losses in pipe flow through bends and fittings
4. Performance characteristics of Pelton turbine
5. Performance characteristics of Francis turbine
6. Compare the characteristics of various pumps

References:

1. B.S. Massy, 1980, Fluid Mechanics, English Language Book Society and Van Nostrand, Reinhold Company, London
2. F.M. White, 1986, Fluid Mechanics, Mc Graw-Hill Book Company, Singapore
3. J.F. Douglas, J. M. Gasiorek and J. A. Swaffield., 2002, Fluid Mechanics, Person Education Pvt. Ltd., Singapore
4. Dr. Jagdish Lal 2002, Fluid Mechanics and Hydraulics, Metropolitan Book Co. Private Ltd., New Delhi, India
5. Dr. Jagdish Lal 1997, Hydraulic Machines, Metropolitan Book Co. Private Ltd., New Delhi, India
6. R. K. Rajput, 1999, S Chand and Company Ltd. Fluid Mechanics and Hydraulics Machines, New Delhi
7. V. L. Streeter and E. B. Wylie., 1983, Mc Graw-Hill Book Company. Singapore
8. Kumar, D. S., Fluid Mechanics, S. K. Katarai and Sons, India

Heating, Ventilation &Air-Conditioning (HVAC) II

EG 2203 RA

Total: 7 hours /week

Year: II **Lecture: 3 hours/week**

Semester: IV **Tutorial: 1 hours/week**

Practical: 3 hours/week

Course Description:

This course deals with the study of Comfort air conditioning, construction and operation of various types of fans, air filters, humidifiers and pumps. It also deals with construction and working of various types of air filters as well as Sound and noise control methods

Course Objectives:

After this course the students will be able to:

1. Explain and analyze working of various types of fans
2. Explain and analyze working of various types of air filters
3. Explain and analyze working of various types of humidifiers
4. Explain and analyze working of various types of pumps
5. Explain and analyze noise and methods of noise control

Course Content:

Unit 1: Comfort Air-conditioning [9 Hr]

- 1.1 Factors affecting Human comfort
- 1.2 Thermodynamics of human body
- 1.3 Comfort zone and comfort chart
- 1.4 Factors governing the optimum effective temperature
- 1.5 Ventilation Requirements
- 1.6 Methods of ventilation

Unit 2: Fans [10 Hr]

- 2.1 Types of Fans (propeller, axial, centrifugal)
- 2.2 Fan characteristic curves
- 2.3 Fan Law
- 2.4 Selection of Fans
- 2.5 Construction and operation of Air Handling Unit (AHU)

Unit 3: Air Filters **[6 Hr]**

3.1 Types and application of Air Filters (Dry Filters, HEPA, Viscous Filters, Wet Filters, Electric Filters)

3.2 Selection of Air Filters

Unit 4: Humidification and Dehumidification **[6 Hr]**

4.1 Humidification process (Steam injection, Atomization, Evaporation, Air washer)

4.2 Dehumidification process

4.3 Representation of humidification and dehumidification on phychromatric chart

Unit 5: Pumps **[6 Hr]**

5.1 Types of Pumps (Positive displacement, centrifugal)

5.2 Pump characteristic curves

5.3 Selection of pump

Unit 6: Sound and sound control **[8 Hr]**

6.1. Fundamentals of sound measurements

6.2 Physiological Effects of Noise Pollution

6.3 Sources of noise in air-conditioning

6.4 Method of noise control

6.5 Noise attenuation in ducts and pipes

Practical :

1. Study of construction and working of various fans
2. Study of construction and working of humidifier
3. Study of construction and working of pumps
4. Pipe sizing for chilled water system
5. Study of effect of sound insulation and attenuator

References:

1. Domkundwar&Arora, A course in Refrigeration and air conditioning, DhanpatRai and sons, 1682, NaiSarak, Delhi – 110006, India
2. R.K. Rajput, Refrigeration and Air-conditioning, S.K. Kataria& Sons, India
3. Carrier Air-conditioning Company, Hand book of Air-conditioning Design, McGraw-Hill Book Company
4. E. G. Pita, Air-conditioning Principles and System, Prentice-Hall of India Pvt. ltd., new Delhi-110006 , India

Electrical Drawing – II

EG 2204 EE

Total: 4 hours /week

Year: II **Lecture: hours/week**

Semester: IV **Practical: 4 hours/week**

Course Description:

This course is designed to make the students aware of different types of control components used in Refrigeration and Air-conditioning and make them practice to draw the electrical control system using various electrical elements.

Course Objective:

After completion of this subject, the students will be able to;

1. Identify and draw various symbols of electrical control components
2. Draw the circuit using contactors,
3. Draw the circuit of commercial and industrial refrigeration system control
4. Draw the circuit of different types of air-conditioners and air-conditioning systems

Course Content:

Unit 1: Basic Information of Symbols and Conventions [4 Hr]

Unit 2: Motor Control Circuits using Contactors [36 Hr]

2.1 Connection Diagram of DOL switch, fuses, permanently star connected three phase motor

2.2 Control and power diagram using DOL starter with energizing contactor coil with high voltage as well as low voltage, indicators, over load relay, permanently delta connected 3- phase motor with load

2.3 Drum type R / F switch (manually operated) for 3-phase motor with load and fuses/MCBs

2.4 Motor reversing after stop circuit

2.5 Plugging (direct reversing)

2.6 Control and power diagram for R / F control of 3-phase motor with contactors, over load relay, indicators and push button switches with bus bar

2.7 Control and power diagram for an electrical circuit with/ without motor using push button switch, indicator lights, power contractors

2.8 Drum type star/delta switch (manually operated) 3-phase compressor motor

2.9 Control and power diagram for star/delta control of 3-phase compressor motor with contactors, over load relay, indicators, timer motor and push button switches with bus bar

2.10 Circuits showing the auxiliary contacts for status display

2.11 Circuits showing the use of time-delay relay

2.12 Control and power circuit with inter locking

Unit 3: Electrical Circuits of refrigerators and Air Conditioning Units [20 Hr]

3.1 Interpretation and drawing of electrical circuits of air conditioning systems

3.2 Drawing and interpretation of electrical circuits of a commercial cold storage/cold room on the basis of information and the components in use

3.3 Drawings of the electrical circuits of different types of air conditioning systems with 3 phase motor

References:

1. Westermann Tables(for Electrical Trade), A. Schillo

2. Principle of Refrigeration , R.J. Dossat, John wiley & Sons Ltd.

3. Refrigeration and Air-condition, R.K. Rajput

4. Air-conditioning Principles and System, E.G. Pita

5. Electric Machines, Ashtag Hussain, Dhanpat Rai and Co.

6. Theory and Performance of electrical Machines, J.B. Gupta, Katson

Computer Aided Drawing (CAD)

EG 2205 CT

Total: 5 hours /week

Year: II **Lecture: 2 hours/week**

Semester: IV **Lab: 3 hours/week**

Course Description:

To develop proficiency in the use of refrigeration and air-conditioning (RAC) oriented computer application software. Students should be able to utilize upgraded version of Computer Aided Drawing (CAD) of Autodesk in drafting work related with working drawings and details of RAC.

Course Objective:

After completion of this course the students will be able to;

8. draw the drawings using computer
9. draw calculate distance, area and perimeter and also label the drawing
10. print the drawn drawing

Course Content:

Unit 1: Introduction to CAD components: [2 Hr]

Basic computer concepts about hardware requirements (RAM, ROM, storage, bits, bytes) and software requirements (Window version, etc.), Installing and Starting AutoCAD, Introduction to AutoCAD screen, saving, opening, exiting.

Unit 2; Coordinate system [1 Hr]

Cartesian and Polar, Relative and Absolute

Unit 3: Drawing set up and drawing aids [2 Hr]

Starting new drawing and drawing units setup, units and limits, mv setup, snap, grid and ortho, polar tracking, object snap and tracking, isometric snap, object selecting methods

Unit 4: Drawing Display [2 Hr]

Blipmode, redraw, regen, zoom, pan, view ports, arial view

Unit 5: Drawing objects **[2 Hr]**

Line, Points, Ray, circle, Rectangle, polygon, arc, easy hands tools (undo, redo, pg up, spacebar and enter), Cursor Modes, Spline

Unit 6: Editing objects **[1 Hr]**

Erasing, Moving, Copying, Rotating, Scaling, Lengthening, Stretching, Array, Mirror, Offset, Explode

Unit 7: Editing Lines **[1 Hr]**

Trim, Extrim, Break, Extend, Fillet, Chamfer

Unit 8: Formatting Drawings **[2 Hr]**

Line types, Line weight, Color, layers, Draw order

Unit 9: Continuous Lines **[1 Hr]**

Polyline, Pedit, Region, Linewidth, Border

Unit 10: Grouping Information **[2 Hr]**

Creating blocks, copying blocks, write blocks, attributes, data extraction, quick select, and filter

Unit 11: Calculations **[2 Hr]**

Calculator, Distance, Area and Perimeter, List, Measure and Divide

Unit 12: Working with Text **[3 Hr]**

Creating simple text, setting text properties, Creating multiline texts, Adding special symbols, stacked function, Editing text, Special text properties: MIRRTEXT, QTEXT.

Unit 13: Dimensions **[2 Hr]**

Dimension types and three components, setting up dimension style, dimensioning commands and their listing

Unit 14: Hatching **[1 Hr]**

Hatching and edit hatching, Super Hatch (express)

Unit 15: Special Function **1 Hr]**

Properties, Express tools, X-reference, Raster image

Unit 16: Introduction to 3D **[3 Hr]**

Extrude, Slice, Solid editing, 3D -UCS changes

Unit 17: Plotting and Printing **[2 Hr]**

Printing in model and layout

References:

Manual

www.EllenFinkelstein.com

Publication tutorial and Books from Autodesk.

Practical

1. Introduction to CAD components
2. Coordinate system
3. Drawing set up and drawing aids
4. Drawing Display
5. Drawing objects
6. Editing objects
7. Editing Lines
8. Formatting Drawings
9. Continuous Lines
10. Grouping Information
11. Calculations
12. Working with Text
13. Dimensions
14. Hatching
15. Special Function
16. Introduction to 3D
17. Plotting and Printing

Project/ Lab Work:

Draft a Layout drawing of a mechanical workshop laboratory and submit a print out in a required format. Or,

Draft a Layout drawing of an electrical workshop laboratory and submit a print out in a required format

Refrigeration – III

EG 2206 RA

Total: 10 hours /week

Year: II **Lecture: 3 hours/week**

Semester: IV **Tutorial: 1 hours/week**

Practical: 6 hours/week

Course Description:

This course is designed to make the students aware of food preservation techniques, Defrosting techniques, Solar collectors and Cold rooms. This course will also guide the students how the total cooling can be calculated considering various factors.

Course Objectives:

After completion of this course, the students will be able to;

1. describe the food preservation methods
2. carry-out defrosting and maintain defrosting mechanism in cooling components
3. identify different types cold storage and carry-out the general maintenance of cold-storage
4. describe the solar energy and identify solar collectors
5. describe and carry-out maintenance of transport refrigeration system
6. calculate cooling load for cold-storage considering all required loads
7. complete the electrical wiring of the refrigerators having automatic defrost system

Course Contents;

Unit 1: Food Preservation **[6 Hr]**

1.1 Factors contributing to food spoilage
1.2 Methods of food preservation
1.3 Milk chilling and Pasteurization

Unit 2: Defrosting **[6 Hr]**

2.1 Necessity of defrosting
2.2 Methods of defrosting (Manual defrosting, Pressure operated defrost system, Temperature operated defrost system, Water

defrosting, Reverse cycle defrosting, Hot gas defrosting and Electric defrosting)

2.3 Safety to be observed while carrying out manual defrosting

Unit 3: Cold storage and Walk-in Coolers [6 Hr]

3.1 Cold storage chain for food preservation

3.2 Types and construction of cold storage

3.3 Ammonia plant for large cold-storages

3.4 Construction of large scale (more than 1000 MT storage capacity) fruit and vegetable cold-storage. Types of evaporator used in such cold-storages

3.5 Different products and storage condition

3.6 Calculation of product load considering respiration load

Unit 4: Transport Refrigeration [5 Hr]

4.1 Fundamentals of surface transportation methods

4.2 Refrigeration system in mobile refrigeration containers

Unit 5: Load Calculation for Cold Rooms [10 Hr]

5.1 Storage requirements for Vegetables, Poultry, Meat, Dairy Products and Fruits (Product Load Calculation)

5.2 Determination of Wall Gain Load for cold rooms

5.3 Determination of Air Change Load for storage above and below freezing

5.4 Determination of Miscellaneous Loads; Lighting, Occupancy, equipment etc.

5.5 Determination of Cooling Capacity of a Refrigeration System for a cold room

Unit 6: Nature of Solar Energy [6 Hr]

6.1 Nature of terrestrial radiation

6.2 Solar constant: Introduction and Units

6.3 Solar Angles: Altitude, Azimuth, Incident and Declination

Unit 7: Solar Radiation [6 Hr]

7.1 Spectral Solar radiation

7.2 Values of solar radiation at different latitude and times

7.3 Measurement of solar radiation on earth's surface using pyranometer

7.4 Introduction to solar refrigerator and its operation

References:

1. Principle of Refrigeration, Dossat, R.J. , John Wiley & Sons Ltd.
2. Basic Refrigeration and Air-conditioning, Ananthnarayan, P.N. TMH
3. A course in refrigeration and Air-conditioning: Domkundwar, Arora, S.C., Dhanpat rai and Sons

Practical

1. Carryout defrosting of different commercial system
2. Visit and prepare report of a Industrial cold-storage with mechanical system diagram, cold-storage layout, its operation and handling
3. Interact with the Industrial cold-storage owner or technical person regarding storage method, handling procedure and temperature maintenance condition within the cold-storage
4. Draw the mechanical and electrical system diagram of a walk-in cooler and check the performance
5. Check the arrangement and system components used in refrigerated vehicle
6. Observe solar water heater and check the performance
7. Observe solar electric system and check the performance

Third Year
(Fifth and Sixth Semesters)

Third Year/Fifth Semester

Subjects:

1. EG 3101 MM Engineering Economics
2. EG 3102 MM Organization and Management
3. EG 3103 RA HVAC - III
4. EG 3104 RA Troubleshooting & Maintenance.
5. EG 3105 RA Estimation and Costing
6. EG 3106 RA Project – I
7. EG 3107.. RA Elective - I

Engineering Economics

EG 3101 MM

Year: III **Total: 4 hours /week**
Semester: V **Lecture: 3 hours/week**
Tutorial: 1 hours/week

Course Description:

This course is designed to provide the students knowledge of the basic tools and methodology of economic studies for evaluation of engineering project in private industry, in the public sector and in the utilities area.

Course objectives:

After completion of this course the students will be able to;

1. explain various terminologies regarding Business and Accounting
2. explain different types of cost and carryout simple cost analysis
3. calculate interest and also identify the time value of money
4. carryout the cost / benefit analysis
5. explain the investment decision
6. explain the taxation system of Nepal

Course Content:

Unit 1: Introduction [6 Hr]

1.1 Business and accounting terminology
1.2 Cash flow
1.3 Economic systems

Unit 2: Cost Classification and Analysis [7 Hr]

2.1 The elements of cost
2.2 Classification of cost: overhead cost, prime cost
2.3 Cost variance analysis
2.4 Job and process costing

Unit 3: Interest and the Time Value of Money [7 Hr]

3.1 Simple interest, compound interest, interest tables, interest charts
3.2 Present worth

3.3 Nominal and effective interest rates
3.4 Continuous compounding and continuous compounding formula
3.5 Interest calculations for uniform gradient

Unit 4: Basic Methodologies of Engineering Economic Studies [7 Hr]

4.1 Present worth and annual worth methods
4.2 Future worth method
4.3 Internal rate of return method
4.4 Drawbacks of the internal method
4.5 External rate of return method
4.6 Minimum attractive rate of return method
4.7 The playback (pay-out) period method

Unit 5: Cost/Benefit Analysis [5 Hr]

5.1 Conventional cost/benefit ratio
5.2 Modified cost/benefit ratio
5.3 Break-even analysis

Unit 6: Investment Decisions: [8 Hr]

6.1 Comparison of alternatives having some useful life
6.2 Comparison of alternatives having different useful life
6.3 Comparison of alternatives excluding the time value of money
6.4 Comparison of alternatives using the capitalized worth method
6.5 Definition of mutually exclusive investment alternatives in terms of combinations of projects
6.6 Comparison of mutually exclusive alternative

Unit 7: Taxation System in Nepal: [5 Hr]

7.1 Taxation law in Nepal
7.2 Depreciation rates for buildings, equipment, furniture, etc
7.3 Recaptured depreciation
7.4 Taxes on normal gains
7.5 Taxes on capital gains
7.6 Value Added Tax (VAT)

References:

1. E.P. DeGramo, W.G. Sullivan and J.A. Bontadelli, 8th Edition, Macmillan Publishing Company, 1988

2. N.N. Borish and S.Kaplan, "Economic Analysis: For Engineering and Managerial Decision Making", McGraw-Hill.

Organization and Management

EG 3102 MM

Total: 3 hours /week

Year: III **Lecture: 3 hours/week**

Semester: V **Tutorial: hours/week**

Course Description:

This course has been designed to make the students aware of the management related terminologies and also make them acquainted with different types of organizations and their importance. This course will also help them to develop management skills and follow the management processes.

Course Objectives:

After completion of this course the students will be able to;

1. Describe the concept of organization and management
2. Understand the basic theories of management
3. Explain the various leadership behaviors of a manager
4. Explain the concept of production management and production control
5. Demonstrate the understanding of materials management

Course content:

Unit 1: Introduction to Organization [10 Hr]

- 1.1 Definition of an Organization
- 1.2 Organization as an open system
- 1.3 Evolution of organizations
- 1.4 Formal and informal organization
- 1.5 Industrial organization
  - 1.5.1 Types of ownership (forms of business organization): private sector, cooperative sector, public sector
  - 1.5.2 Individual ownership: introduction, advantages and disadvantages
  - 1.5.3 Partnership organization: introduction, types, advantages, disadvantages
  - 1.5.4 Joint stock company: introduction, types, advantages, disadvantages

1.5.5 Cooperative organizations: basic concept, advantages, disadvantages
1.5.6 State enterprises and undertakings: departmental undertakings, public corporation, government company
1.5.7 Difference between private sector and public sectors enterprises

1.6 Organization structure and its types
1.6.1 Introduction of organization structure
1.6.2 Line organization
1.6.3 Line and staff organization
1.6.4 Functional organization

1.7 Departmentalization: basic concept, basis of departmentalization

Unit 2: Introduction to Management [10 Hr]

2.1 Introduction and definitions of management
2.2 Characteristics of management
2.3 Basic levels of management in industry: top level, middle level and lowest or supervisory level of management
2.4 Basic responsibilities at different level of management
2.5 Managerial skills for different level of management: technical skills, human relation skills/interpersonal skills (includes communication skills, motivating skills and leadership skills), conceptual skills (includes decision making and organizational skills)
2.6 Processes and functions of management: planning, organizing, staffing, directing, motivating, controlling, leading, decision making and communication
2.6 Evolution of management theory
2.6.1 Handicraft system
2.6.2 Factory system
2.6.3 Stages of evolution of management: classical theory, neo-classical theory and modern management theories
2.6.4 Scientific management theory and its principles
2.6.5 Administrative management theory (Henri Fayol and others) and its 14 principles
2.6.6 Bureaucracy theory
2.6.7 Human relations and behavior science theories
2.6.8 The decision theory of management
2.6.9 Management science theory

2.6.10 Systems theory of management
2.6.11 Contingency theory of management

Unit 3: Leadership and Supervisory [6 Hr]

3.1 Introduction and definition of leadership
3.2 Basic functions of leadership
3.3 Qualities of leadership
3.4 Difference between management and leadership
3.5 Leadership styles
3.6 Definition of supervision
3.7 Factors governing effective supervision
3.8 Importance of supervision
3.9 Duties of a foreman
3.10 Essential qualities of a foreman

Unit 4: Motivation [3 Hr]

4.1 Concept
4.2 Nature/Features/Characteristics of motivation
4.3 Individual needs/Human needs
4.4 Importance of motivation
4.5 Maslow's Need Hierarchy Theory
4.6 Positive and Negative Motivation

Unit 5: Communication [4 Hr]

5.1 Concept of communication
5.2 Communication Process
5.3 Importance of communication
5.4 Barrier to Effective Communication
5.5 Types of Communication
5.6 Principles of Communication

Unit 6: Planning [5 Hr]

6.1 Concept of planning
6.2 Nature/Feature of planning
6.3 Types of planning
6.4 Planning process
6.5 Need/Rationale for planning
6.6 Benefits of planning
6.7 Limitations of planning

Unit 7: Materials Management and Inventory Control [7 Hr]

7.1 Definition of materials management
7.2 Functions of material management: material planning, store/stock control, purchasing, receiving and issue of materials, simplification/standardizing/coding of materials, transportation and handling, value engineering and value analysis, disposal of scrap, surplus and obsolete materials.
7.3 Store management: meaning, objectives, function of store
7.4 Definition of inventory control
7.5 Inventory level
7.6 Economic lot size
7.7 Duties and responsibilities of store keeper

References:

1. Ahuja, K.K. (1994). Industrial Management. CBS Publishers and Distributors, India.
2. Agrawal, G.R. (2003). Principles of management in Nepal. M.K. Publishers and istributors, Kathmandu, Nepal.
3. Panneerselvam, R. (2005). Production and Operations management (2nd ed.).Prentice-Hall of India, Private Limited, Delhi.
4. Verma, A.P. (2002). Industrial Engineering. S. K. Kataria & Sons, Delhi.
5. Sharma P.R et.al. (2013), Business Studies“, Buddha Academic Enterprises, Kathmandu.

Heating, Ventilation &Air-Conditioning (HVAC) III

EG 3103 RA

Total: 7 hours /week
Year: III **Lecture: 3 hours/week**
Semester: V **Tutorial: 1 hours/week**
Practical: 3 hours/week

Course Description:

This course deals with the study of Chillers, AHUs, FCUs, Heating system, water conditioning and VRF/VRV systems

Course Objectives:

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

a. Explain and maintain working of various types of chillers
b. Explain and maintain working of various types of AHUs/FCUs
c. Explain the working of heating system
d. Explain the working of VRF system
e. Understand water conditioning system
f. Perform basic thermal load calculation

Unit 1: Chillers **[6 Hr]**

1.1 Application of chillers
1.2 Types, construction and operation of Chillers (DX, flooded type shell & tube, shell & coil)

Unit 2: Air Handling Units and Fan Coil Units **[4 Hr]**

2.1 Introduction
2.2 Types of AHUs (ceiling concealed, ceiling suspended, floor standing, single skin, double skinned , high pressure, low pressure)
2.3 Types of FCUs (ceiling concealed, ceiling suspended, floor standing, single skin, double skinned , high pressure, low pressure)

Unit 3: Heating system **[6 Hr]**

3.1 Warm air furnace heating system

3.2 Hot water heating system (Boiler, Heat pump, solar)
3.3 Steam heating system

Unit 4: Water Conditioning [6 Hr]

4.1 Constituents and characteristics of water
4.2 Water quality requirement for chiller and boiler
4.3 Fundaments of water treatments
4.4 Water treatment plants
4.5 Types and causes of Scale and Deposit
4.6 De-scaling methods

Unit 5: Inverter based Variable Refrigerant Flow/Volume (VRF/VRV) types of Air-conditioning system [8 Hr]

5.1. Principle of operation of inverter system
5.2 Operation and application of VRV system
5.3 Limitation of VRF system
5.4 Comparison of 1:1 Split and VRV system

Unit 6: Automotive Air-conditioning system [3 Hr]

6.1 Operation of automotive Air-conditioning
6.2 Components of automotive Air-conditioning

Unit 7: Cooling and heat load calculation [12 Hr]

7.1 Introduction
7.2 Cooling load calculation
7.3 Heating load calculation
7.4 Equipment selection
7.5 Sample calculation of residential and commercial buildings

Practical:

1. Study of construction and working of various types of chillers
2. Study of construction and working of various types of AHUs
3. Study of construction and working of various types of FCUs
4. Thermal load calculation of residential buildings
5. Visit local Air-conditioned spaces and submit report

References:

1. Domkundwar&Arora, A course in Refrigeration and air conditioning, DhanpatRai and sons, 1682, NaiSarak, Delhi – 110006, India
2. R.K. Rajput, Refrigeration and Air-conditioning, S.K. Kataria& Sons, India
3. Carrier Air-conditioning Company, Hand book of Air-conditioning Design, McGraw-Hill Book Company
4. E. G. Pita, Air-conditioning Principles and System, Prentice-Hall of India Pvt. ltd., new Delhi-110006 , India

Trouble Shooting Repair & Maintenance

EG 3104 RA

Total: 7 hours /week

Year: III **Lecture: 1 hours/week**

Semester: V **Tutorial: hours/week**

Practical: 6 hours/week

Course Description:

This course is designed to understand operation, maintenance, installation and troubleshooting of refrigeration and air conditioning systems in order to gain theoretical and practical knowledge.

Course objective:

After completion of this course, students will able to

i Trouble shoot in RAC system
ii Carry out the maintenance of RAC system and components
iii Dismantle and assemble the system components
iv Perform repair of refrigerator, deepfreeze, and electrical systems.
v Keep records and prepare report.

Course Contents:

Unit 1: Techniques of trouble shooting [7 Hr]

1.1 Meaning of trouble shooting and its logical approach.
1.2 Trouble shooting of domestic refrigerator.
1.3 Trouble shooting of and window and split air conditioner. The possible causes and remedies
1.4 Trouble shooting of cold storage, deep freeze, ice bank system, causes and remedies
1.5 Trouble shooting techniques of various electrical system and safety.
1.6 Exercise on trouble shooting on electronics simulators

Unit 2: Maintenance Methods [8 Hr]

2.1 Different approaches to maintenance system (Preventive, predictive, breakdown and major overhauls)

2.2 Equipment records, machine cards and job cards

2.3 Scheduling of maintenance works

2.4 Preventive system for various refrigeration systems.

2.5 Condenser & Evaporator fans removal and assembly of shaft & bearings.

2.5 Dismantling and assembling of hermetic, semi hermetic and open type of compressors.

2.6 Installation, charging and testing of small prefabricated walk in cooler and split A/C

2.7 Fault and fault finding of refrigeration systems.

References:

11. Air Conditioning and Refrigeration Troubleshooting Handbook By Langley, Billy C.
12. Refrigeration Service Manual, By Manely HP, Fredrick J. Drake and Co.
3. Basic Refrigeration and Air-conditioning, P. N. Anantha Narayanan
4 . A Course in Refrigeration and Air-conditioning, S. C. Arora
5. Hand Book of Maintenance Management and Engineering, Ben-Daya, M Duffuaa, S.O. Raouf, A Knezevic,
6. Complete Guide to Preventive and Predictive Maintenance, Joel Levitt

Practical

1. Repair and maintenance of domestic refrigerator, fault finding, wiring, replacement of hermetic compressors.
2. Repair, maintenance and fault finding of split ac.
3. Servicing and preventive maintenance of split A/C, prefabricated walk in cooler which includes:
4. Dismantling and assembling of compressors.

5. Installation of split A/C, prefabricated walk in cooler which includes
    a. Assembling- Tube cutting- brazing- flaring leak testing- vacuuming- purging-charging
    b. Electrification
    c. Commissioning
6. Various trouble and remedy of the refrigeration system
7. Trouble shooting electrical problems, changing contactors, overload relays, timers and other accessories.
8. Safely charging of gas, safety precautions in gas welding
9. Dismantling of fan motor stator & replacement of bearings

Estimation and Costing

EG 3105 RA

Year: III **Total: 4 hours /week**
Semester: V **Lecture: 2 hours/week**
Tutorial: 2 hours/week

Course Description:

This course is designed to make the students well aware of estimating process and requirement of estimation and costing of refrigeration and air-conditioning equipment installation, Repair, maintenance and fabrication.

Course Objectives:

After completion of this course the students will be able to;

1. Explain different terminologies regarding estimation and costing
2. Estimate the different cost involved in refrigeration and air-conditioning installation
3. Estimate the cost of service to be provided in refrigeration business
4. Understand
5. Explain the tender document
6. Prepare the specification for different components used in Refrigeration and Air-conditioning industries

Course Content:

Unit 1: Estimation **[3 Hr]**

1.1 Introduction
1.2 Different terminologies used in estimation
1.3 Methods of estimation

Unit 2: Costing **[5 Hr]**

2.1 Introduction
2.2 Define different costs

Unit 3: Analysis of work **[6 Hr]**

3.1 Labor

3.2 System Components
3.3 Electrical cable and other components

Unit 4: Specification [4 Hr]

4.1 Writing of specification for refrigeration system and components
4.2 Writing of specification for Duct work and air-conditioning components and system installation

Unit 5: Practices [6 Hr]

5.1 Practices on preparing Bill of Quantities (BoQ), Specification and Estimation of Refrigeration and Air-Conditioning (RAC) System and components.
5.2 Practice on calculating the total cost, including tax and profit for given project

Unit 6: Tender document [6 Hr]

6.1 Introduction
6.2 Essential components of tender document
6.3 Study various tender documents concerning Refrigeration and Air-conditioning works
6.4 Prepare tender document for RAC system/component installation and commissioning

References:

1. **Mechanical Estimating and Costing including contracting, T. R. Banga, S.C. Sharma, Khanna Publisher**
2. **Mechanical Estimating Methods, 4th edition, R.S. Means**

Project - I

EG 3106 RA

Total: 6 hours /week

Year: III **Lecture: hours/week**

Semester: V **Practical: 6 hours/week**

Course Description:

This section of the syllabus will be the combination of the knowledge and the skill learnt during the semester I, II, III and IV of the program. The student will be given an outline of component/device/item/tool for the propose. S/he shall then have to do basic design of the selected product. The finished design and drawing of the product along with project report shall be submitted for appraisal. The project report will consist of the following:

- Application of the project outcome
- Basic design considerations.
- Considerations on material selection.
- Related drawing/s.
- List of material required and estimation of cost
- Time Schedule

The student will be allocated a team of guides or an supervisor to assist for her/his project and design work. The student shall also consult the library and internet for his/her work.

As the project is completed, the students will have to submit a final report and presentation of report in front of jury must be done and operation of completed project must be demonstrated. There will be viva for individual student regarding their project.

The marks will be allocated as follow;

1. Concept, Design and Drawing 25
2. Workmanship and Performance 75
3. Report 50
4. Viva 50

Total: 200

Cold-Storage and Food Preservation

EG 3107 RA

(Elective – I)

Total: 5.5 hours /week

Year: III **Lecture: 3 hours/week**

Semester: V **Tutorial: 1 hours/week**

Practical: 1.5 hours/week

Lab: hours/week

Course Description:

This course has been designed for such students, who want to specialize in medium and large scale cold-storages used for food preservation and also Ice manufacturing. This subject will be taught in third year as an elective.

Course Objectives:

After completion of this course the students will be able to;

1. Explain different methods of food preservation
2. Calculate the size of the storage space for required quantity
3. Design the layout of a cold-storage and Ice manufacturing space
4. Handle the large cold storages
5. Handle the Ice plants

Course Content:

Unit 1: Methods of Food preservation [8 Hr]

1.1 Traditional Techniques;

- 1.1.1 Burying
- 1.1.2 Drying
- 1.1.3 Salting
- 1.1.4 Sugaring
- 1.1.5 Smoking
- 1.1.6 Pickling
- 1.1.7 Jellying

1.1.8 Fermentation

1.1.9 Lye

1.1.10 Refrigeration

1.1.11 Freezing

1.1.12 Canning and Bottling

1.2 Industrial / Modern Techniques

1.2.1 Pasteurization

1.2.2 Vacuum packing

1.2.3 Artificial food additives

1.2.4 Irradiation

1.2.5 Pulsed electric field electroporation

1.2.6 Modified atmosphere

1.2.7 Non-thermal plasma

1.2.8 High-pressure food preservation

1.2.9 Bio-preservation

1.2.10 Hurdle technology

1.3 Storage condition in a cold-storage (Temperature, Humidity and Air-circulation)

1.3.1 For various fruits

1.3.2 For Vegetables

1.3.3 For meats

1.3.4 For fish

1.3.5 Dry fruits

1.3.6 For Flowers

1.3.7 Other perishable and non-perishable items.

1.4 Cold chain for food preservation

Unit 2: Types of cold-storage [3 Hr]

2.1 Purpose built and Adapted (Later converted)

2.2 Single Chamber and Multi chamber

2.3 Single storey and Multi storey

2.4 Medium temperature and Frozen food stores

Unit 3: Design and Construction of Cold storage **[5 Hr]**

3.1 Layout of large cold storage

3.2 Conventional Walls and Prefabricated panels

3.3 Insulations and Insulation fixing methods

3.4 Air-curtain

Unit 4: Site selection for cold-storage **[2 Hr]**

3.5 Road

3.6 Electricity

3.7 Water

3.8 Foundation Soil

Unit 5: Method of Refrigeration and cooling **[2 Hr]**

5.1 Direct expansion

5.2 Brine cooling

5.3 Air circulation

5.4 Liquid circulation

Unit 6: Load Calculation **[6 Hr]**

6.1 Load calculation of a large cold storage

6.2 Load calculation of Ice manufacturing plant

Unit 7: Ammonia Plant **[8 Hr]**

7.1 Types of Ammonia Compressors

7.2 Lubrication system in Ammonia plant

7.3 Safety devices and control system in Ammonia plant

7.4 Safety to be observed in ammonia plant

7.5 Condenser in ammonia plant

Unit 8: Ice Plant **[7 Hr]**

8.1 Types of Ice

8.2 Ice cube manufacturing and plant

8.3 Ice Flakes and Granules manufacturing

8.4 Ice block Manufacturing and Ice Plant

Unit 9: **Frozen food manufacturing and storage** **[4 Hr]**

9.1 Frozen Manufacturing process and plants
9.2 Frozen food storage conditions
9.3 Handling of frozen foods

Practical:

1. Check and Maintain the Walk-in coolers
2. Visit at least two large cold-storages and prepare the report including Mechanical drawing of the plant and cold storage layout.
3. Practice the installation of different insulations on the wall, ceiling and floor
4. Design a cold storage for single or multi product with simple calculation

References:

1. New York (State) Department of Agriculture, "Cold storage", 2009
2. "Industrial Refrigeration", Volume 62, Nickerson and Collins Company, 1922, University of Chicago.
3. Clive Dellino, "Cold and Chilled Storage Technology", Springer 1997
4. Pieter C. Koelet, T.B. Gray, "Industrial Refrigeration –Principles, Design and Application", Macmillan 1992.

Heating System

EG 3108 RA
(Elective – I)

Year: III **Lecture: 3 hrs/Week**
Semester: II **Tutorial: 1 hrs/Week**
Practical: 1.5 hrs/Week

Course Description:

This course deals with the application and methods of heating system. It also deals with the various components and means of energy used for the heating purpose.

Course Objectives:

After completing this course the student will be able to:
1. Explain the application of heating system
2. Explain the methods of heating the space
3. Identify various heating equipment and explain their working process
4. Carryout basic maintenance of the heating system equipment
5. Install the system components
6. Find the fault, repair and replace the faulty component

Course content:

Unit 1: Introduction **[1 Hr]**

1.1 Need for heating system
1.2 Spaces requiring heating

Unit 2: Methods of heating **[4 Hr]**

2.1 Forced air
2.2 Radiant heat
2.3 Hydronic
2.4 Geothermal
2.5 Heat pump
2.6 Solar

Unit 3: Fuel and energy used for heating system **[4 Hr]**

3.1 list of common fuel or energy used for heating purpose
- 3.1.1 Biomass (Fire Wood)
- 3.1.2 Coal
- 3.1.3 Oil
- 3.1.4 Solar
- 3.1.5 Geothermal
- 3.1.6 Gas
- 3.1.7 Electricity

3.2 Properties of Coal / Diesel /Furnace oil

Unit 4: Forced Air System [3 Hr]

4.1 Working process
4.2 Methods of heating air
4.3 System components
4.4 Working method of various components used in this system
4.5 Methods of installation of this system
4.6 Advantages and Disadvantages of this system

Unit 5: Radiant heat heating system [4 Hr]

5.1 Working process
5.2 Methods of heating water
5.3 System components
5.4 Working method of various components used in this system
5.5 Methods of installation of this system
5.6 Maintenance of the sustem and system components
5.7 Advantages and Disadvantages of this system

Unit 6: Hydronic Heating system [3 Hr]

6.1 Working process
5.2 Methods of heating water
6.3 System components
6.6 Working method of various components used in this system
6.7 Methods of installation of this system
6.7 Advantages and Disadvantages of this system

Unit 7: Geothermal Heating System [2 Hr]

7.1 Working process
7.2 System components

7.3 Working method of various components used in this system
7.4 Methods of installation of this system
7.5 Advantages and Disadvantages of this system

Unit 8: Heat Pump Heating System [2 Hr]

8.1 Working process
8.2 System components
8.3 Methods of installation of this system
8.4 Advantages and Disadvantages of this system

Unit 9: Solar Heating System [4 Hr]

9.1 Methods of Solar heating
9.2 Components and layout of the system
9.3 Advantage and Disadvantage of the system

Unit 10: Electric Heating System [3 Hr]

10.1 Electric Resistance Heaters
10.2 Storage heating system
10.3 Advantage and Disadvantage of Electric Heating System

Unit 11: Furnaces and Boilers [8 Hr]

11.1 Types of Furnaces and their operation
11.2 Types of Boiler
11.3 Construction and operation `of boilers
11.4 Maintenance procedure of furnaces and boilers
11.4 The difference between Combi boiler and Conventional boiler
11.5 Safety to be observed while operating boilers
11.6 Advantage and disadvantage of different types of boiler

Unit 12: Private house heating system [3 Hr]

12.1 Heating System for individual room
12.1.1 Electric Resistance heaters
12.1.2 Gas Heaters
12.1.3 Kerosene heaters
12.1.4 Firewood heaters/Fire place
12.1.5 Storage heating system
12.5.6 Solar heating system
12.3 Central Heating Systems
12.4 District Heating System

Unit 13: Heat Load **[4 Hr]**

13.1 Calculation of heat load of a residential building
13.2 Wall, Floor and Ceiling leakage
13.3 Air change
13.4 Light gain, Appliance gain, Body gain

Practical:

1. Observe the chimneys and test its working
2. Observe the furnaces and check its operation
3. Observe the various types of boilers and check its operation
4. Visit nearby house having heating system if available

References:

1. Domkundwar&Arora, A course in Refrigeration and air conditioning, DhanpatRai and sons, 1682, NaiSarak, Delhi – 110006, India
2. R.K. Rajput, Refrigeration and Air-conditioning, S.K. Kataria& Sons, India
3. Carrier Air-conditioning Company, Hand book of Air-conditioning Design, McGraw-Hill Book Company
4. E. G. Pita, Air-conditioning Principles and System, Prentice-Hall of India Pvt. ltd., new Delhi-110006 , India
5. D.S. Kumar, Thermal Science Engineering, S.K. Kotaria& Sons, India
6. P.K. Nag, Basic and Applied Thermodynamics, Tata McGraw-Hill, India
7. R.K. Rajput, Thermal Engineering, Laxmi Publications, India

Renewable Energy Technology

EG 3109 RA

(Elective-I)

Total: 5.5 hours /week

Year: III **Lecture: 3 hours/week**

Semester: V **Tutorial: 1 hours/week**

Practical: 1.5 hours/week

Course Description:

This course deals with the basic fundamentals of renewable energy technology. Students will understand basic principles and application of various forms of renewable energy technology.

Course Objectives:

After completing this course the student will be able to:

7. Understand energy basics, unit conversion, potential of energy resources
8. Design, install and analyze the renewable energy projects
9. Operate, repair and maintenance equipment and systems of renewable energy technology
10. Estimate potential of resources

Course content:

Unit 1. Introduction [6 Hr]

1.1 Definition, units and conversion of Energy and Power

1.2 Energy consumption pattern in households, institutions and industrial sectors.

1.3 National, regional and global energy production and consumption scenarios

1.4 Classification of energy resources: Primary and secondary resources; Conventional and non-conventional resources; Commercial and non- commercial resources; Renewable and non – renewable resources; Traditional and modern resources.

1.5 Environmental aspects of Renewable and Non renewable energy resources

Unit 2. Solar Energy [12 Hr]

2.1 Introduction: Solar radiations, components of radiations, geometry of sun- earth, measurement of solar radiations and measuring devices

2.2 Solar thermal

- Low temperature applications of solar energy: Domestic hot water system, Solar dryer; Solar distillation; Solar cooker, Concentrating collectors, Flat plate collectors

2.3 Solar electricity

- Semiconductors and principle of solar cells
- Analysis of Photovoltaic cells: IV and PV characteristics, Effect of irradiance and temperature on IV and PV curve.
- Types of Photovoltaic cells
- Solar Home System: Components, design and installations
- Institutional Solar Photovoltaic System: Components, design and installations
- Solar water pumping: Basic design
- Storage battery: Principle, types and applications
- Introduction to PV grid connection system and net metering

2.4 Environmental impacts and socio economic benefits of solar energy

Unit 3. Hydropower [9 Hrs]

3,1 Introduction

3.2 Principles

3.3 Classifications, and assessing the resource for small installations

- Pre feasibility study
- Detail Feasibility study

3.4 Turbines

- An impulse turbine
- Reaction turbines

3.5 Flow and head measurement techniques in micro hydropower

3.6 Hydroelectric systems: Basic design and power output calculations

3.7 Generators: Induction and Synchronous

3.8 Introduction of transformer, transmission line and controllers

3.9 Environmental impacts and socio economic benefits of hydropower development

Unit 4. Bio Energy Technology [7 Hrs]

4.1 Introduction to Biogas and Biomass

4.2 Types of Biogas and Biomass technology

4.3 Design and construction of Biogas plants and Improved Cooked Stoves (ICS)

4.4 Methods of bioconversion: Physical, Thermo-chemical and Biological methods

4.5 Applications of Biomass and Biogas energy in Nepal

4.6 Conversion of biogas to electricity to power up small scale refrigerators

4.7 Environmental impacts and socio economic benefits of solar energy

Unit 5. Power from the wind [5 Hr]

5.1 Introduction

5.2 Turbine types

5.3 Power extraction by a turbine

5.4 Electricity generation

5.5 Mechanical power

5.6 Scope and potential in Nepal

Unit 6. Introduction to Geothermal Energy, Fuel Cell technology, Tidal Energy and other modern renewable energy technologies [3 Hr]

Unit 7. Renewable Energy Policies and Strategies [3 Hr]

7.1 Rural Energy Subsidy Policy of Nepal

7.2 Climate change and mitigation: Global Climate Change, greenhouse gas and global warming, Mitigation of Climate Change: UNFCCC, IPCC, Kyoto Protocol (CDM)

References:

1. Renewable Energy, Power for a Sustainable Future, Edited by Godfrey Boyle
2. John W. Twidell and Anthony D. Weir, Renewable Energy Resources, English Language Book Society, ISBN 0419144706, Edition 1986

3. Philip G. Hill, Power Generation, Resources, Hazarch Technology and Costs, MIT Press, 1977
4. A. Thumann, Fundamentals of Energy Engineering, Fairmount Press, Prentice Hall Inc., 1984
5. A.W. Culp, Principles of Energy Conversion

Practical

1. Experiment on solar radiation measurement using Pyranometer
2. Design and installation practice on Solar PV System with practical problems considering the loads like lights, DC vaccine refrigeration for remote applications, small AC refrigerators etc.
3. Site visit to standalone and grid connected solar PV system
4. Head/pressure and discharge measurement of Micro Hydro Power project by different methods
5. Small Hydropower site visit
6. Biogas installation visit

Third Year/Sixth Semester

Subjects:

1. EG 3201 MM Entrepreneurship
2. EG 3202 RA Safety Engineering
3. EG 3203 MM Eng. Professional Practice
4. EG 3204 RA Technology, Environment and Society
5. EG 3205 RA Applied Mechanics
6. EG 3206 RA Project - II
7. EG 3207 RA Elective - II

Entrepreneurship Development

EG 3201 MM

Total: 3 hours /week

Year: III **Lecture: 3 hours/week**

Semester: VI

Course Description:

Entrepreneurship development seeks to provide students with the knowledge, skills and motivation to enact entrepreneurial possibilities, often in a variety of settings. It deals with the financial, administrative, and legal requirements of setting up an Enterprise in Nepal

Course Objectives:

After completing this course the students will be able to;

1. Explain different types of enterprises
2. Explain the basic laws of companies
3. Explain the processes to establish companies in Nepal.

Course content:

Unit 1: Introduction [2 Hr]

1.1 Enterprise and Entrepreneurship.
1.2 Difference between Goal, Project, and Activity.

Unit 2: Types of Companies [5 Hr]

2.1 Private,
2.2 Partnership,
2.3 Private Limited,
2.4 Public Limited;
2.5 Their advantages and disadvantages, legal structuring. Corporation & their structures. Board of Directors

Unit 3: Rules for setting up of industry in Nepal [7 Hr]

3.1 Nepal Company Laws,

3.2 Company registration.
3.3 Draft of Company regulations and laws and bi-laws.
3.4 Environmental regulations.

Unit 4: Manufacturing [6 Hr]

4.1 Manufacturing
4.2 Types of Manufacturing,
4.3 Inventory control
4.4 Store management

Unit 5: Marketing [5 Hr]

5.1 Meaning of marketing
5.2 Marketing strategy
5.3 Marketing Techniques
5.4 Advertisement and Effects of advertisement

Unit 6: Account Keeping [8 Hr]

6.1 Simple Interest Calculation
6.2 Debit and Credit
6.3 Ledger Keeping
6.4 Cash Flow

Unit 7: Formulation of Project [10 Hr]

7.1 Pre-Feasibility Study
7.2 Detail Feasibility Study
7.3 Definition and Application of Initial Environment Examination (IEE)
7.4 Definition and Application of Environment Impact Assessment (EIA)
7.5 Pre-establishment cost
7.6 Capital Investment
7.7 Operating Cost
7.8 Fixed Cost
7.9 Variable Cost
7.10 Gross Profit / Loss
7.11 Net Profit / Loss
7.12 Value Added Tax (VAT)

Unit 8: Certification **[2 Hr]**

8.1 Nepal Standard (NS) Certification

8.2 ISO Certification: Its value, Process and Implication

References:

1. Hillier, Frederick S. and Lieberman, Gerald J. "Introduction to Operations Research", McGraw-Hill: Boston MA. Eight edition. International edition. (2005) ISBN 0-07-321114-1
2. Ecker, Joseph G. and K-upferschmid, Michael "Introduction to Operations Research", Krieger Pub Co ISBN 0-89464-576-5

Safety Engineering

EG 3202 RA

Year: III **Total: 2 hours /week**
Semester: VI **Lecture: 2 hours/week**

Course Description:

Awareness about hygiene and safety is the most important thing which every operator, worker, technician and engineer must always bear in mind while working in the industry. Human life is very precious and the organization of the industry must pay full attention to health and safety of workers. This course deals with various industrial hazards and their prevention.

Course Objectives:

After completing this course the students will be able to;

1. induce safety awareness
2. locate unsafe locations and activities on shop floor and take corrective actions
3. explain statutory requirements regarding industrial hygiene and safety
4. mitigate or control various kinds of hazards
5. manage industrial safety

Course content:

Unit 1: Introduction [6 Hr]

- 1.1 Scope of industrial hygiene and safety
- 1.2 Cost and liability of industrial hygiene and safety
- 1.3 Difference between Hazard and Accident
- 1.4 Causes of accident and accident prevention methods (Cardinal Rule
- 1.5 Safety control devices; Signs, Signals and Instructions
- 1.6 Principles and practices of safety management

Unit 2: Industrial Environment [4 Hr]

- 2.1 Sanitation in industry
- 2.2 Ventilation system
- 2.3 Lighting system
- 2.4 Pollution and Temperature control

Unit 3: Types of Hazards **[6 Hr]**

3.1 Mechanical Energy Hazards: Thermal Energy Hazards
3.2 Electrical Energy Hazards: Acoustic Energy Hazards
3.3 Chemical Energy Hazards: Radiant Energy Hazards
3.4 Kinetic (Impact) Energy Hazards: Air/Land/ Sea Energy Hazards
3.5 Potential (Stored) Energy Hazards: Biological Energy Hazards

Unit 4: Fire Prevention and control **[3 Hr]**

4.1 Fire hazards
4.2 Types of Fire
4.3 Fire control methods for different fires

Unit 5: Noise Pollution and its control **[3 Hr]**

5.1 Effect of noise on health
5.2 Standard requirements for industrial noise levels
5.3 Noise control principle and methods
5.4 Personal protective equipment

Unit 6: Air Pollution **[2 Hr]**

6.1 Classification of pollutants in industry
6.2 Sources of pollutants
6.3 Permissible limits
6.4 Control of the environment

Unit 7. Industrial Safety **[6 Hr]**

9.1 Introduction
9.2 Employer Liability Laws
9.3 Workmen's Compensation Laws
9.4 Agencies rendering safety services
9.5 Industrial Relations, Trade Unions and Safety Representatives

References:

1. William Handley, Industrial Safety handbook, Mc-Graw Hill
2. H. V. Krishnan, An introduction to Safety Engineering and Management
3. M. K. Polter, Occupational Health & Safety in Manufacturing Industries, Mir Publishers, Moscow
4. H. W. Henrich, Industrial Accident Prevention, Mc-Graw Hill

Engineering Professional Practice

EG 3203 MM

Total: 2 hours /week

Year: III **Lecture: 2 hours/week**

Semester: VI

Course Description:

This course has been designed to make the student realize the importance of their profession and their responsibility towards the society. This subject is expected to contribute to motivate the students to practice their profession in ethical manner.

Course Objectives:

After completion of this course the students will be able to;

1. Explain what is professionalism
2. Realize the implication of labor laws on Nepal
3. Understand contract laws and contract procedures of Nepal
4. Realize the duty and ethical values of own profession

Course Content:

Unit 1: Engineering Professionalism [6 Hr]

- 1.1 Engineering Morale, Ethics and Professionalism
- 1.2 Features of profession
- 1.3 Causes of loosing professionalism
- 1.4 Code of ethics and guidelines for engineering professionals
- 1.5 Relationship of engineering profession to basic science and technology: Relationship to other profession
- 1.6 Industrialization vs protection of the environment

Unit 2: Labor Law in Nepal [8 Hr]

- 2.1 Introduction
- 2.2 Labor Acquisition
- 2.3 Conditions of work
- 2.4 Compensation

2.5 Conditions for pay cut
2.6 Trade Unions
2.7 Health and security provision
2.8 Employee welfare
2.9 Disciplining
2.10 Resolving labor dispute
2.11 Process for collective bargaining
2.12 Process to go on strike
2.13 Personal and Financial Regulation: Tippani system

Unit 3: Engineering Professional Practice in Nepal [7 Hr]

3.1 Contract law
3.2 Preparation of Tender Document and Tendering process
3.3 Finalization of Contract documents
3.4 Approval of contract agreement
3.5 Liability and negligence
3.6 Personnel and financial regulations; Tippani system
3.7 Duties, Responsibilities, Authority and Power delegation system

Unit 4: Accuracy and rigor [3 Hr]

4.1 Acting with care and competence
4.2 Staying within your limits
4.3 Keeping up to date
4.4 Ensuring others are not misled
4.5 Being objective
4.6 Evaluating risks

Unit 5: Honesty and integrity [2 Hr]

5.1 Affecting others
5.2 Preventing corruption
5.3 Rejecting bribery
5.4 Gaining trust

Unit 6: Respect for life, law and public good [4 Hr]

6.1 Justifying the work

6.2 Minimizing and justifying adverse effects
6.3 Respecting limited resources
6.4 Health and safety
6.5 The reputation of engineering

References:

1. Carson Morrison and Philip Hughes, "Professional Engineering Practice – Ethical Aspects", McGraw-Hill Ryerson Ltd., Totanto, 1982

2. References to be selected by the related lecturer(s) from among the texts available in the market that meet the content needs of this subject.

3. The related institute may develop its own textbook and approve from the related authority so as to have a prescribed textbook of this subject

Technology Environment and Society

EG: 3204 RA

Total: 3 hours /week
Year: III **Lecture: 3 hours/week**
Semester: VI **Tutorial: 1 hours/week**
Practical: hours/week
Lab: hours/week

Course Description:

This course is designed to impart the fundamental knowledge of the necessity to deal with natural systems in a compassionate manner by invoking the very core of values that separates human beings from the rest of animal kingdom. It deals with the basic environmental systems like the five primordial elements and Earth's environment and teach Human Values based approach in the interaction with environments for long term sustainable and environment friendly ways of development.

Course Objectives:

After completing the course, the students would be able to:

1. Explain the basic characteristics of Air, Water and their pollutants
2. Understand earth's eco system including that of animal kingdom
3. Human values and ways to interact with nature in a sustainable mode

Course Content:

Unit 1: Environmental Elements [4 Hr]

- 1.1 Five primordial elements; Earth, Water, Air, Fire (Energy), Sky (Ether) that sustain life
- 1.2 Structure of earth
- 1.3 Stage of the development of human societies from stone age onwards
- 1.4 Brief history of major world civilizations

Unit 2: Water **[7 Hr]**

2.1 Sources and uses of water
2.2 Earth's water cycle and distribution of earths water
2.3 Water pollution and its adverse effects to human and environment
2.4 Causes of water pollution

Unit 3: Air **[7 Hr]**

3.1 Constituents of Air
3.2 Major contaminants of Air
3.3 Air Pollution and its effects to humans and materials
3.4 Measures to reduce & control air pollution

Unit 4: Education in Human Values **[10 Hr]**

4.1 The Five Human Values of Truth, Right conduct, Peace, Love and Non-violence
4.2 The meaning and the source from where Human values emanates
4.3 Education and Educare for balanced development of individuals
4.4 Importance of EHV in early childhood

Unit 5: Earth's Environment **[9 Hr]**

5.1 Environment and earth's eco system
5.2 Role of water bodies, rivers and open spaces for healthy society
5.3 Role of plants, animals, and birds in eco system
5.3 Need for sustainable development

Unit 6: Social and Environmental Responsibilities of Technicians **[8 Hr]**

6.1 Role of Character in social development
6.2 Human values based approach in interaction with environment
6.3 Non invasive and environmentally sustainable developments
6.4 Human value based interaction with earth's eco systems for sustainability

References:

1. **Climate Change**, by Jonathan Cowie, Cambridge University Press, New Delhi, India
2. **A Textbook on Professional Ethics and Human Values,** by R.S.Nagarazan, New Age International (P) Ltd. Publishers, New Delhi, India

Applied Mechanics

EG 3205 ME

Total: 4 hours /week

Year: III **Lecture: 3 hours/week**

Semester: VI **Tutorial: 1 hours/week**

Course Description:

Knowledge of mechanics is essential of every discipline of engineering. This subject provides the initial base of engineering and students get the fundamentals of basic theories of engineering. Students develop their ability in analysis and introduce them to synthesis.

Course Objective:

After completing the course students are able to solve problems

- on concurrent force system
- involving the principle of moment equilibrium
- dealing with centre of gravity and centroid
- involving friction, energy in simple machines.

Course Content:

Unit 1: Vectors **[2 Hr]**

1.1 Scalar and vector quantities

1.2 Vector representation, examples

1.3 Addition and subtraction of vectors for resultant

1.4 Drawing vectors from given information

Unit 2: Forces **[8 Hr]**

2.1 Units and effect of forces on a body

2.2 Addition and subtraction of forces

2.3 Resultant of forces acting on a body

2.4 Triangle, parallelogram, and polygon law of forces

2.5 Equilibrium condition and equilibrant

2.6 Lami's theorem

2.7 Resolution of forces and finding resultant.

Unit 3: Moments [8 Hr]

3.1 Moment of force

3.2 Magnitude of moment

3.3 Moment equilibrium

3.4 Couple

3.5 Levers having perpendicular and inclined forces

4.6 Torque : magnitude of torque

3.7 Force and radius calculation from a given torque.

Unit 4: Center of Gravity and Centroid [5 Hr]

4.1 Relation between mass, weight, volume and density

4.2 Centre of mass and centre of gravity

4.3 Centroid of a lamina

4.4 Position of the centre of gravity and centroid of symmetrical bodies

Unit 5: Friction [7 Hr]

5.1 Static and Dynamic friction

5.2 Angle of friction and angle of repose

5.3 Coefficient of friction, factors affecting friction

5.4 Advantages and disadvantages of friction, application

5.5 Problems on screw jack, wedge, ladders like machines

5.6 Methods of reducing and increasing friction

Unit 6: Energy [8 Hr]

6.1 Definition of work, power and energy – its units

6.2 Work done by a constant force and variable force

6.3 Potential and kinetic energy

6.4 Conservation of energy

6.5 Kinetic energy of rotation

6.6 Efficiency with respect to work and power

Unit 7: Machines and Drives [7 Hr]

7.1 Working principles of mechanism and machines

7.2 Definition of Mechanical advantage, velocity ratio, efficiency

7.3 Mechanical advantage, velocity ratio, efficiency of simple machines such as inclined plane, wheel and axle, lever, Pulleys, gear wheel train.

7.4 Types of Mechanical Drives

7.4.1 Direct Shaft

7.4.2 Coupling

7.4.3 Chain drive

7.4.4 Belt and Pulley drive (Speed Reduction or Increase Calculation)

References:

1. Engineering Mechanics by R.C. Hibbeler
2. Engineering Mechanics by R.S. Khurmi
3. Applied Mechanics by Rajput

Laboratory Works:

1. Verification of the law of parallelogram and polygon of forces
2. Verification of the principle of moments
3. Determination of coefficient of friction between two surfaces
4. Determination of M A , V R, and efficiency of simple machines considered
5. Determination of M A , V R, and efficiency of different system of pulleys

Project - II

EG 3206 RA

Year: III **Total: 6 hours /week**

Semester: VI **Practical: 6 hours/week**

Course Description:

This section of the syllabus will be the combination of the knowledge and the skill learnt during the semester I, II, III and IV of the program. The student will be given an outline of component/device/item/tool for the propose. S/he shall then have to do basic design of the selected product. The finished design and drawing of the product along with project report shall be submitted for appraisal. The project report will consist of the following:

- Application of the project outcome
- Basic design considerations.
- Considerations on material selection.
- Related drawing/s.
- List of material required and estimation of cost
- Time Schedule

The student will be allocated a team of guides or an supervisor to assist for her/his project and design work. The student shall also consult the library and internet for his/her work.

As the project is completed, the students will have to submit a final report and presentation of report in front of jury must be done and operation of completed project must be demonstrated. There will be viva for individual student regarding their project.

The marks will be allocated as follow;

1. Concept, Design and Drawing 25
2. Workmanship and Performance 75
3. Report 50
4. Viva 50

Total: 200

Transport Refrigeration and Air-conditioning

EG 3207 RA

(Elective – II)

Total: 5.5 hours /week

Year: III **Lecture: 3 hours/week**

Semester: VI **Tutorial: 1 hours/week**

Practical: 1.5 hours/week

Course Description:

This course has been designed for such students, who want to specialize in Transport Refrigeration and air-conditioning. This subject will be taught in third year (Sixth Semester) as an elective.

Course Objectives:

After completion of this course the students will be able to;

- explain the methods and use of transport refrigeration,
- explain the different systems used in various means of transport
- repair the refrigeration system of refrigerated trucks/vans
- repair and maintain air-conditioning system of air-conditioned car/bus

Course Content:

Unit 1: Introduction to Transport Refrigeration [8 Hr]

1.1 Need of Refrigerated Transport

1.2 Refrigerated Trucks

1.3 Refrigerated Train

1.4 Marine Refrigeration

1.5 Refrigerated air cargo

Unit 2: Methods of Refrigeration in Road Transport [4 Hr]

2.1 Liquid Nitrogen

2.2 Dry Ice

2.3 Mechanical Refrigeration

2.4 System, Components and controls of above listed systems

Unit 3: Refrigerated Trucks/Vans **[9 Hr]**

3.1 Body Insulation
3.2 Refrigeration systems
3.3 System components
3.4 Control system

Unit 4: Bus Air-conditioning **[9 Hr]**

4.1 Heating systems
4.2 Cooling systems
4.3 System components
4.4 Control system

Unit 5: Car Air-conditioning **[6 Hr]**

5.1 Heating systems
5.2 Cooling systems
5.3 System components
5.4 Control system

Unit 6: Train Air-conditioning **[3 Hr]**

6.1 Heating systems
6.2 Cooling systems
6.3 System components
6.4 Control systems

Unit 7: Marine Air-conditioning **[3 Hr]**

7.1 Heating system
7.2 Cooling system
7.3 System components
7.4 Control systems

Unit 8: Airplane Air-conditioning **[3 Hr]**

7.1 Heating system
7.2 Cooling system
7.3 System components
7.4 Control systems

References:

1. **Refrigeration and Air-conditioning, Second edition, New Age International Publisher**
2. **Operation and Service manual, Transport Air-conditioning Unit, Carrier**

Practical:

1. Observe and draw the diagram of various systems used in refrigerated Trucks/Vans as per arrangement.
2. Identify all the components used in refrigerated Trucks/Vans.
3. Check the system performance of a Refrigerated Trucks/Vans.
4. Identify all the components used in refrigerated
5. Check the system performance of a Air-conditioned Car/ Bus.
6. Charge the refrigerant in Car air-conditioner

Refrigerant Management

EG 3208 RA
(Elective – II)

Total: 5.5 hours /week
Year: III **Lecture: 3 hours/week**
Semester: VI **Tutorial: 1 hours/week**
Practical: 1.5 hours/week

Course Description

This course deals with the global environmental issues and teaches the role of the Ozone Depleting Substances (ODS) and the mechanism of Ozone depletion. It deals with the recovery recycling of Ozone depleting refrigerants and Good Practices in Refrigeration that should be followed.

Course Objectives

After completing the course, the students would be able to:

1. Explain the global environmental issues like Ozone Depletion and Global warming
2. Explain the recovery techniques
3. Explain the constituents and applications of environmentally safer refrigerants

Course Content:

Unit 1: Refrigerants [7 Hr]

1.1 Characteristics of refrigerants
1.2 Nomenclature of refrigerants, commercial name, generic name and chemical formula of major refrigerants
1.3 Refrigerant footprints

Unit 2: Ozone layer [7 Hr]

2.1 Layers of Earth's atmosphere and the role of Ozone layer in the stratosphere

2.2 Formation of Ozone in near ground levels and their effects
2.3 The process of the formation and destruction of ozone

Unit 3: The process of Ozone depletion [8 Hr]

3.1 Ozone depletion mechanism and Ozone Depleting Substances
3.2 Causes and effects of Ozone depletion
3.3 Effect on Ozone by Fully halogenated and not fully Halogenated refrigerants
3.4 Ozone Depleting Potential (ODP) of refrigerants

Unit 4: Global Warming [8 Hr]

4.1 Global Warming Mechanism
4.2 Causes and effects of Global Warming
4.3 Global Warming potential of Refrigerants

Unit 5: Refrigerant Recovery equipments and their operation [8 Hr]

5.1 Refrigerant Recovery, meaning and processes
5.2 Recovery equipments
5.3 Push/Pull liquid recovery
5.4 Vapor transfer recovery

Unit 6: Good Practices in Refrigeration [7 Hr]

6.1 Montreal Protocol and Nepalese efforts in control of ODS
6.2 Recycling and Reclaim
6.3 Recycling equipment and process
6.4 Current Zero ODP refrigerants and their applications

References:

1. **A Course in Refrigeration and Air Conditioning, Sixth Edition, Reprint 2008,** by Arora & Domkundwar, Dhanpat Rai & Co., India
2**. Introduction to Environmental Engineering and Science, Third Edition,** by Gilbert M. Masters & Wendell P. Ela Pearson Education Inc. publishing, as Pearson, Printice Hall

Practical

1, Study of recovery equipment
2. Recovery of refrigerant from a refrigerator
3. Refrigerant charging

Energy Audit and Management

EG 3209 ME

(Elective-II)

Total: 5.5 hours /week

Year: III **Lecture: 3 hours/week**

Semester: VI **Tutorial: 1 hours/week**

Practical: 1.5 hours/week

Course Description:

This course deals with the fundamentals of energy auditing and management. Students will understand basic principles and importance of energy audit, analysis and conservation.

Course Objectives:

After completing this course the student will be able to:

1. Understanding the basic principle and importance behind energy audit
2. Understand the energy consumption patterns of common electro-mechanical equipments
3. Deal with the efficient use of energy in a given system with energy audit
4. Optimize the use of energy system under varying conditions
5. Optimize the source of energy that produce goods and provide services with the least cost and least environmental effect.

Course content:

Unit : Introduction [4 Hr]

1.1 Types of energy
1.2 Definition and objective of energy audit and management
1.3 Principles of energy management
1.4 Energy Management Skills.
1.5 Energy Management Strategy

Unit 2: Energy Auditing Technique [5 Hr]

2.1 Energy Audit - Types & Methodology
2.2 Needs of energy audits
2.3 Methods of energy auditing and System approach

2.4 History of energy use
2.5 Familiarization with the systems
2.6 Existing energy consumption pattern
2.7 Field survey
2.8 Approach to analysis of fuel and electricity figures
2.9 Energy saving potential by good housekeeping, electricity, waste heat recovery

Unit 3: Energy Audit Instruments [9 Hr]

3.1 Principal and working of Electrical Measuring Instruments (Voltmeter, ammeter, Power factor meter, Frequency analyzer)
3.2 Principal and working of Speed measuring devices (Tachometer contact/ non- contact type, Stroboscope)
3.3 Principle and working of temperature measuring devices(Contact and non- contact type thermometers, Infrared thermometers)
3.4 Principle and working of flue gas analyzer (Combustion analyzer, Fuel efficiency monitor, Fyrite)
3.5 Pressure and velocity Measurement (Bourdon gauge, Manometers, Anemometer)
3.6 Flow Measurement of steam, water and air (Pitot Tube and manometer)
3.7 Humidity Measurement and leak Detectors
3.8 Measure of illumination using Lux meter

Unit 4: Energy Conservation and Management [16 Hr]

4.1 **Electrical energy survey:** Understanding the bill, tariffs, analysis, instruments for electrical energy survey, efficiency calculation; Energy conservation in distribution system and distribution system arrangement; Power factor management and problems associated with poor power factor.

4.2 **Energy conservation in Lighting System:** Types of lighting equipments; Energy conservation opportunities in lighting system.

4.3 **Energy conservation in Buildings:** Building heat gain, Types of heating, ventilating and air-conditioning, thermal insulation, solar passive architecture.

4.4 **Energy conservation in Steam Generation, Distribution:** losses in boilers, boiler and furnace efficiency calculation; Losses in steam distribution system and condense recovery.

Unit 5: Electrical Energy Demand and Load Management [5 Hr]

5.1 Maximum demand: demand charges, Cost saving from demand control
5.2 Demand control potential: load factor, load curves and demand profiles, identification of load
5.3 Method of demand control: manual and automatic
5.4 Load management

Unit 6: Co-generation [1 Hr]

6.1 Waste heat recovery in plats, Topping cycle, bottoming cycle

Unit 7: Energy Audit Reporting [5 Hr]

7.1 Energy Audit Reporting format
7.2 Understanding energy cost
7.3 Benchmarking and Energy Performance
7.4 Matching energy usage to requirement
7.5 Maximizing System Efficiency

References:

1. Paul O' Callaghan, "Energy management", McGraw Hill, 1993
2. Charles M. Gottschalk, "Industrial Energy Conservation", John Wiley and Sons, 1996
3. Energy management handbook, John Wiley and Sons - Wayne C. Turner
4. Guide to Energy Management, Cape Hart, Turner and Kennedy

Field Visit:

Field visit be conducted to the local industry to observe mechanical and electrical system in operation.

Laboratory:

At least 6 labs related to the energy consumption pattern of electrical and mechanical equipments and investigate the energy saving opportunity. Following experiment can be conducted in lab:

1. Experiment on heat transfer
2. Experiments on refrigeration and air-conditioning
3. Experiments on compressor
4. Stag gas measurement and analysis
5. Use of electrical energy meter and calculations
6. Electrical light flux measurements
7. Experiment on electrical motor
8. Experiments on pumps and fans
9. Exercise on energy auditing from simple to complex one in step
10. Project on specific energy auditing