CURRICULUM

DIPLOMA
Mechanical Engineering
(Three year program-semester system)

Council for Technical Education and Vocational Training
Curriculum Development & Equivalence Division
Sanothimi, Bhaktapur
2007
First Revised, 2014
Second Revised, 2022

Contents

Introduction

Mechanical Engineering is one of the prominent and popular disciplines within engineering. Many people in the developed countries, developing countries and under developed countries have given emphasis for the broader application of mechanical engineering. This field has been helping the world for the mechanical 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 the middle level technical workforce equipped with knowledge and skills related to the field of mechanical 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 national needs in the field of electronics engineering.

Rationale of Revision

Diploma in Mechanical Engineering curriculum was last revised in 2014. This is the Second revision after the implementation of its first revision. The rationales behind its revision are as follows:

- It crossed the 5 years maturity period of its implementation after the 1st revision and similarly the implementing agencies/college have requested to revise this curriculum based on their teaching experiences.
- The year-wise re-adjustments of the existing subjects are felt necessary.
- Some new subjects seem to be introduce as per the advancement in technology.
- It is needed to revisit its weightage in both theory and practical marks and contents to make it more practical oriented.
- The technologies invented in the field of automobile are necessary to incorporated.

Furthermore, technology of Mechanical occupation upgraded rapidly and new technology are introducing in the recent year. With the advent in technology trained technicians are needed throughout the world. To cope with the national and international demand, the knowledge and the skills should be updated to make the skills relevant and pertinent to the industry. Hence this curriculum is revised to equip the students as per the changing technology in changing environmental context.

Curriculum title

Diploma in Mechanicals Engineering (DME).

Aim

The program aims to produce mid-level technical human resource equipped with knowledge and skills in allied field of study.

Objectives

This curriculum has following objectives to:

- Produce middle level competent workforce in the field of mechanical engineering.
- Prepare such technicians who are able to work in the mechanical sector related local workshop and industrial settings of the country.
- Meet the demand of such technical workforce for the mechanical industries of Nepal.
- Reduce the dependence on employing such technicians from foreign countries.

- Prepare technical workforce demonstrating positive attitude and respect for the profession and socio-cultural values.
- Create self-employment opportunities.

Group size

The group size is a maximum 48 students.

Entry criteria

- SLC pass or SEE or equivalent with minimum C Grade (2.0 Grade Point) in Mathematics and Science and 1.6 Grade Point or equivalent in English and as per the provisions mentioned in the admission guidelines of Office of the Controller of Examinations, CTEVT.
- Pre-diploma in related subject or equivalent with minimum 68.33%.
- Pass entrance examination administered by CTEVT.

Duration

The total duration of this curricular program is three academic years [six semesters]. The program is based on semester system. Moreover, one semester consists of 19.5 academic weeks including evaluation period. Actual teaching learning Hrs. will be not less than 15 weeks in each semester.

Medium of instruction

The medium of instruction is in English and/or Nepali.

Pattern of attendance

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

Teacher (Instructor) and Student Ratio

The ratio between teachers and students must be:

- Overall ratio of teacher and student must be 1:12 (at the institution level)
- 1:48 for theory and tutorial classes
- 1:12 for practical/demonstration
- 1:8 for bench work
- 75 % of the technical teachers should be full timer

Qualification of Instructional Staff

- The program coordinator should be a master's degree holder in the related subject area.
- The disciplinary subject related teachers should be a bachelor’s degree holder in the related subject area.
- The demonstrators should be a bachelor’s degree holder or diploma or equivalent with 3 years work experience in the related subject area.
- The foundational subject related teacher (refer to course codes SH and MG) should be master’s degree holder in the related subject area.

Instructional Media and Materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- ***Printed media materials:*** Assignment sheets, case studies, handouts, performance checklists, textbooks etc.
- ***Non-project media materials:*** Displays, models, photographs, flipchart, poster, writing board etc.
- ***Projected media materials****:* Slides, Multimedia Projector.
- ***Audio-visual materials:*** Audiotapes, films, slide-tapes, videodisc, etc.
- ***Computer based instructional materials:*** Computer based training, interactive video etc.
- **Web-Based Instructional Materials** (Online learning)
- **Radio/Television/Telephone**
- **Education-focused social media platform**)

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, fieldwork, block study, industrial practice, report writing, term paper presentation, heuristic and other independent learning exercises.

- **Theory**: Lecture, Group discussion, assignment and group work etc.
- **Practical**: Demonstration, observation and self-practice.
- **Internship**: Industrial Practice.

Approach of Learning

There will be inductive, deductive and learner-centered approaches of learning.

Examination and Marking Scheme

a. Internal assessment

- There will be a transparent/fair evaluation system for each subject in both theory and practical exposure.
- Each subject will have internal assessment at regular intervals and students will get the feedback about it.
- Weightage of theory and practical marks are mentioned in curriculum structure.
- Continuous assessment format will be developed and applied by the evaluators for evaluating student's performance in the subjects related to the practical experience.

b. Final examination

- Weightage of theory and practical marks are mentioned in course structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject, s/he will appear in the re-examination administered by CTEVT.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

c. Requirement for final practical examination

- Professional of relevant subject teacher must evaluate final practical examinations.
- One evaluator in one setting can evaluate not more than 24 students.

- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned constituent or affiliated institute led by external evaluator nominated by CTEVT.
- Provision of re-examination will be as per CTEVT policy.

d. Final practicum evaluation will be based on

- Institutional practicum attendance - 10%
- Logbook/Practicum book maintenance - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%
- Viva voce :
    - Internal examiner - 20%
    - External examiner - 20%

e. Pass marks

- The students must secure minimum 40% marks in theory and 50% marks in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

Provision of Back Paper

There will be the provision of back paper but a student must pass all the subjects of all semester within six years from the enrollment date; however, there should be provision of chance exam for final semester students as per CTEVT rules.

Disciplinary and Ethical Requirements:

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

Grading System

The grading system will be as follows:

Grading	**Overall marks**
• Distinction:	80% and above
• First division:	65% to below 80%
• Second division:	50 % to below 65%
• Pass division:	Pass marks to Below 50%

Certificate Awarded

Students who have passed all the components of all subjects of all 6 semesters are considered to have successfully completed the program.

Students who have successfully completed the program will be awarded with a degree of **"Diploma in Mechanical Engineering".**

Career Path

The graduates will be eligible for the position equivalent to Non-gazetted 1st class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies.

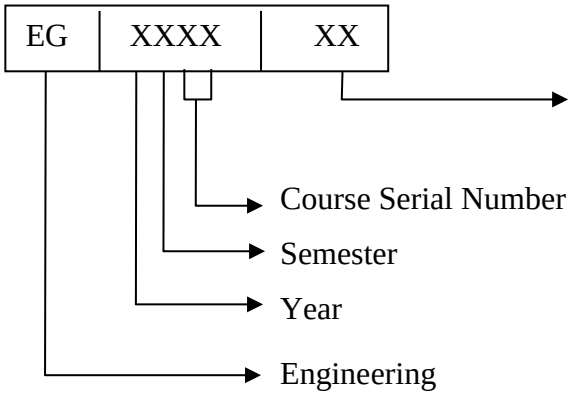
General Attitudes Required

A student should demonstrate following general attitudes for effective and active learning.

Acceptance, Affectionate, Ambitious, Aspiring, Candid, Caring, Change, Cheerful, Considerate, Cooperative, Courageous, Decisive, Determined, Devoted, Embraces, Endurance, Enthusiastic, Expansive, Faith, Flexible, Gloomy, Motivated, Perseverance, Thoughtful, Forgiving, Freedom, Friendly, Focused, Frugal, Generous, Goodwill, Grateful, Hardworking, Honest, Humble, Interested, Involved, Not jealous, Kind, Mature, Open minded, Tolerant, Optimistic, Positive, Practical, Punctual, Realistic, Reliable, Distant, Responsibility, Responsive, Responsible, Self-confident, Self-directed, Self-disciplined, Self-esteem, Self-giving, Self-reliant, Selfless, Sensitive, Serious, Sincere, Social independence, Sympathetic, Accepts others points of view, Thoughtful towards others, Trusting, Unpretentiousness, Unselfish, Willingness and Work-oriented

Subjects codes

Each subject is coded with a unique number preceded and followed by certain letters as mentioned in the following chart:



Code of Offering Diploma Programmes:

1. AGE: Agricultural Engineering
2. AR: Architecture Engineering
3. AE: Automobile Engineering
4. BM: Biomedical Engineering
5. BM: Biomedical Equipment Engineering
6. CE: Civil Engineering
7. CT: Computer Engineering
8. EE: Electrical Engineering
9. EEX: Electrical & Electronics Engineering
10. EX: Electronics Engineering
11. GE: Geomatics Engineering
12. HE: Hydropower Engineering
13. IT: Information Technology
14. MG: Management
15. ME: Mechanical Engineering
16. MX: Mechatronics Engineering
17. RAE: Refrigeration & Air Conditioning Engineering
18. SH: Science and Humanities

CURRICULUM STRUCTURE

Diploma in Mechanical Engineering

YEAR: I **PART: I**

S.N.	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hrs	Credit Hrs	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Time Hrs	*Assmt Marks	Final Marks	Time Hrs		
1	EG 1101 SH	Applied Nepali	4				4	4	20	80	3				100	*Continuous assessment
2	EG 1102 SH	Applied English	4				4	4	20	80	3				100	
3	EG 1103 SH	Engineering Mathematics I	4	2			6	4	20	80	3				100	
4	EG 1104 SH	Engineering Physics I	4	2		2	8	5	20	60	3	10	10	2	100	
5	EG 1105 SH	Engineering Chemistry I	4	2		2	8	5	20	60	3	10	10	2	100	
6	EG 1101 AR	Engineering Drawing I	1		4		5	3	0	0		60	40	4	100	
7	EG 1101 CT	Computer Application	2		2		4	3	10	40	1.5	30	20	3	100	
TOTAL			**23**	**6**	**6**	**4**	**39**	**28**							**700**	

YEAR: I **PART : II**

S.N.	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hrs	Credit Hrs	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Time Hrs	*Assmt Marks	Final Marks	Time Hrs		
1	EG 1201 SH	Engineering Mathematics II	4	2			6	4	20	80	3				100	*Continuous assessment
2	EG 1202 SH	Engineering Physics II	4	2		2	8	5	20	60	3	10	10	2	100	
3	EG 1203 SH	Engineering Chemistry II	4	2		2	8	5	20	60	3	10	10	2	100	
4	EG 1201 CE	Workshop Practice I	2		6		**8**	**5**				60	40	4	100	
5	EG 1201 AR	Engineering Drawing II	0		4		4	2				60	40	4	100	
6	EG 1202 CE	Applied Mechanics	3	2		2/2	6	4	20	60	3	20			100	
TOTAL			**17**	**8**	**10**	**5**	**40**	**25**							**600**	

Diploma in Mechanical Engineering

YEAR: II **PART: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 2101 ME	Basic Electronics Engineering	3			2	5	4	20	80	3	25			125	*Continuous assessment
2	EG 2102 ME	Electrical Technology	3			2	5	4	20	80	3	25			125	
3	EG 2103 ME	Machine Drawing	1		3		4	3				60	40	4	100	
4	EG 2104 ME	Material Science	3			2/2	4	4	20	80	3	25			125	
5	EG 2105 ME	Thermal Engineering	3	1		2/2	5	4	20	80	3	25			125	
6	EG 2106 ME	Engineering Dynamics	2	1			3	3	10	40	1.5				50	
7	EG 2107 ME	Workshop Practice II	4		7		11	8	20	80	3	120	80	6	300	
8	EG 2108 ME	Industrial Engineering	3				3	3	20	80	3				100	
TOTAL			**22**	**1**	10	**6**	**40**	**33**							**1050**	

YEAR: II **PART: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt. Marks	Final Marks	Exam Hours		
1	EG 2201 ME	Manufacturing Technology I	4		10		14	9	20	80	3	150	100	6	350	*Continuous assessment
2	EG 2202 ME	Computer Aided Drawing	1		3		4	3				60	40	4	100	
3	EG 2203 ME	Internal Combustion Engine	3		3		6	5	20	80	3	60	40	4	150	
4	EG 2204 ME	Machine Element & Mechanism	3				3	3	20	80	3				100	
5	EG 2205 ME	Strength of Materials	3	1		2/2	5	4	20	80	3	25			125	
6	EG 2206 ME	Fluid Mechanics and Machines	3	1		2/2	5	4	20	80	3	25			125	
7	EG 2207 ME	Project I			3		3	2				60	40	4	100	
TOTAL			**17**	**2**	**16**	**5**	**40**	**30**							**1050**	

Diploma in Mechanical Engineering

YEAR: III **PART: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 3101 ME	Manufacturing Technology II	4		10		14	9	20	80	3	150	100	6	350	*Continuous assessment
2	EG 3102 ME	Automobile Technology	3		4		7	5	20	80	3	60	40	4	200	
3	EG 3103 ME	Fundamentals of Hydraulics and Pneumatics	3			2	5	4	20	80	3	25			125	
4	EG 3104 ME	Machine Design, Estimating & Costing	3	1			4	3	20	80	3				100	
5	EG 3105 ME	Project II			4		4	2				60	40	4	100	
6	EG 3106 ME	Industrial Attachment			6		6	3				100	50	4	150	
TOTAL			**13**	**1**	**24**	**2**	**40**	**26**							**1025**	

YEAR: III **PART: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt. Marks	Final Marks	Exam Hours		
1	EG 3201 ME	Advanced Manufacturing Technology	3		4		7	5	20	80	3	60	40	4	200	*Continuous assessment
2	EG 3202 ME	Basic Refrigeration and Air-conditioning	3	1		2	6	4	20	80	3	25			125	
3	EG 3203 ME	Occupational Hygiene and Safety	3				3	3	20	80	3				100	
4	EG 3201 MG	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	
5	EG 3204 ME	Project III			12		12	6				200	100	6	300	
6		Elective (One of the followings)	3			4	7	5	20	80	3	50			150	
	EG 3205 ME.1	a: Product Design														
	EG 3205 ME.2	b: Hydropower Engineering														
	EG 3205 ME.3	c: Renewable Energy Technology														
	EG 3205 ME.4	d. Planning of Mechanical Job Shop														
TOTAL			**15**	**1**	**18**	**6**	**40**	**27**							**975**	

L = Lecture, T = Tutorial, P = Practical

First Year (First and Second Semester)

[See Separate Curriculum]
First Year Engineering All
(Year I Part I and Year I Part II)

Second Year
Part I & II
(Third and Fourth Semester)

Third Semester

Year II Part I

Subjects:

1. EG 2101 ME Basic Electronics Engineering
2. EG 2102 ME Electrical Technology
3. EG 2103 ME Machine Drawing
4. EG 2104 ME Material Science
5. EG 2105 ME Thermal Engineering
6. EG 2106 ME Engineering Dynamics
7. EG 2107 ME Workshop Practice II
8. EG 2108 ME Industrial Engineering

Basic Electronics Engineering

EG 2101 ME

Total: 5 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course deals with various types of electronic components, devices and circuits with their basic application required for the diploma in mechanical/automobile engineering.

Course Objectives:

After completing this course the student will be able to:

1. Identify and explain the working principles of various semiconductor devices, relate their characteristics and applications.
2. Explain the characteristics of CB, CE and CC configuration circuits.
3. Identify and explain the working of digital electronics.

Course contents:

Unit 1: Introduction **[2 hrs]**

1.1 Status of electronics in Nepal

1.2 Basic electronics components and their application in the field of mechanical and automobile engineering

Unit 2: Semiconductor Diode and Applications **[9 hrs]**

2.1 Basic concept of semiconductors, intrinsic and extrinsic semiconductor

2.2 Types of semiconductor (N type and P type)

2.3 Introduction to PN junction diode: Basic structure, biasing, VI characteristics

2.4 Application of diode: Half and full wave rectifier circuit and their operation with filter

2.5 Zener diode: Basic construction, principle of operation, VI characteristics, Zener diode as voltage regulator

2.6 Introduction of LED, Photodiode, Varacters diode, Tunnel diodes

Unit 3: Introduction to Bipolar Junction Transistor (BJT) **[8 hrs]**

3.1 Basic structure of BJT, principle of PNP and NPN configuration

3.2 Concept of BJT biasing, load line and Q-point, general characteristics of BJT

3.3 BJT as an amplifier and switch

3.4 Basic configuration of transistor circuits (CE, CB, CC), VI characteristics of CE, CB, CC and their comparison

Unit 4: Introduction to Special Semiconductor Devices **[4 hrs]**

4.1 Basic construction, features, and uses of:

- 4.1.1 Silicon controlled rectifier
- 4.1.2 UJT (unijunction transistor)
- 4.1.3 JFET (junction field effect transistor)
- 4.1.4 MOSFET (metal oxide semiconductor)
- 4.1.5 Photo diode and optocoupler

Unit 5: Introduction to Integrated Circuit **[2 hrs]**

5.1 Introduction

5.2 Schematic symbol

5.3 Introduction to SSI, LSI, VLSI

Unit 6: Fundamentals of Digital Electronics **[10 hrs]**

6.1 Number systems: Decimal, Binary, Octal and Hexa- decimal, conversion of number system

6.2 Binary arithmetic: Addition, subtraction, multiplication and division of binary numbers

6.3 Logic gates: Symbols, truth table, Boolean expression of OR, NOT, NOR, AND, NAND, XOR and XNOR gates

6.4 Boolean algebra and associated rules

6.5 De-Morgan's theorem (statement only)

6.6 Introduction to universal gate

Unit 7: Introduction to Combinational Logic Devices **[5 hrs]**

7.1 Encoder/decoder

7.2 Multiplexer and de-multiplexer

7.3 Adder and sub-tractor

Unit 8: Introduction to Sequential Logic Devices **[5 hrs]**

8.1 Introduction to latches and flip flops

8.2 Basic construction, symbol and truth table of SR, JK, D, T flip flop

8.3 Introduction to counters: Synchronous and asynchronous counters (ring counter)

8.4 Shift registers: shift left and shift right

Practical/ Laboratory: ***[30 hrs]***

1.	Study of VI characteristics of PN junction diode	[3 hrs]
2.	Design and study of rectifier circuits	[3 hrs]
3.	Study of VI characteristics of CE, CB and CC configuration of transistor	[6 hrs]
4.	Study of logic gates using trainer kits	[6 hrs]
5.	Study of encoder and decoder	[3 hrs]
6.	Study of multiplexer and de- multiplexer	[3 hrs]
7.	Study of adder and sub-tractor	[3 hrs]
8.	Study of counter and register	[3 hrs]

References:

1. T.F. Bogard, "Electronics device and circuit", Pearson Publication
2. M. Morris Mano, "Digital Logic and Computer Design",Pearson Publication
3. J.B Gupta, "Electronics devices and circuits", S.K. Kataria and Sons
4. V.K Mehta, "Principle of electronics", S.Chand and Company.
5. Malvino Brown, "Fundamentals of digital electronics" Tata McGrow-Hill.

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	2	4
2	Semiconductor Diode and Applications	9	16
3	Introduction to Bipolar Junction Transistor (BJT)	8	16
4	Introduction to Special Semiconductor Devices	4	8
5	Introduction to Integrated Circuit	2	4
6	Fundamentals of Digital Electronics	10	16
7	Introduction to Combinational Logic Devices	5	8
8	Introduction to Sequential Logic Devices	5	8
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Electrical Technology

EG 2102 ME

Total: 5 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course provides a basic framework for understanding the fundamental concept of single and three phase electric circuits. The course deals with circuit fundamentals and electric machines.

Course Objectives:

After completing this course the students will be able to:

1. Understand the fundamental concept of electric circuits
2. Understand the fundamental principles of AC and DC systems
3. Understand the DC and AC electrical machines.

Course contents:

Unit 1: Introduction [4 hrs]

1.1 Electric sources: Current and Voltage Source, AC and DC sources
1.2 Concept of electric charge and current flows in a circuit
1.3 Emf and potential differences
1.4 Concept of generation, transmission and distribution system of electricity in Nepal
1.5 Concept of resistance, inductance and capacitance
1.6 Resistance, resistivity, temperature coefficient of resistance, variation of resistance with temperature
1.7 Series and parallel combination of resistors, inductors and capacitors

Unit 2: Electric Circuit and Theorem [7hrs]

2.1 Electric circuit, series and parallel circuit
2.2 Ohm's law, its application and limitations
2.3 Electrical Power & Energy
2.4 Kirchhoff's Law and their application using mesh analysis and nodal analysis method
2.5 Ideal and practical sources
2.6 Condition for maximum power transfer

Unit 3: AC Circuit Analysis [9 hrs]

3.1 Generation of 1-phase AC voltage and current
3.2 Waveform and terms used in AC: Cycle, frequency, time period, amplitude, phase and phase difference
3.3 Average and r.m.s, peak and peak-to-peak value of current and voltage

3.4 AC in pure resistance, inductance and capacitance (equation and waveform of current, voltage and average power)
3.5 AC in RL, RC and RLC series circuit (equation and waveform of current and voltage; analysis of power and power factor)
3.6 Types of power in AC, power factor, its practical importance and power factor improvement
3.7 Measurement of power in single phase AC circuit
3.8 Basic concept and advantages of 3-phase system, phase and line quantities

Unit 4: Lighting Devices, Wiring System, Electrical Safety and Protection [3 hrs]

4.1 Different types of lighting system: Incandescent, Tungsten- halogen, Compact florescent, Tubular Florescent and LED lamp
4.2 Types of wiring: Open wiring vs Conceal wiring
4.3 Grounding, Earthing and its importance, system grounding vs equipment grounding
4.4 Definition and function of protection devices: Fuse, MCB, Lightning arrestor
4.5 Electric shock, preventive method and first aid to be taken in electrical accident

Unit 5: Transformer [3 hrs]

5.1 Transformer: construction and working principle
5.2 Emf equation of transformer
5.3 Voltage and current transformation ratio of transformer
5.4 Basic concept on losses and efficiency of transformer

Unit 6: DC Machines [7 hrs]

6.1 DC Generators: operating principle of dc generator, method of excitation, armature reaction
6.2 DC Motor: Operating principle of dc motor, back emf in dc motor, types of dc motor
6.3 Speed and direction control of DC motor

Unit 7: AC Machines [9 hrs]

7.1 Construction of AC machine
7.2 Synchronous Machine:
  7.2.1 Synchronous Generator: Construction and operating principle, application, advantages and disadvantages.
  7.2.2 Synchronous Motor: Synchronous speed, construction and operating principle, application, advantages and disadvantages.
7.3 Induction motor: Introduction and construction, operating principle, application, advantages and dis-advantages.

Unit 8: Selection of Motor [3 hrs]

8.1 Relationship between force, torque, rpm and power of motors
8.2 Sizing and selection of motors
8.3 Practical applications with examples.

Practical/ Laboratory: ***[30 Hrs]***

1. Use of ammeter and voltmeter to measure current and voltage [3 Hrs]
2. Verification of ohm's law. [3 Hrs]
3. Verification of KCL and KVL. [3 Hrs]
4. Measurement of AC circuit parameters using RLC series circuit. [6 Hrs]
5. Voltage, current and power measurements in 1-Ø and 3-Ø system [3 Hrs]
6. Measurement of power factor of ac loads [3 Hrs]
7. Demonstration of various parts of AC and DC machine. [3 Hrs]
8. Basic design and selection of motors for practical applications [6 Hrs]

References:

1. B L Thareja & A.K. Thareja, "A text book of electrical technology Volume I and II", S. Chand and Company, India
2. S.K.Sahdev, "Fundamentals of Electrical Engineering & Electronics", Dhanapati Rai & Company, India.
3. J.B. Gupta, "Fundamentals of Electrical Engineering and Electronics", S.K. Kataria & Sons.

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	4	8
2	Electric Circuit and Theorem	7	12
3	AC Circuit Analysis	9	20
4	Lighting Devices, Wiring System, Electrical Safety and Protection	3	4
5	Transformer	3	4
6	DC Machines	7	12
7	AC Machines	9	16
8	Selection of Motor	3	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Machine Drawing

EG 2103 ME

Year: II **Total: 4 Hrs/week**
Part: I **Lecture: 1 Hrs/week**
Tutorial: Hrs/week
Practical: 3 Hrs/week
Lab: Hrs/week

Course description:

This course deals with drawings about machines, elements of machine, standard graphical signs, symbols and notations, different type of fits with limits and tolerances, layout - installation, assembled and detail drawings of a plant or machine parts.

Course objectives:

After completing this course the students will be able to:

1. Read and sketch different universally accepted graphical signs, symbols and notations.
2. Understand the importance of limits, fits and tolerances in machines.
3. Draw few common machine elements with prevailing common practices.
4. Prepare working (detail & assembled) drawings.
5. Understand layout and installation drawings.

Course contents:

Unit: 1 Standard symbols [1 hr]

1.1 Introduction to machining symbols.
1.2 Introduction to surface roughness symbols and their meaning.
1.3 Introduction to welding symbols
1.4 Introduction to pipe and fittings symbols
1.5 Introduction to electronics and electrical symbols

Unit: 2 Limits, tolerances and fits [2 hrs]

2.1 Introduction to Nominal and basic size, limits of size.
2.2 Introduction to fundamental deviations, tolerances, upper & lower deviation.
2.3 Introduction to clearance fit, interference fit & transition fit.
2.4 Introduction to hole basis & shaft basis system.
2.5 Introduction to go, no-go gauge, interchangeability & selective assembly.

Unit: 3 Gear, Pulley and Belt [2 hrs]

3.1 Introduction to spur gearing, definitions of spur gear terminology & their definitions
- Construction of base circle.
- Construction of spur gear teeth (involute) profile.

3.2 Introduction to Pulleys & Belts
- Fast and loose pulleys
- V-belt pulleys
- Rope pulleys

Unit: 4 Working Drawing (Detail or production drawing) [3 hrs]

4.1 Introduction – drawing layout, title box, bill of materials (part list)
4.2 Sketch of details of different components of a machine with free hand dimensioning.
4.3 Review of different type of sectioning - full, half, partial (or broken), revolved, removed and offset.
4.4 Review of common dimensioning types.

Unit: 5 Working drawing (Assembly drawing) [7 hrs]

5.1 Introduction to drawing layout, detail item list (bill of materials), drawing numbers (sheet numbers), sheet folding and filing styles.
5.2 Accepted norm and common practices for assembly drawing.
5.3 Introduction to sectioning & dimensioning concept for assembly drawing.
5.4 Introduction to sequences of preparing the assembly drawing.
5.5 Introduction to plant or machine layout and installation drawing

Practical (Class work sheet):

Sheet No 1: [3 hrs]

Exercise in machining symbols, surface roughness symbols, welding symbols, pipe and fittings symbols, electronics and electrical symbols.

Sheet No 2: [6 hrs]

1. Make the complete fit analysis of hole basis system. (Not less than 3 exercises)
2. Make the complete fit analysis of shaft basis system. (Not less than 3 exercises)

Sheet No 3: [6 hrs]

1. Draw the profile of involute spur gear teeth. (Not less than 3 exercises)
2. Draw neatly the two views of fast and loose pulleys, rope pulleys and V-belt pulleys. (Not less than three exercises)

Sheet No 4: [9 hrs]

1. Draw the detail drawings of the different machine components. (Not less than four exercises)

Sheet No 5: [21 hrs]

5.1 Draw the assembly drawing of the different machine components with full sectional and half sectional views. (Not less than five exercises)

5.2 Observation and group discussion of minimum two sets of installation and layout drawings.

References:

1. N.D. Bhatt and V.M. Panchal, "Machine Drawing", Charotar Publishing House.
2. W.J. Luzadder, "Fundamental of Engineering Drawing" Prentice-Hall of India Pvt-Ltd., New Delhi
3. P.S. Gill, "Engineering Drawing", S. K. Kataraia & Sons, New Delhi.
4. M. C. Luintel, "Engineering Drawing II", Heritage Publishers & Distributors Pvt. Ltd., Nepal
5. K.L. Narayanan, P. Kannaiah and K. Venkata Reddy, "Machine drawing", New Age International Publishers, India.

Material Science

EG 2104 ME

Total: 4 Hrs/week

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

Part: I **Tutorial: Hrs/week**

Practical: Hrs/week

Lab: 2/2 Hrs/week

Course description:

This course deals with the classification and properties of several materials. It also describes the production of steel, testing methods of different materials and heat treatment process in brief. It covers the job specific material selection, substitution, and property evaluation.

Course objectives:

After completing this course the students will be able to:

1. Explain the properties of materials and their dependence on.
2. Explain different types of failure and their remedies
3. Understand the role of carbon in iron.
4. Explain the principle of heat treatment.
5. Perform different mechanical test.

Course contents:

Unit 1: Introduction: **[6 hrs]**

1.1 Importance and Scope

1.2 Classification of materials based on:

- State
- Natural, artificial
- Metals, non-metals

1.3 Physical properties: luster, color, density

1.4 Mechanical properties: plasticity, elasticity, ductility, malleability, toughness

1.5 Electrical properties: conductivity and effect of temperature

1.6 Magnetic properties: ferro-magnet, para-magnet, dia-magnet and hysteresis loss

1.7 Thermal properties: specific heat, latent heat and thermal expansion

Unit 2: Arrangement of Atoms **[4 hrs]**

2.1 Crystalline and amorphous solids

2.2 Unit cell, coordination number, Atomic packing factor

2.3 Crystal structure (BCC, FCC and HCP)

2.4 Crystal imperfection : Point defect, line and surface defect in brief

Unit 3: Fracture **[8 hrs]**

3.1 Introduction

3.2 Types of failure: Ductile, Brittle, Fatigue and Creep

3.3 Mechanism and remedies of Ductile and Brittle Fracture

3.4 Mechanism and remedies of Fatigue Failure

Unit 4: Testing of Metals **[8 hrs]**

4.1 Types of testing
4.2 Non-destructive testing and their uses : X-ray, ultrasonic, magnetic tests
4.3 Destructive testing
- Tensile test
- Fatigue test
- Hardness test: Brinell, Vicker and Rockwell
- Impact test: Charpy and Izod

Unit 5: Steels and Cast Iron **[7 hrs]**

5.1. Micro constituents in iron and cooling curve
5.2. Effect of carbon in iron
5.3. Difference between steels and cast iron
5.4. Types of steels: HSLA steel, stainless steel, tool steel
5.5. Types of cast iron: Grey, white, malleable, ductile
5.6. Various steel making processes: Bessemer, Open hearth, Duplex

Unit 6: Heat Treatment Process **[6 hrs]**

6.1 Purpose of heat treatment
6.2 Annealing
6.3 Normalizing
6.4 Quenching
6.5 Tempering
6.6 Surface hardening: Nitriding and Carburizing

Units 7: Engineering Materials **[6 hrs]**

7.1 Ferrous alloys
7.2 Non-ferrous alloys
7.3 Polymers: Properties, classification and uses
7.4 Rubber: Properties and uses
7.5 Ceramics: Properties, classification and uses
7.6 Composite materials: properties, classification and uses
7.7 Glass: properties, classification and uses

Practical (Laboratory): ***[15 hrs]***

Lab 1: Identification of material from physical properties such as density, color, sound etc.
Lab 2: Performing Tensile test on standard specimen and draw stress-strain diagram
Lab 3: Performing Hardness test on standard specimen (Brinell, Vicker and Rockwell)
Lab 4: Performing Fatigue test on standard specimen
Lab 5: Performing Impact test (Izod and Charpy) on standard specimen
Lab 6: Performing Heat treatment, compare its Mechanical properties.

References:

1. H. S. Bawa, Material and Metallurgy, TMG edition, New Delhi, India
2. K Gupta, R.C Gupta, Material Science, S. Chand and Co. Ltd, New Delhi, India
3. Sunil Risal, Khem Gyanwali, Material Science, Sigma Carts printing, Nepal

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	12
2	Arrangement of Atoms	4	6
3	Fracture	8	14
4	Testing of Metals	8	14
5	Steels and Cast Iron	7	12
6	Heat Treatment Process	6	10
7	Engineering Materials	6	12
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Thermal Engineering

EG 2105 ME

Year: II **Total: 5 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:

This course deals with the fundamental laws of thermodynamics, basic thermodynamics processes, introduction to heat transfer, types and uses of air compressors and boilers.

Course Objectives:

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

1. Laws of thermodynamics
2. Basic thermodynamics processes
3. Heat transfer
4. The uses and operation of boilers and air compressors

Course content

Unit 1: Basic Concept of Thermodynamics: **[6 hrs]**

- 1.1 Definition and importance of thermodynamics
- 1.2 Thermodynamic system (closed, open and isolated system)
- 1.3 Properties of system (intensive and extensive properties)
- 1.4 Thermal equilibrium
- 1.5 Thermodynamic state
- 1.6 Thermodynamic process, cycle
- 1.7 Forms of energy
- 1.8 Sensible heat and latent heat

Unit 2: Zeroth Law of Thermodynamics: **[2 hrs]**

- 2.1 Definition and applications
- 2.1 Different types of thermometer and their applications.

Unit 3: First Law of Thermodynamics: **[7 hrs]**

- 3.1 Statement of first law, mathematical representation
- 3.2 Application of first law; closed system only
- 3.3 General energy equation, internal energy, enthalpy, relationship between heat transfer and change in internal energy

Unit 4: Second Law of Thermodynamics: **[7 hrs]**

- 4.1. Limitation of first law
- 4.2. Statements of second law: Kelvin Planck and Clausius statement

4.3. Concept of Carnot cycle, heat engine, heat pump and refrigerator; thermal efficiency and COP
4.4. Reversible and irreversible processes, entropy, T-S diagram

Unit 5: Basic Thermodynamic Processes: **[5 hrs]**

5.1. Constant volume process
5.2. Constant pressure process
5.3. Constant temperature process
5.4. Adiabatic process
5.5. Polytropic processes

Unit 6: Heat Transfer: **[6 hrs]**

6.1. Modes of heat transfer (conduction, convection and radiation)
6.2. Fourier's law of heat conduction (Temperature gradient, Thermal conductivity)
6.3. Newton's law of heat transfers by convection, free and forced convection
6.4. Heat transfer by radiation, Stefan- Boltzmann law of thermal radiation

Unit 7: Air Compressors: **[4 hrs]**

6.1 Classifications of Air compressors
6.2 Uses of compressed air
6.3 Single stage reciprocating compressors: construction, operation and care
6.4 Centrifugal compressors: construction, operation and care

Unit 8: Boilers **[8 hrs]**

8.1. Introduction and applications
8.2. Classifications and comparison between water tube and fire tube types of boilers
8.3. Requirements of an ideal boiler
8.4. Boiler mountings and accessories: water level indicator, feed check valve, Blow off cock, steam separator, safety valves, Feed pump, air preheater, super heater and economizer
8.5. Water conditioning
    8.5.1 Water problems and Benefits of water conditioning
    8.5.2 Constituents and Characteristics of water
    8.5.3 Types and causes of scale and deposits
    8.5.4 Scale deposit prevention methods

Tutorials: ***[15 hrs]***

Assist students for conceptual & critical problem solving

1. Problems related to properties of system [2 hrs]
2. Problems related to energy conservation equation for closed system [4 hrs]
3. Problems on heat engine, heat pump and refrigerator [3 hrs]
4. Problems related to different thermodynamic processes [3 hrs]
5. Problems on conduction, convection and radiation [3 hrs]

Practical (Laboratory): ***[15 hrs]***

1) Determine thermal conductivity of given specimen.
2) Compare different types of thermometers.
3) Demonstrate steam tables & charts
4) Study performance of air-compressor
5) Conduct a visit to local food processing industry/hotel to study the operation and performance of boiler

Suggestion for instruction:

1. Use illustrative teaching materials like model, charts and video to visualize the complex parts.

References:

1. M. C. Luintel, “Fundamentals of Thermodynamics and Heat Transfer”, Heritage Publishers & Distributors Pvt. Ltd., Nepal
2. RS Khurmi and JK Jupta, "A text book of Thermal Engineering", S. Chand Publishing, India
3. R.K. Rajput, “Thermal engineering” Laxmi Publications, New Delhi.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Basic Concept of Thermodynamics	6	11
2	Zeroth Law of Thermodynamics	2	4
3	First Law of Thermodynamics	7	12
4	Second Law of Thermodynamics	7	12
5	Basic Thermodynamic Processes	5	9
6	Heat Transfer	6	11
7	Air Compressors	4	7
8	Boilers	8	14
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Engineering Dynamics
EG 2106 ME

Total: 2 Hrs/week
Year: II **Lecture: 2 Hrs/week**
Part: I **Tutorial: 1 Hrs/week**
Practical: Hrs/week
Lab: Hrs/week

Course Description:

This course provides the students with a fundamental knowledge of several motions as engineering dynamics. Also it covers the basics of work, power energy and simple machines. The students will become familiar with the basic problems of dynamics and learn the methods to solve them.

Course Objectives:

After completing the course students are able to

1. Develop the knowledge about the kinematics of particle.
2. Develop knowledge about kinetics of particle
3. Explain the concept of work, energy and power
4. Develop knowledge about circular and curvilinear motion
5. Explain the concept of simple machines.

Course Content:

Unit 1. Kinematics of Particles [8 hrs]

1.1 Kinematics of particles
1.2 Concept of Position, rest and motion, Displacement, speed, Velocity, uniform and variable velocity, Acceleration, Uniform and Variable acceleration.
1.3 Equation of motion and their uses.
1.4 Concept of Rectilinear motion of particles
1.5 Determination of motion of particle:
- When acceleration in given function of time
- When position is given function of time.

1.6 Concept of curvilinear motion of particles
1.7 Projectile motion and determination of time, range and elevation of flight.
1.8 Motion under gravity
1.9 Relative motion and dependent motion

Unit 2: Kinetics [6 hrs]

2.1 Introduction to kinetics
2.2 Newton's laws of motion
2.3 Gravitational and Absolute units of force

2.4 Law of conservation of momentum
2.5 Concept of Impulse and impulsive force
2.6 D'alembert's principle and its uses.
2.7 Motion of connected bodies

Unit 3: Work, Power and Energy **[5 hrs]**

3.1 Introduction: definition, units and types
3.2 Graphical representation of work
3.3 Potential and kinetic energy
3.4 Law of conservation of energy

Unit 4: Circular and Curvilinear Motion **[5 hrs]**

4.1 Introduction and Definitions
4.2 Equations of Angular Motion
4.3 Equations of Linear Motion and Angular Motion
4.4 Relation between Linear and Angular Motion

Unit 5: Simple Machine **[6 hrs]**

5.1 Machine: Simple and compound
5.2 Basic Terms: Mechanical Advantages, efficiency, velocity ratio, input and output of machine, Ideal machine.
5.3 Relationship between Mechanical Advantages, Velocity ratio and Efficiency.
5.4 Condition for reversibility of a machine and Self-Locking of machine
5.5 Condition of maximum mechanical advantage and efficiency.

Tutorial: ***[15 Hrs]***

Tutorial 1: Simple problem to determine time, position, velocity and acceleration using equation of motion.
Tutorial 2: Simple problem related to determination of acceleration, velocity and position from the given equation of acceleration and position in function of time.
Tutorial 3: Determination of Time of flight, maximum height and range by using standard formula of projectile motion.
Tutorial 4: Simple problem related to motion under gravity.
Tutorial 5: Simple problem related to relative motion and dependent motion.
Tutorial 6: Problem related to determination of motion of two bodies connected by string passing over frictionless pulley (not more than two pulley)
Tutorial 7: Simple problem using D'Alembert's principle.
Tutorial 8: Problem to determine work, energy and power
Tutorial 9: Problem related circular and curvilinear motion.
Tutorial 10: Simple problem using the relationship between Mechanical Advantages, Velocity ratio and Efficiency

References:

1. R.K. Rajput, "Applied Mechanics", Laxmi Publishers (P) ltd, India.
2. D.S. Kumar, "Engineering Mechanics," Kataria S.K & Sons, India.
3. S. Neupane, H. R. Parajuli, "Applied Mechanics for engineers", M.K Publishers and Distributors, Bhotahity, Kathmandu, Nepal
4. Malhotra, M.M, Subramanian, R., Gahlot Rathor, P.S, B.S, "Text book in applied mechanics", Wiley Eastern Limited, India.
5. R.S. Khurmi, "Applied Mechanics and Strength of Materials", S. Chand & Co, New Delhi India.

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Kinematics of Particles	8	12
2	Kinetics	6	8
3	Work, Power and Energy	5	6
4	Circular and Curvilinear Motion	5	6
5	Simple Machine	6	8
	Total	**30**	**40**

Note: There might be minor deviation on the above specified marks

Workshop Practice II
EG 2107 ME

Total: 11 Hrs/week
Year: II **Lecture: 4 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: 7 Hrs/week
Lab: Hrs/week

Course Description:

This course is the extension one for the students who have undergone Workshop Practice-I. The course deals with basics of mechanical measuring instruments, plumbing works, foundry, casting, forging and different types of metal joining processes. It covers the component description, basic working and handling procedures of different equipment at mechanical fabrication shop.

Course Objectives:

After completing this course the students will be able to

1. Use the basic mechanical measuring instruments.
2. Handle and explain the pipe fittings.
3. Understand and follow the safety rules in foundry and welding shops;
4. Produce simple casting parts as per supplied drawing;
5. Produce parts as per specification using forging hand tools in forging Shop;
6. Perform the heat treatment of forged parts;
7. Describe the different types of welding methods and processes.
8. Weld the given job (mild steel plates, rods) as per supplied drawing.
9. Connect and disconnect/dismantle oxyacetylene welding equipment set;
10. Weld the given job in flat position using oxyacetylene flame with or without filler rod;
11. Solder and Braze the given job by selecting hard solders, fluxes

Course contents:

Unit 1: Introduction to Metrology **[6 hrs]**

1.1 Units, Dimensions and Standards
1.2 Types and Scope of Metrology
1.3 Metrological terminology: Accuracy, Precision, Repeatability, Reproducibility, Sensitivity, Resolution, Calibration, Magnification, Backlash, Range, Span, Traceability, Drift, Response, Stability
1.4 Errors: types and sources
1.5 Types of mechanical measuring instruments: precision and non-precision, linear and angular.

Unit 2: Plumbing Works **[4 hrs]**

2.1 Introduction
2.2 Plumbing tools: types, materials, use and care.
2.3 Pipes:
2.3.1 Types: polythene, GI, CI
2.3.2 Operations (bending, thread cutting, joining)
2.3.3 Applications

2.4 Pipe fittings: types and uses
2.5 Introduction to water supply system: city and domestic
2.6 Importance and general layout of Domestic sewerage and drainage system

Unit 3: Foundry **[6 Hrs]**

3.1 Introduction to foundry:

2.1.1 Describe introduction to foundry practice
2.1.2 Development, advantages and uses of casting
2.1.3 Describe safety in foundry practice

3.2 Casting

3.2.1 Types of casting process (permanent mould, centrifugal, die, shell moulding, investment)
3.2.2 Types and properties of casting materials
3.2.3 Types and properties of casting materials
3.2.4 Construction and uses of Melting furnace (Cupola, induction and crucible)

3.3 Sand casting

3.3.1 Pattern making:
- Types & Materials of Pattern
- Consideration for Pattern making allowances

3.3.2 Sand Moulding
- Introduction: Sand Mould, Cope & Drag
- Use of different hand tools and applications
- Types of Sand and binders
- Core making and application
- Finishing process

Unit 4: Forging **[4 hrs]**

4.1 Introduction to forging

4.1.1 Introduce to hand forging, its applications, advantages and limitations
4.1.2 Forging materials
4.1.3 Safety in forging practice

4.2 Hand forging operations

4.2.1 Tools: nomenclature, application
4.2.2 Operations: Bending, Cutting down, Setting down, Swaging, Squeezing, drawing, twisting, Upsetting, Punching, Fullering and drifting, Forge welding

4 **4.3 Power forging**

4.3.1 Power hammer: types, working, application and care (drop, press machine)
4.3.2 Defects on forging process, cause and their possible remedies

4.4 Heat treatment of forged materials

4.4.1 Introduction and purposes of heat treatment
4.4.2 Types and uses (Annealing, Hardening, Tempering)

Unit 5: Arc Welding **[16 Hrs]**

4.1 Introduction to welding

4.1.1 Introduction to welding
4.1.2 Classification of welding
4.1.3 Selection of different types of welding processes

4.2 Introduction to arc welding

4.2.1 Introduction to arc welding
4.2.2 Arc column theory
4.2.3 Power sources for arc welding
4.2.4 Types of welding: SMAW, GMAW, GTAW
4.2.5 Safety precautions in arc welding

4.3 Arc Welding equipment and accessories

4.3.1 Arc welding machines: types, uses and care
4.3.2 Problems in welding machines: troubles, causes and remedies
4.3.3 Arc welding machine and operators' accessories.

4.4 Arc welding electrode: classification, application and care

4.5 Arc Welding fundamentals and techniques:

4.5.1 Condition of welding table and welding machine
4.5.2 Influencing factors in arc welding: position, face protection, arc length, Angles of electrode, Travel speed of electrode, amperage
4.5.3 Method, application and advantages of striking an arc (tap, Scratch)
4.5.4 Weld movement: types, application and advantages
4.5.5 Welding joints: types and application
4.5.6 Defects on welding process, cause and their possible remedies

Unit 6: Gas Welding **[20 Hrs]**

6.1 Introduction to oxyacetylene (Gas) welding:

6.1.1 Oxy-acetylene welding principle
6.1.2 Advantages and application of oxy-acetylene welding
6.1.3 Safety precaution in oxy-acetylene welding

- Personnel safety
- Fire prevention
- Care of cylinders, hoses, acetylene generators
- Lighting of welding torch
- Safety accessories

6.2 Properties, uses, storages and handling of oxygen and acetylene gases

6.3 Oxyacetylene welding equipment and accessories

6.3.1 Oxygen cylinder
6.3.2 Acetylene cylinder/generator
6.3.3 Acetylene cylinder/generator
6.3.4 Oxygen and acetylene regulator
6.3.5 Wrenches
6.3.6 Hoses, hose clips and hose coupler
6.3.7 Welding torch-low pressure, equal pressure
6.3.8 Welding nozzle-solid piece, multiple piece
6.3.9 Filler rod holder
6.3.10 Gas lighter
6.3.11 Operator's safety accessories

6.4 Filler rod and flux: classification, selection, use and storages

6.5 Oxy-acetylene flame: types, properties and use

6.6 Oxy-acetylene welding operations and welding techniques

6.1 Equipment set up
6.2 Testing for leaks
6.3 Lighting the torch and flame adjustment
6.4 Shutting off equipment
6.5 Running a bead with filler rod
6.6 Backfire and flashback
6.7 Restarting the weld
6.8 Welding techniques-leftward and rightward welding
6.9 Weld movements

6.7 Welding joints, welding position and types of welds

6.10 Welding joints, their types and application
6.11 Welding positions, their types and application
6.12 Types of weld and their applications

6.8 Distortion in welding: types and their control

6.9 Testing of welding joints: types and process

6.10 Oxygen gas cutting

6.10.1 Gas cutting principle
6.10.2 Major influencing factors of gas cutting
6.10.3 Composition of steel
6.10.4 Temperature of work-piece
6.10.5 Thickness of work- piece
6.10.6 Surface defects
6.10.7 Purity of oxygen
6.10.8 Temperature of oxygen

6.11 Cutting methods

6.11.1 Oxygen cutting: manual and machine
6.11.2 Oxygen de-seaming
6.11.3 Oxygen gauging and lancing

6.12 Selecting of tip and working pressure in manual gas cutting
6.13 Cleaning of the cutting tips
6.14 Examples of correct and incorrect techniques in manual gas cutting

Unit 7: Soldering and Brazing **[4 hrs]**

7.1 Soldering: principle, application and advantages
7.2 Brazing: principle, application and advantages
7.3 Soldering and Brazing equipment and materials
7.4 Difference between welding, soldering and brazing
7.5 Brazing procedures
7.6 Requirement for a successful brazing

Practical/Laboratory: ***[105 Hrs]***

1. **Sheet Metal Practice:** [14 hrs]
   - Sheet metal working: Hands pipe bend plot, blow horn, groove and seaming
   - Sheet Developing: Patterns, templates, for the sheet boxes, book stand, scoop funnel, pipe and the machine guards
2. **Foundry exercise:**
   - Single Wood pattern making [4 hrs]
   - Split wood pattern making [4 hrs]
   - Core box making [4 hrs]
3. **Forging exercise:**
   - Safety and familiarization with equipment and tools [1 hr]
   - Square piece [3 hrs]
   - Rectangular Small Flat Chisel [3 hrs]
   - Heat treatment of Chisel [4 hrs]
4. **Arc welding exercise:**
   - Safety precaution and familiarization with welding machine and accessories [2 hrs]
   - Striking an arc welding on plate [1 hr]
   - Padding on flat surface [3 hrs]
   - Closed and Square butt joint [4 hrs]
   - Corner joint [4 hrs]
   - Tee joint [4 hrs]
   - Lap joint [4 hrs]
   - V-butt joint [4 hrs]

- Vertical & Over Head Welding [6 hrs]
- Arc cutting on mild steel plate [4 hrs]

5. **Gas Welding Exercise:**
   - Lining without filler rod [4 hrs]
   - Lining with filler rod [4 hrs]
   - Butt joint [3 hrs]
   - Corner joint [3 hrs.]
   - Lap joint [2 hrs]
   - Tee joint [2 hrs]
   - Straight gas cutting [3 hrs]
   - Circular gas cutting [2 hrs]
6. **Soldering and Brazing Exercise:**
   - Closed square butt joint [3 hrs]
   - Lap joint [2 hrs]
   - Tee joint [2 hrs]
   - Circular Brazing [2 hrs]

References:

1. R. K. Jain, “Engineering Metrology”, Khanna Publishers.
2. Manohar Mahajan, “A Text book of Metrology”, Dhanapat Rai & Co. (P) Ltd., Delhi.
3. S. K. Hajra Choudhary, A. K. Hajra Choudhary, "Elements of workshop technology Vol. I: Manufacturing Processes"' Media Promoter & Publishers Pvt. Ltd., Bombay, India.
4. R. S. Khurmi & J. K. Gupta, "A textbook of workshop technology, manufacturing processes", Publication division of Nirja construction & development co. Pvt. Ltd.
5. K. Vara Prasada Rao, "Manufacturing science technology [manufacturing processes & machine tools", New age international publishers, Daryaganj, New Delhi-110 002
6. B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. I", Dhanpat Rai and Co. (P) Ltd, Delhi, India.
7. H. S. Bawa, "Workshop Technology, Vol. I", Tata McGrawHill publishing company Limited, New Delhi, India.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Metrology	6	8
2	Plumbing Works	4	4
3	Foundry	6	8
4	Forging	4	4
5	Arc Welding	16	24
6	Gas Welding	20	28
7	Soldering and Brazing	4	4
	Total	**60**	**80**

Note: There might be minor deviation on above specified marks

Industrial Engineering
EG 2108 ME

Total: 3 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: Hrs/week

Course Description:

This course deals with the fundamental concepts of organization, management, leadership and supervisory, production management, marketing of products or services, materials management and inventory control and basics of engineering economics required for supervisors and first line managers engaged in industrial activities.

Course Objectives:

After completing the course the student 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. Understand the process of marketing
6. Demonstrate the understanding of materials management
7. Apply the principles of basic engineering economics

Course contents:

Unit 1: Industrial Engineering **[2 hrs]**

1.1 Definition and evolution of industrial engineering
1.2 Functions of industrial engineering: problem solving and decision making
1.3 Broad functional areas of industrial engineering

Unit 2: Organization and Management **[10 hrs]**

2.1 Introduction to Organization
2.2 Classification of Organization (basic concept, advantages and disadvantages)
- Single ownership
- Partnership
- Joint stock company
- Cooperative
- Public

2.3 Organization Structure
- Line organization
- Line and staff organization
- Functional organization
- Departmentalization

2.4 Management
- Introduction
- Functions of management
- Level of management
- Managerial skills
- Theory of management: Scientific, Administrative, Behavioral, Contingency

Unit 3: Leadership and Motivation **[3 hrs]**

3.1 Definition of leadership and motivation
3.2 Qualities of good leaders
3.3 Difference between manager and leader
3.4 Leadership styles
3.4 Theories of motivation: Theory X and Y, Maslow's hierarchy of needs

Unit 4: Introduction to Production System **[7 hrs]**

4.1 Introduction to a manufacturing plant
4.2 Classification of manufacturing processes
4.3 Plant location
- Importance of plant location
- Factors affecting plant location

4.4 Factory building and plant layout
- Types of factory building (basic features, pros and cons)
- Importance of plant layout
- Types of plant layout (basic features, pros and cons)

4.5 Material handling
- Factors affecting material handling (engineering and economics)

4.6 Classification of material handling equipment
4.7 Store management: meaning, objectives, function of store

Unit 5: Production Planning and Control (PPC) **[10 hrs]**

5.1 Introduction
5.2 Principle and objectives and functions of PPC
5.3 Types of production system (job, batch, continuous)
5.4 Forecasting methods, techniques and types
5.5 Inventory control (economic order quantity, ABC analysis)
5.6 Network techniques
- Critical path method (CPM)
- Program evaluation and review technique (PERT)

5.7 Definition and concept of quality, Quality control and Quality Assurance
5.8 Definition and concept of productivity
- Measurement of productivity
- Factors affecting productivity
- Productivity improvement techniques

Unit 6: Marketing of Product or Services **[3 hrs]**

6.1 Definitions of market and marketing
6.2 Concept of marketing mix: product, price, place, promotion
6.3 Understanding consumer behavior
6.4 Functions of marketing

Unit 7: Maintenance Engineering **[5 hrs]**

7.1 Introduction
7.2 Objectives of maintenance
7.3 Types of maintenance :Breakdown, Preventive, Reliability-centered, Risk based maintenance
7.4 Maintenance activities: Inspections, Adjustment, Testing, Calibration, Rebuilt and Replacement

Unit 8: Engineering Economics **[5 hrs]**

8.1 Introduction to engineering economic decision
8.2 Concept of time value of money
8.3 Concept of Simple and compound interest rates, effective interest
8.4 Depreciation methods, straight line, declining balance method
8.5 Project Evaluation Techniques : simple payback period, NPV, IRR, MARR

References:

1. K.K. Ahuja, "Industrial Management ", CBS Publishers and Distributors, India
2. R. Panneerselvam, "Production and Operations management", Prentice-Hall of India, Private Limited, Delhi.
3. S.K Sharma and Savita Sharma, "Industrial Engineering and Organization management", S.K. Kataria and Sons

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Industrial Engineering	2	4
2	Organization and Management	10	20
3	Leadership and Motivation	3	12
4	Introduction to Production System	7	12
5	Production Planning and Control (PPC)	10	8
6	Marketing of Product or Services	3	6
7	Maintenance Engineering	5	8
8	Engineering Economics	5	10
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Fourth Semester
Year II Part II

Subjects:

1. EG 2201 ME Manufacturing Technology I
2. EG 2202 ME Computer Aided Drawing
3. EG 2203 ME Internal Combustion Engine
4. EG 2204 ME Machine Element & Mechanism
5. EG 2205 ME Strength of Materials
6. EG 2206 ME Fluid Mechanics and Machines
7. EG 2207 ME Project I

Manufacturing Technology I

EG 2201 ME

Total: 14 Hrs/week
Year: II **Lecture: 4 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: 10 Hrs/week
Lab: Hrs/week

Course Description:

The subject aims at imparting knowledge and skill components in the field of basic manufacturing processes. The course is offered as an extension of the Workshop Practice II. It deals with different machine tools required for manufacturing processes.

Course Objectives:

After the completion of the course, the student shall be able to

1. Practice workshop safety rules effectively
2. Operate various equipment and machine tools and manipulate them
3. Produce simple metal components and articles using different machine tools and accessories
4. Supervise mechanical works in the subject related field
5. Perform maintenance works of the machines and undertakes repair works wherever necessary.

Course contents:

Unit 1: General safety Considerations on Machining Workshop [1 hr]

Unit 2: Metal Cutting [10 hrs]

2.1 Introduction
2.2 Orthogonal and Oblique cutting
2.3 Classification of cutting tools
2.4 Tool geometry in Co – ordinate System
2.5 Types of chips
2.6 Sources of heat in metal cutting
2.7 Tool failure
2.8 Tool life
2.9 Tool wear
2.10 Machinability
2.11 Cutting Tool Materials

Unit 3: Cutting Fluids [2 hrs]

3.1 Introduction
3.2 Functions of Cutting Fluids

3.3 Qualities of Good Cutting Fluids
3.4 Classification of Cutting Fluids
3.5 Application of Cutting Fluids
3.6 Safety in the Use of Cutting Fluids

Unit 4: Lathe Machine [8 hrs]

4.1 Introduction and Classification of lathe machine
4.2 Working Principle and construction of Engine lathes
4.3 Lathe Accessories: Centers, Face plates, Chuck, dogs, Mandrels, Tool Posts, Steady rests and follower rests
4.4 Lathe Operations: Turning, Facing, Taper turning, Threading, Drilling, Boring, Reaming and Knurling
4.5 Cutting variables: Cutting Speed, Feed and Depth of Cut
4.6 Machining Time
4.7 General repair and maintenance of lathe machine

Unit 5: Shaping Machines [5 hrs]

5.1 Introduction and Working Principle
5.2 Classification of Shaping Machines
5.3 Shaper Mechanism – Quick Return Mechanism
5.4 Shaper Tools
5.5 Work holding devices and tool holding devices
5.6 Shaper Operations – Horizontal, Vertical and Angular cutting
5.7 Cutting Speed, Feed and Depth of Cut
5.8 Machining Time
5.9 General repair and maintenance of shaper machine

Unit 6: Drilling Machines [4 hrs]

6.1 Introduction and Working Principle
6.2 Classification of Drill Presses
6.3 Work Holding attachments and accessories
6.4 Drilling Tools
6.5 Drilling Operations: Drilling, Counter- boring, Counter-sinking and Reaming
6.6 General repair and maintenance of Drill machine

Unit 7: Milling Machines [8 hrs]

7.1 Introduction and Working Principle
7.2 Classification of Milling Machines
7.3 Principal Parts of Column and Knee type Milling Machine
7.4 feed mechanism of milling machine
7.5 Milling Cutters: types, nomenclature and uses
7.6 Milling Operations: Plain, Face, Angular, Form, Gang and Keyway Milling
7.7 Milling Methods: Peripheral, Up, Down, Face and End Milling

7.8 Work Holding Devices and Cutter Holding Devices
7.9 Indexing Heads
7.10 Indexing Methods: Direct, Plain, Compound and Differential Indexing
7.11 Cutting Speed, Feed and Depth of Cut
7.12 Machining Time
7.13 General repair and maintenance of Milling machine

Unit 8: Grinding Machines [6 hrs]

8.1 Introduction and Working Principle of Grinding Machine
8.2 Abrasives and Bonds
8.3 Grain, Grade and Structure
8.4 Specification of Grinding Wheels
8.5 Mounting, Loading and Glazing of Grinding Wheels
8.6 Trueing and Dressing of Grinding Wheels
8.7 Classification of Grinding Machines
8.8 Grinding Operations: Cylindrical, Internal, Surface, Face, Form, Center less Grinding and Sharpening of Cutting Tools
8.9 Cutting Speed, Feed and Depth of Cut
8.10 Machining Time

Unit 9: Planer Machines [4 hrs]

9.1 Introduction and Working Principle
9.2 Classification of Planer Machines
9.3 Planer Mechanism
9.4 Planer Operations – Planning horizontal surface; Planning vertical surface; Planning angular surface and Planning Formed surface
9.5 Cutting Speed, Feed and Depth of Cut
9.6 Machining Time
9.7 General repair and maintenance of Planer machine

Unit 10: Boring Machines [3 hrs]

10.1 Introduction and Working principle
10.2 Classification of Boring Machines
10.3 Boring Operations: Facing; Counter-boring; Counter-sinking and Trepanning
10.4 Jig Boring Machines
10.5 Cutting Speed, Feed and Depth of Cut
10.6 General repair and maintenance of Boring machine

Unit 11: Capstan and Turret Lathes [6 hrs]

11.1 Introduction and Working Principle
11.2 Difference between a Capstan and Turret Lathe and a Engine Lathe
11.3 Classification of Capstan and Turret Lathes
11.4 Difference between a Capstan Lathe and a Turret Lathe
11.5 Work Holding Devices and Tool Holding Devices

11.6 Capstan and Turret Lathe Operations: External Thread cutting; Internal Thread Cutting
11.7 Cutting Speed, feed and Depth of Cut
11.8 General repair and maintenance of Capstan and Turret lathe machine

Unit 12: Broaching Machines [3 hrs]

12.1 Introduction and Working Principle
12.2 Classification of Broaching Machine
12.3 Broaching Methods: Internal Broaching; External Broaching; Pull Broaching; Push Broaching and Continuous Broaching
12.4 Cutting speed, Feed and Depth of Cut
12.5 Machining Time
12.6 General repair and maintenance of Broaching machine

Practical/Laboratory ***[150 Hrs]***

List of Practical

S. N	Description of practical	Time (hrs)
1	Demonstration of formation of chips on a lathe, continuous, discontinuous and fractured by changing variables like rake angle, speed feed and depth of cut.	10
2	Grinding of single point (H.S.S.) tools.	6
3	Demonstration of preparing soluble oil cutting fluid and its use for improving the surface	6
4	Practice of various operations on Lathe (Facing, turning, step turning, knurling)	10
5	Practice of taper turning and screw cutting on a centre lathe	10
6	Practice of drilling, boring and reaming on a lathe.	10
7	Practice of mounting cutters on the milling m/c and setting of m/s.	6
8	Practice of up milling and down milling operation.	10
9	Practice on shaper machine.	15
10	Practice on Milling machine.	20
11	Surface grinding on a flat surface.	10
12	Practice on drilling machine	8
13	Practice on Capstan & Turret Lathes	20
14	Schedule maintenance work required for various machine tools.	9
	Total (hrs.)	**150**

References:

1. S. K. Hajra Choudhury and A. K. Hajra Choudhury, "Elements of Workshop Technology, Vol. I: Manufacturing Processes", Media Promoters and Publishers Pvt. Ltd., Bombay, India.
2. S. K. Hajra Choudhury, S. K. Bose and A. K. Hajra Choudhury, "Elements of Workshop Technology, Vol. II: Machine Tools", Media Promoters and Publishers Pvt. Ltd. , Bombay, India.
3. B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. I and II ", Dhanpat Rai and Co. (P) Ltd, Delhi, India.
4. W. A. J. Chapman, "Workshop Technology, Part 1 and 2", Standard Publishers and Distributors, Delhi, India, First Edition, 1998
5. H. S. Bawa, "Workshop Technology, Vol. I and II", Tata McGrawHill publishing company Limited, New Delhi, India.
6. R. S. Khurmi and J. K. Gupta, "A text book of Workshop Technology", S. Chand and Company Ltd, New Delhi. India
7. Heinrich Gerling, "All about Machine Tools", New Age International (P) Limited, Publishers, New Delhi, India.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	General safety Considerations on Machining Workshop	1	4
2	Metal Cutting	10	10
3	Cutting Fluids	2	4
4	Lathe Machine	8	8
5	Shaping Machines	5	8
6	Drilling Machines	4	6
7	Milling Machines	8	10
8	Grinding Machines	6	8
9	Planer Machines	4	8
10	Boring Machines	3	4
11	Capstan and Turret Lathes	6	6
12	Broaching Machines	3	4
	Total	**60**	**80**

Note: There might be minor deviation on above specified marks.

Computer Aided Drawing

EG 2202 ME

Total: 4 Hrs/week

Year: II **Lecture: 1 Hrs/week**

Part: II **Tutorial: Hrs/week**

Practical: 3 Hrs/week

Lab: Hrs/week

Course description:

This course deals with generation of two-dimensional and three-dimensional drawing using AutoCAD. It also deals with the inserting dimensions and text in drawing as well as plotting of the drawing.

Course objectives:

After completing this course the students will be able to:

1. Draw two dimensional objects using Auto-CAD,
2. Draw three dimensional objects using solid modeling, and
3. Insert dimension and text on drawing.
4. Plot the drawing

Course contents:

Unit 1: Introduction **[1 hrs]**

1.1 Loading AutoCAD, Screen organization
1.2 Communicate with AutoCAD using the keyboard, the cursor menu, the screen menu, the pull-down menu, the toolbar menu and the dialogue box
1.3 AutoCAD command and system variables, Command options and default
1.4 Setting UNITS and DRAWING LIMITS
1.5 Coordinate System: entering distances and angles

Unit 2: Basic Drawing Commands **[2 hrs]**

2.1 LINE command and its options
2.2 POINT command
2.3 XLINE command and its options
2.4 ARC command and its options
2.5 CIRCLE command and its options
2.6 POLYGON command and its options
2.7 PLINE command and its options
2.8 MLINE command and its options
2.9 SPLINE command and its options

Unit 3: Modifying Commands **[2 hrs]**

3.1 Object selection methods
3.2 ERASE, OOPS, UNDO, REDO commands
3.3 OFFSET command
3.4 COPY, MOVE, ROTATE, MIRROR, ARRAY commands
3.5 SCALE, STRETCH commands
3.6 CHAMFER, FILLET commands
3.7 TRIM, EXTEND commands
3.8 EXPLODE, BREAK, LENGTHEN, DIVIDE commands
3.9 PEDIT command
3.10 CHPROP command, ltype, ltscale, lweight and color
3.11 DDSELECT, DDMODIFY commands
3.12 Use of Grips

Unit 4: Drawing Aids in AutoCAD **[1 hr]**

4.1 ORTHO, GRID, SNAP commands
4.2 ROTATED SNAP, OSNAP commands
4.3 Creation of LAYERS and layer properties
4.4 Point filter
4.5 Use of Calculator

Unit 5: Display Commands **[1 hr]**

5.1 ZOOM, PAN, VIEW commands
5.2 REGEN command
5.3 Creating Viewports

Unit 6: Inquiry Commands **[1 hr]**

6.1 HELP command
6.2 ID, DIST, AREA commands
6.3 MASSPROP command
6.4 LIST, DBLIST, STATUS commands
6.5 TIME command

Unit 7: Fine Tuning Drawings **[1 hr]**

7.1 HATCH and BHATCH commands
7.2 Creating Isometric drawing

Unit 8: Grouping in AutoCAD **[1 hr]**

8.1 BLOCK, WBLOCK commands
8.2 INSERT, MINSERT commands
8.3 EXPLODE, BASE commands

Unit 9: Working with Text in AutoCAD **[1 hr]**

9.1 TEXT, MTEXT, DTEXT commands

9.2 Justifying text and text fonts
9.3 STYLE command

Unit 10: Dimensioning in AutoCAD [1 hr]

10.1 Dimensioning commands
10.2 Dimension styles and dimension setup
10.3 Dimension scale

Unit 11: 3-D solid modeling [2 hrs]

11.1 Creating solid box, solid cylinder, solid cone and solid sphere
11.2 Boolean operations: Union, Subtraction, Intersection
11.3 EXTRUDE command

Unit 12: Plotting drawings [1 hr]

12.1 Title block and layout management
12.2 Device information, pen parameters, paper size and orientation
12.3 Scale, rotation and origin
12.4 MVIEW, MVSETUP commands

Practical/Laboratory: ***[45 hrs]***

Unit 1: Introduction [3 hrs]

1.1 Familiarization with Software Environment, Setting up Drawing

Unit 2: Basic Drawing Commands [9 hrs]

2.1 2D Drawing Consisting Straight Lines
2.2 2D Drawing Consisting Circle and Arc
2.3 2D Drawing Consisting Ellipse, spline and Polygon

Unit 3: Modifying commands [3hrs]

3.1 2D Drawing Using Modifying Commands complex objects drawings

Unit 4: Fine tuning drawings [6 hrs]

4.1 Creating Hatch, Working with Layers, Group and Blocks
4.2 Isometric Drawing: Object and Text

Unit 5: 3-D solid modeling [6 hrs]

5.1 3D Drawing: Solid Modeling
5.2 3D Drawing: Solid Editing and 3D Operations

Unit 6: Plotting drawings [6 hrs]

6.1 Plotting 2D and 3D Drawings

Project 1: Drawing of standard mechanical components: [6 hrs]

Spring, Nut Bolt, Gear, Cam Profile, etc

Project 2: Drawing of assembly and detailed drawing of simple mechanical systems.[6 hrs]

References:

1. G. Omura, "Mastering AutoCAD", Latest Edition
2. " AutoCAD User's Guide", Autodesk, Latest Edition

Marks specification for final examination

1. 2D Drawing including drawing setup by using 2D Draw and Modify Command and dimension [15marks]
2. Isometric Drawing including drawing setup by using 2D Draw and Modify Command and dimension [10marks]
3. 3D Drawing including drawing setup by using 3D Draw and operator Command and dimensions [15 marks]

Note: There might be minor deviation on above specified marks.

Internal Combustion Engine

EG 2203 ME

Total: 6 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 3 Hrs/week

Course Description:

This course deals with internal combustion engines' operation, types, and functions, including the performance of IC engines and engine emissions. It also imparts knowledge on the characteristics of fuel & its calorific values.

Course Objectives:

After completing this course the students will be able to

1. Describe the operation of two stroke and four stroke cycle engine
2. Explain the working principle of various systems & components of internal combustion engines
3. Describe the performance of internal combustion engines.
4. Perform test for engine emission

Course contents:

Unit 1: Internal Combustion Engine: [6 hrs]

- 1.1 Introduction to internal combustion engine
- 1.2 Classification of I. C. Engine
- 1.3 Engine components and their function
- 1.4 Operation of two stroke and four stroke cycle petrol and diesel engines and their comparison.
- 1.5 DI and IDI combustion chamber

Unit 2: Fuels and Combustion of Fuels: [5 hrs]

- 1.1 Classification of fuels
- 1.2 Merits and Demerits of fuels
- 1.3 Combustion equation
- 1.4 Combustion characteristic of Petrol and Diesel fuel
- 1.5 Heating value of fuels: higher and lower heating values
- 1.6 Air fuel mixture ratio: lean, stoichiometric and rich mixtures

Unit 3: Petrol fuel System [8 hrs]

- 3.1 Purpose and layout of petrol fuel system
- 3.2 Fuel pump: mechanical and electric fuel pump

3.3 Fuel filter
3.4 Carburetor and carburetion
3.5 Simple carburetor and its defect
3.6 Systems of carburetor
3.7 Idle system
3.8 Main metering or fuel supply system
3.9 Accelerating pump system
3.10 Power fuel supply system
3.11 Choke system,
3.12 Drawbacks of Carburetor
3.13 Introduction to electronic fuel injection system: SPI and MPFI

Unit 4: Diesel fuel system **[5 hrs]**

4.1 Purpose and layout of diesel fuel injection system
4.2 Fuel feed pump
4.3 Fuel filters
4.4 Fuel injection pump: Inline type and Distributor type
4.5 Fuel injectors and its types
4.6 Introduction to common rail direct injection system

Unit 5: Ignition systems **[6 hrs]**

5.1 Importance of Ignition Timing
5.2 Types of Ignition system
5.2.1 Battery ignition systems
5.2.2 Magneto ignition system, CDI System
5.2.3 Electronic ignition system, Distributor less ignition system
5.3 Ignition advance mechanism

Unit 6: Cooling system **[3 hrs]**

6.1 Importance of cooling system, overheating and excessive cooling
6.2 Types of cooling system: Air cooling and water cooling system
6.3 Importance of engine coolant

Unit 7: Lubrication system **[3 hrs]**

7.1 Purpose of lubrication system
7.2 Functions of lubricating oil
7.3 Viscosity numbers and grade of lubricating oil
7.4 Types of lubrication system: splash system and pump pressurized system

Unit 8: Basics parameters of engine performance: **[5 hrs]**

8.1 Indicated power
8.2 Brake power
8.3 Friction power

8.4 Specific fuel consumption
8.5 Efficiencies of I.C. engines: Indicated thermal, brake thermal, Mechanical efficiency

Unit 9: Engine emission control [4 hrs]

9.1 Constituents of exhaust gases, Engine emission and legal requirements
9.2 Types of emission control system
9.3 Exhaust gas recirculation (EGR) system
9.4 Evaporative emission control system
9.5 Positive crankcase ventilation
9.6 Catalytic converter

Practical/Laboratory: ***[45 hrs]***

1. Dismantling petrol and diesel engine, identify engine components, measure cylinder bore, crankshaft journals, main bearings etc. [12 hrs]
2. Assembling petrol and diesel engine, set valve timing, valve clearance, set ignition timing, set fuel injection timing for diesel engine [12 hrs]
3. Demonstrate various systems of internal combustion engines:- [15 hrs]
   a. Fuel Supply System
   b. Cooling System
   c. Ignition System
   d. Lubrication System
   e. Governing
4. Perform engine emission test [6 hrs]

Suggestion for instruction:

1. Use illustrative teaching materials like model, charts, and overhead transparencies to visualize the complex parts.
2. Show videos in the class in related topics.
3. Students are asked to assemble, dismantle and test the parts in the practical classes.
4. Use of appropriate tools is emphasized to test the condition of parts.

References:

1. W. W. Pulkrabek, "Fundamentals of Internal Combustion Engines", Prentice Hall of India Pvt. Ltd. New Delhi – 110001, India
2. P. L. Ballaney, “Internal Combustion Engines”, Khanna Publishers, Delhi.
3. V.M. Domkundwar, A.V. Domkundwar, “Internal Combustion Engines”, Dhanpat Rai & Co.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	8
2	Basic Drawing Commands	5	8
3	Modifying Commands	8	12
4	Drawing Aids in AutoCAD	5	8
5	Display Commands	6	8
6	Inquiry Commands	3	6
7	Fine Tuning Drawings	3	6
8	Grouping in AutoCAD	5	8
9	Working with Text in AutoCAD	4	6
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Machine Elements and Mechanism

EG 2204 ME

Total: 3 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: Hrs/week

Course Description:

This course deals with the basic components and their application in different mechanism or machines. The main emphasis is given on component description and working principle of different machines and covers simple numerical examples on power transmission. It also introduces the types of joints and balancing of mechanism and machines.

Course Objectives:

After completing this course the students will be able to
1. Understand design and uses of various machine components.
2. Understand design and uses of various mechanisms.
3. Calculate basic transmission ratio of different mechanism.

Course contents:

Unit 1: Machine Elements **[22 hrs]**

1.1 Introduction
1.2 Shaft, axles: concept, types and comparison between shaft and axle
1.3 Bearing: types, application, selection
1.4 Belt, pulleys: types, application, selection
1.5 Gear: types, application, nomenclature
1.6 Chains: types, application
1.7 Ropes: types, application
1.8 Power transmission: speed calculation of belt, gear and chain drive
1.9 Couplings, clutches: types, function and application
1.10 Springs: types and application
1.11 Seals: types and application

Unit 2: Joints/Connection **[12 hrs]**

2.1 Detachable joints
2.1.1 Thread: types, description and application
2.1.2 Screws: types, description and application
2.1.3 Nut and bolts: types, description
2.1.4 Pin & keys: types, description and application
2.1.5 Tapers: types, description and application
2.1.6 Splines: description and application

2.2 Permanents joints

2.2.1 Rivet joints

2.2.2 Shrink connection (shrinking process and application)

2.2.3 Soldering

2.2.4 Welded joints

Unit 3: Working of Mechanisms [8 hrs]

3.1 Mechanical advantages, velocity ratio and efficiency: related problems

3.2 Crank mechanism

3.3 Cam mechanism

3.4 Wedge and screw mechanism

3.5 Gear mechanism

3.6 Friction mechanism

3.7 Belt mechanism

3.8 Electro mechanical mechanisms

3.9 Watt Governor mechanism

Unit 4: Introduction to Balancing [3 hrs]

4.1 Introduction

4.2 Static: principle and application

4.3 Dynamic: principle and application

List of Demonstration:

1. Geometry of machine elements
   1.1. Detachable joint
   1.2. Permanent joint
   1.3. Machine element (shaft, axle, bearing, belt, pulley, chain, gears, belt drive, gear drive, chain drive, coupling & clutches, spring, seals)
2. Mechanisms
   2.1 Crank mechanisms
   2.2 Cam mechanisms
   2.3 Wedge & screw mechanism
   2.4 Gear mechanism
   2.5 Friction mechanism
   2.6 Belt mechanism
   2.7 Electro-mechanical mechanism
   2.8 Watt Governor mechanism

References:

1. J. S. Rao & R. V. Dukkipati, "Mechanism & Machine Theory", New Age International, India
2. J.E. Shigley & J.J. Uicker, "Theory of Machines and mechanisms", McGraw Hill, Singapore.
3. R.S. Khurmi, J.K. Gupta," A textbook of Machine design", S. Chand and Company Ltd. India.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Machine Elements	22	36
2	Joints/Connection	12	24
3	Working of Mechanisms	8	16
4	Introduction to Balancing	3	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Strength of Materials
EG 2205 ME

Total: 5 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **Tutorial: 1 Hrs/week**
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course description:

This course deals with the concept of stress and strain applicable in different cases of material loading condition. It also covers the explanation and numerical problems of bending, shear stress, torsion and column with different supports.

Course Objectives:

After completing this course the students will be able to
1. Understand the concept of stress and strain
2. Understand the concept of bending stress and bending equation.
3. Understand the concept of torsion and buckling of column

Course contents:

Unit 1: Introduction to Strength of Materials and It's Scope [1 hr]

Unit 2: Concept and Stress and Strain [16 hrs]

2.1 Direct stress and direct strain – compressive and tensile.
2.2 Determination of direct stresses and strains for uniform sections
2.3 Determination of direct stresses and strains for stepped sections.
2.4 Statement of Hooke's law and definition of Young's Modulus of Elasticity.
2.5 Stress-strain diagram for tensile test on mild steel, explanation of elastic limit.
2.6 Limit of proportionality, yield point, ultimate stress, and breaking stress – actual and nominal.
2.7 Factor of safety.
2.8 Applications of Hooke's law to homogeneous and composite section.
2.9 Temperature stresses and strains for homogenous and composite section
2.10 Definition of shear stress, shear strain and modulus of rigidity.
2.11 Concept of single shear and double shear.
2.12 Determination of shear stress and shear strain for homogeneous sections.
2.13 Definition of linear strain, lateral strain and poison's ratio, volumetric strain, bulk modulus.
2.14 Relationship between elastic constants

Unit 3. Simple Bending [8 hrs]

3.1 Theory of simple bending

3.2 Definition of moment of resistance, neutral axis, Section modulus.
3.3 Assumptions in simple theory of bending
3.4 Derivation and use of Theory of Bending Equation

Unit 4: Shear Stress in Beam [6 hrs]

4.1 Shear stress formula and its application
4.2 Calculation and distribution of shear stress in (a) Rectangular (b) I – section (c) T –section

Unit 5: Torsion [8 hrs]

5.1 Introduction
5.2 Definition of torque and angle of twist
5.3 Power transmitted by shaft
5.4 Derivation of torsional equation

Unit 6: Columns [6 hrs]

6.1 Definition of column and strut
6.2 Columns with different support conditions
6.3 Euler's formula and its assumption.
6.4 Effective length, Critical load and Slenderness ratio
6.5 Problem related to critical load with different support condition.

Tutorial: ***[15 hrs]***

Tutorial 1: Simple problem of calculation of stress and Strain in Uniform section and Step Section of homogeneous material. [2 hrs]
Tutorial 2: Simple problem of calculation of stress and strain in Uniform and Stepped Section with the use of principle of superposition. [2 hrs]
Tutorial 3: Problem to find yield stress, ultimate stress, strain, modulus of elasticity, factor of safety from tensile test data. [2 hrs]
Tutorial 4: Problem related to find linear strain, lateral strain and poison's ratio, volumetric strain, bulk modulus [2 hrs]
Tutorial 5: Problem to find modulus of elasticity from relationship between elastic constants. [1 hr]
Tutorial 6: Simple problem using bending equation. [2 hrs]
Tutorial 7: Simple problem using torsion equation. [2 hrs]
Tutorial 8: Problem related to critical load on column with different support condition. [2 hrs]

Practical/Laboratory: ***[15 hrs]***

Lab 1: Tensile and compression test to find the tensile and compressive strength of different material.
Lab 2: Torsion test to demonstrate the behavior of ductile and brittle materials in torsion.
Lab 3: Bending test of steel bar.
Lab 4: Demonstration of Column behavior and buckling: effect of end conditions on buckling load of beams.
Lab 5: Demonstration of stress develop in compound bar due to temperature effect.

References:

1. R.K. Bansal, "A text book of Strength of material", Laxmi publications (p) ltd
2. S.S. Bhavikatti, "Strength of Materials", Vikas Publishing House, New Delhi.
3. R.S. Khurmi, "Applied Mechanics and Strength of Materials", S. Chand & Co, Delhi

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Strength of Materials and It's Scope	1	2
2	Concept and Stress and Strain	24	32
3	Simple Bending	10	12
4	Shear Stress in Beam	7	10
5	Torsion	10	12
6	Columns	8	12
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks

Fluid Mechanics and Fluid Machines

EG 2206 ME

Total: 5 Hrs/week

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

Part: II **Tutorial: 1 Hrs/week**

Practical: Hrs/week

Lab: 2/2 Hrs/week

Course Description:

This course deals with the general theories and equations of fluid mechanics with application. 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 losses on pipe flow
5. Dynamic action of fluid
6. Basic theories and working principles of fluid machines

Course contents:

Unit: 1 Properties of Fluid **[3 hrs]**

- 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 capillarity
- 1.5 Compressibility and Bulk modulus
- 1.6 Related numerical examples

Unit 2: Fluid Static **[8 hrs]**

- 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
- 2.4 Simple type manometer: classification and working
- 2.5 Force on plane submerged bodies
- 2.6 Buoyancy, flotation and stability
- 2.7 Related numerical examples

Unit 3: Kinematics of Fluid [2 hrs]

3.1 Reynold's number
3.2 Description of fluid motion, path line and stream line
3.3 Types of fluid displacement
3.4 General types of fluid flow

Unit 4: Basic Equations of Fluid Flow [6 hrs]

4.1 Continuity equation: Statement and application on pipe flow
4.2 Bernoulli's equation: Statement and application on pipe flow
4.3 Momentum equation: Statement and application on pipe flow
4.4 Related numerical examples

Unit 5: Losses on Pipe Flow [4 hrs]

5.1 Major loss: Darcey-Weisbach Equation and Moody diagram
5.2 Minor losses: contraction, expansion, bend, obstruction
5.3 Related numerical examples

Unit 6: Flow Measurement [4 hrs]

6.1 Coefficients: velocity, contraction, discharge
6.2 Flow measuring devices: orifice, venturi-meter, notches
6.3 Related problems on flow over rectangular and triangular notches

Unit 7: Dynamic Action of Fluid [4 hrs]

7.1 Dynamic force and power
7.2 Force exerted by fluid jet on stationary and moving flat plates
7.3 Related numerical examples

Unit 8: Water Turbines [8 hrs]

8.1 Basics of hydropower plants
8.2 Introduction and development of water turbines
8.3 Classification of water turbines
8.4 Working principles of Pelton, Francis, Propeller and Cross flow turbines
8.5 Characteristics curve of turbine on 8.4: Head, discharge, efficiencies, specific speed
8.6 Introduction of water turbine governor and their functions

Unit 9: Pumps [6 hrs]

9.1 Classification of pumps (positive displacement and roto-dynamic pumps)
9.2 Working of centrifugal and piston pumps
9.3 Pump characteristics and selection of pump
9.4 Working principle of Hydraulic ram pump

Tutorial: ***[15 Hrs]***

1. Properties of fluid: Density, specific volume, specific weight, specific gravity, surface tension [2 hrs]
2. Fluid Static: pressure measurement, simple manometers, force on plane submerged bodies [3 hrs]
3. Basic equations of fluid flow: Continuity, Bernoulli's and Momentum equation for pipe flow cases [4 hrs]
4. Losses on Pipe flow: Darcey-Weisbach Equation and Moody diagram [2 hrs]
5. Flow measurement: rectangular and triangular notches [2 hrs]
6. Dynamic action of fluid: Force exerted by fluid jet on stationary and moving flat plates [2 hrs]

Practical/Laboratory: ***[15 Hrs]***

1. Study of properties of fluid [1 hr]
2. Validity of Bernoulli's theorem [3 hrs]
3. Losses in pipe flow through bends and fittings [2 hrs]
4. Discharge measurement through rectangular/triangular notch [3 hrs]
5. Study/Performance test of Pelton/Francis turbine [3 hrs]
6. Study/Performance test of centrifugal/piston pump [3 hrs]

Suggestions for instruction:

1. Give appropriate examples of surrounding.
2. Use SI units as well as possible.
3. Solving related problems in the class and give as home assignment.
4. Use as much as figures and diagrams with direction of flow.
5. Site visit of power plant, irrigation plant and drinking water supply system are advantage for this course

References:

1. B.S. Massy, "Fluid Mechanics", English Language Book Society and Van Nostrand Reinhold Company, London
2. F.M. White, "Fluid Mechanics", Mc Graw-Hill Book Company, Singapore
3. J.F. Douglas, J. M. Gasiorek and J. A. Swaffield., "Fluid Mechanics", Person Education Pvt. Ltd., Singapore
4. Dr. Jagdish Lal, "Fluid Mechanics and Hydraulics", Metropolitan Book Co. Private Ltd., New Delhi India
5. Dr. Jagdish Lal, "Hydraulic Machines", Metropolitan Book Co. Private Ltd., New Delhi India
6. R. K. Rajput, "Fluid Mechanics and Hydraulics Machines", S Chand and Company Ltd., New Delhi

Marks Specification for final evaluation:

Unit	Content	Course Hours	Marks
1	Properties of Fluid	3	5
2	Fluid Static	8	14
3	Kinematics of Fluid	2	4
4	Basic Equations of Fluid Flow	6	11
5	Losses on Pipe Flow	4	7
6	Flow Measurement	4	7
7	Dynamic Action of Fluid	4	7
8	Water Turbines	8	14
9	Pumps	6	11
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Project I

EG 2207 ME

Total: 3 Hrs/week

Year: II **Lecture: Hrs/week**

Part: II **Tutorial: Hrs/week**

Practical: 3 Hrs/week

Lab: Hrs/week

Course Description:

This subject includes the fabrication of any basic component(s) on the basis of the knowledge and the skill learnt during the previous courses in a team. A small team of the students will be given an outline of device/item/tool for the purpose. The finished product along with the final project report and viva voce will be conducted for final evaluation.

Course Objective:

The main objective of this course are:

1. To develop basic hand on skills.
2. To use skills and knowledge that they have acquired.
3. Get exposure on industrial work environment and work ethics.
4. To play role on a team work.
5. To prepare collaborative edition of the final project report.

Course content:

- A small team should be selected at the initial of the semester.
- Each team should be given a different group work regarding the simple fabrication of a functional/ daily life product that they can complete.
- Each team should submit a project report including the following.
    - Introduction to the content of the project.
    - Objective
    - Application and working of the component
    - Procedure of fabrication
    - List of materials used.
    - Part and Assembly drawing
    - Conclusion
    - References

Note: The student will be allocated a team of guides comprising of the theory teacher and the practical teacher for the project work. The student shall also consult the library and internet for completion of the work.

Evaluation Scheme:

Examination	Content	Marks
Internal	Attendance and job performance	20
	Product demonstration	20
	Report	10
	Presentation	10
Final	Group Report and Viva voce	40
Total		**100**

Third Year
Part I & II
(Fifth and Sixth Semester)

Fifth Semester

Year III Part I

Subjects:

1. EG 3101 ME	Manufacturing Technology II
2. EG 3102 ME	Automobile Technology
3. EG 3103 ME	Fundamentals of Hydraulics and Pneumatics
4. EG 3104 ME	Machine Design, Estimating & Costing
5. EG 3105 ME	Project II
6. EG 3106 ME	Industrial Attachment

Manufacturing Technology II

EG 3101 ME

Total: 14 Hrs/week
Year: III **Lecture: 4 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: 10 Hrs/week
Lab: Hrs/week

Course Description:

This course deals with different advanced machine tools required for manufacturing industry. The subject aims at imparting knowledge and skill components to the student making them competent and potential in the field of applied manufacturing science. The course is offered as an extension of the Manufacturing Technology I.

Course Objectives:

After taking this course, student should have the ability to:
1. Practice special casting processes for casting different metals
2. Apply advanced welding techniques for joining different metals
3. Use surface finishing processes for obtaining required surface finish in different components
4. Produce simple gears using gear generating processes
5. Produce simple threads using threads generating processes
6. Use powder metallurgy for producing simple articles
7. Operate machines that uses advanced machining processes

Course contents:

Unit 1: Jigs and Fixtures **[6 hrs]**

1.1 Introduction
1.2 Difference between Jig and Fixture
1.3 Uses of Jigs and Fixtures
1.4 Principles of Design of Jigs and Fixtures
1.5 Materials for Jigs and Fixtures
1.6 Drilling Jigs
1.7 Turning Jigs
1.8 Milling Fixtures
1.9 Grinding Fixtures
1.10 Welding Fixtures
1.11 Boring Fixtures

Unit 2: Special Casting Processes **[10 hrs]**

2.1 Introduction

2.2 Permanent Mould Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.3 Slush Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.4 Die Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.5 Centrifugal Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.6 Investment Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.7 Mercast Process: Introduction; Working Principle, Advantages, Limitations and Applications
2.8 Continuous Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.9 Precision Casting: Introduction; Working Principle, Advantages, Limitations and Applications
2.10 Casting Defects and their possible remedies

Unit 3: Metal Forming [8 hrs]

3.1 Bulk Deformation Processes
- 3.1.1 Introduction of Hot & cold working
- 3.1.2 Forging - Open Die, Impression Die, Closed Die
- 3.1.3 Forging Dies, Hammers and Presses
- 3.1.4 Rolling – Flat rolling and Shape Rolling
- 3.1.5 Extrusion – Types of Extrusion; Dies and Presses
- 3.1.6 Drawing – Wire, Bar and Tube Drawing

3.2 Sheet Metal Working
- 3.2.1 Introduction
- 3.2.2 Bending
- 3.2.3 Deep Drawing
- 3.2.4 Spinning

Unit 4: Advanced Welding Techniques [8 hrs]

4.1 Atomic Hydrogen Welding: Introduction; Working Principle and Applications
4.2 Plasma Arc Welding: Introduction; Working Principle and Applications
4.3 Electro – Slag Welding: Introduction; Working Principle and Applications
4.4 Ultrasonic Welding: Introduction; Working Principle and Applications
4.5 Explosive Welding: Introduction; Working Principle and Applications
4.6 Electron Beam Welding: Introduction; Working Principle and Applications
4.6 Laser Beam Welding: Introduction; Working Principle and Applications
4.7 Welding Defects and their possible remedies

Unit 5: Surface Finishing Processes **[6 hrs]**

5.1 Introduction
5.2 Terminology
5.3 Lapping: Introduction, Working Principle and Applications
5.4 Honing: Introduction, Working Principle and Applications
5.5 Super finishing: Introduction, Working Principle and Applications
5.6 Buffing: Introduction, Working Principle and Applications
5.7 Polishing: Introduction, Working Principle and Applications
5.8 Tumbling: Introduction, Working Principle and Applications
5.9 Burnishing: Introduction, Working Principle and Applications

Unit 6: Gear Cutting Processes **[8 hrs]**

6.1 Introduction to Gear Cutting
6.2 Classification of Gears
6.3 Terminology of Spur Gear
6.4 Methods of Forming Gears
6.5 Machining of Gears
6.6 Gear Shaping
6.7 Gear Cutting by Rack Cutters
6.8 Gear Hobbing
6.9 Gear Milling by a Formed Disc Cutter

Unit 7: Thread Cutting Processes **[8 hrs]**

7.1 Introduction to Thread Cutting
7.2 Types of Threads
7.3 Terminology of thread
7.4 Thread Cutting
7.5 Thread Milling
7.6 Thread Grinding
7.7 Thread Rolling

Unit 8: **Powder Metallurgy** **[6 hrs]**

8.1 Introduction, definition and concept
8.3 Characteristics of Metal Powders
8.4 Methods of Producing Metal Powders
8.5 Principles of Powder Metallurgy
8.6 Process of Powder Metallurgy
8.7 Advantages and Disadvantages of Powder Metallurgy
8.8 Applications of Powder Metallurgy

Practical/Laboratory: ***[150 hrs]***

1. Practice on Jigs and Fixtures. [5 hrs]
2. Casting Processes [25 hrs]
    - Sand molding for split pattern with core [6 hrs]
    - Making wax suitable pattern such as anyone of flying bird, twisted spiral coiled or any simple irregular article. [2hrs]
    - Making moulds with plaster of Paris [2 hrs]
    - Casting on sand moulds [5hrs]
    - Casting on permanent moulds [5 hrs]
    - Casting on investment mould [5 hrs]
3. Practice on Forming Processes (Rolling, Extrusion, Drawing and Spinning [15 hrs]
4. Practice of TIG/MIG And plasma Cutting/Welding [20 hrs]
5. Practice on Spot Welding [5 hrs]
6. Practice on Surface Finishing Processes (Honing, Lapping, buffing Grinding). [15 hrs]
7. Produce Spur/Helical gears using gear cutting processes by Milling Machine. [25 hrs]
8. Produce threads on a job by thread cutting process (External, Internal, left & right hand and double start). [15 hrs]

References:

1. H. S. Bawa, "Manufacturing Processes I and II" — Tata McGraw Hill Publishing company Limited, New Delhi, India.
2. G. K. Lal and S. K. Choudhury, "Fundamentals of Manufacturing Processes", Narosa Publishing House, New Delhi, India.
3. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East – West Press Private Limited, New Delhi, India.
4. B. Kumar and Sujay Kumar, "Manufacturing Processes and Technology", Khanna Publishers, New Delhi, India.
5. C. Elanchezhian and B. VijayaRamnath, "Production Technology-Manufacturing processes, Eswar Press, Chennai, India.
6. B. S. Nagendra Parashar and R. K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India Pvt Ltd, New Delhi, India.
7. P. C. Sharma, "A text book of Production Technology (Manufacturing Processes)", S. Chand and Company Ltd, New Delhi, India.
8. P. N. Rao, "Manufacturing Technology, Foundry, Forming and Welding", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
9. B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. II", DhanpatRai and Co. (P) Ltd, Delhi, India.
10. S. K. Hajra Choudhury, S. K. Bose and A. K. Hajra Choudhury, "Elements of Workshop Technology Vol. II (Machine Tools)", Media Promoters and Publishers Pvt Ltd, Bombay, India.
11. G. K. Lal, Vijay Gupta and N. Venkata Reddy, "Fundamentals of Design and Manufacturing", Narosa Publishing House, New Delhi, India.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Jigs and Fixtures	6	8
2	Special Casting Processes	8	10
3	Metal Forming	10	10
4	Advanced Welding Techniques	8	12
5	Surface Finishing Processes	6	10
6	Gear Cutting Processes	8	12
7	Thread Cutting Processes	8	10
8	Powder Metallurgy	*6*	8
	Total	**60**	**80**

Note: There might be minor deviation on above specified marks

Automobile Technology

EG 3102 ME

Total: 7 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: 4 Hrs/week
Lab: Hrs/week

Course Description:

This course deals with the main components, types, and functions of an automobile. It also describes the uses and types of automobiles' electrical systems.

Course Objectives:

After completing this course the students will be able to
1. describe the uses of various kinds of motor vehicles,
2. explain the operation of various aggregates, components of motor vehicle,
3. check to the condition and motor vehicles components, and
4. carry out servicing of those components.

Course contents:

1. Introduction to Automobile [4 hrs]

1.1. Meaning of automobile
1.2. Classification of automobile
1.3. Layout of Chassis

2. Automobile Transmission System [10 hrs]

2.1 Clutch: functions, types, construction and operation
2.2 Gear box: functions, types, construction and operation
2.3 Transfer case: construction and operation
2.4 Propeller shaft and universal joints: functions, construction and operation
2.5 Differential: functions, construction and operation, importance of limited slip differential (LSD)
2.6 Live rear axle: functions and types

3. Front axle and Steering System [9 hrs]

3.1 Front axle: function, types and construction
3.2 Steering system: purpose, types, construction and operation
3.3 Steering gearbox: functions, types, construction and operation
3.4 Steering geometry and wheel alignment: front suspension height, camber, steering axis inclination, included angle, caster, toe in, toe out, turning radius

4. Brakes **[5 hrs]**

4.1 Braking system: Mechanical, Hydraulic and Pneumatic
4.2 Disc and drum brakes: construction and operation
4.3 Concept of Anti-lock braking system

5. Tires and Wheels **[4 hrs]**

5.1 Tires: purpose, types, construction, size, tire pressures
5.2 Wheels: Spoke wheel, steel wheel, alloy wheel

6. Suspension System **[5 hrs]**

6.1 Main components of suspension system
6.2 Springs: leaf spring, coil spring, torsion spring
6.3 Dampers: purpose, construction and operation
6.4 Dependent and independent suspension system
6.5 Introduction to hydraulic and pneumatic suspension system

7. Electrical and Electronics **[8 hrs]**

7.1 Battery: construction, operation and care of lead-acid battery
7.2 Starting system: construction, operation and care
7.3 Charging system: construction, operation and care
7.4 Circuit diagram of electrical system: wire color code, symbols and connections
7.5 Electronic components identification and function: ABS, Air bags, Power window, power steering, central locking. Immobilizer, parking assist, Traction control, cruise control

Practical/Laboratory: ***[60 Hrs]***

Unit 1. Introduction to automobile **[2 hrs]**

1.1 Demonstrate main components of automobile
1.2 Distinguish the various types of automobile

Unit 2. Transmission (Power train)

2.1 Clutch **[6 hrs]**

2.1.1 Demonstrate construction and operation of coil spring clutch and a diaphragm clutch
2.1.2 Trouble shooting in clutch system
2.1.3 Perform repair and maintenance of different types of clutch

2.2 Gearbox **[8 hrs]**

5.1.1 Demonstrate different types of manual gear box and transfer case
5.1.2 Trouble shooting in gearbox and transfer case
5.1.3 Repair and maintenance of different types of gearbox and transfer case

2.3 Propeller shaft differential and rear axle **[2 hrs]**

2.3.1 Explain function of propeller shaft, slip joint, universal joints and differential in rear axle drive

2.3.2 Repair and maintenance of propeller shaft, slip joint universal joints, differential and rear axle

Unit 3. Front Axle and Steering System **[8 hrs]**

3.1 Inspect the condition of front axle
3.2 Function of steering system
3.3 Dismantling the parts of steering system
3.4 Identification of parts of steering system and their function
3.5 Checking and replacement of defective parts
3.6 Assembling and testing of parts

Unit 4. Brakes **[8 hrs]**

4.1 Identify and describe the construction of components of brake
4.2 Trouble shooting in brake system
4.3 Repair and maintenance of different types of brake system

Unit 5. Wheels and tires **[8 hrs]**

5.1 Explain function of wheels and tires
5.2 Demonstrate types of tires and their specification
5.3 Checking defective tire and their repair and replacement
5.4 Fitting of tires to the vehicle

Unit 6. Suspension system **[8 hrs]**

6.1 Demonstrate different types of suspension system
6.2 Identification of parts and their function
6.3 Dismantling the parts
6.4 Checking and replacement of defective parts
6.5 Assembling and testing of parts

Unit 7. Electrical and electronic system **[10 hrs]**

7.1 Identify the major components of electrical and electronic system
7.2 Explain the purpose, construction, operation of battery, starter motor, alternator, regulator and accessories
7.3 Check the condition of battery, starter motor, alternator, regulator, switches, diodes and wirings

Suggestion for instruction:

1. Use illustrative teaching materials like model, charts, and overhead transparencies to visualize the complex parts.
2. Show videos in the class in related topics.
3. Students are asked to assemble, dismantle and test the parts in the practical classes.
4. Use of appropriate tools is emphasized to test the condition of parts.

References:

1. W.W. Pulkrabek, "Engineering Fundamentals of the Internal Combustion Engine", Prentice-Hall of India Private Limited, New Delhi – 110001, India.
2. W. H. Crouse and D. L. Anglin, "Automotive Mechanics",TATA-McGrawHill publishing company ltd, New Delhi, India.
3. R. K. Rajput, "A textbook of Automobile Engineering", Laxmi Publications (P) Ltd, New Delhi, India.
4. Kirpal Singh, "A text book of automobile engineering"
5. P.S. Gill, "Automobile Engineering", S.K. Katariya, India

Marks specification for final examination

Unit	Content	Course Hours	Marks
1	Introduction to Automobile	4	5
2	Automobile Transmission System	10	20
3	Front Axle and Steering System	9	15
4	Brakes	5	10
5	Tires and Wheels	4	5
6	Suspension System	5	10
7	Electrical and Electronics	8	15
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Fundamentals of Hydraulics and Pneumatics

EG 3103 ME

Year: III
Part: I

Total: 5 Hrs/week
Lecture: 3 Hrs/week
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course deals with the fundamentals of industrial hydraulics and pneumatics. It describes the general application of components, mechanism and working principle of the hydraulic and pneumatic system. It also covers the basic diagnostic steps for problem solving on the systems.

Course Objectives:

After completing this course the student will be able to:

1. describe the uses of various kinds of hydraulic and pneumatic components
2. explain the operation of various kinds of hydraulic and pneumatic components
3. demonstrate basic knowledge of service, check, maintenance, diagnosis and testing of hydraulic and pneumatic system

Course contents:

Unit 1. Fundamental of Hydraulics and Pneumatics [4 hrs]

- 1.1 Introduction
- 1.2 Development stage of hydraulic and pneumatic equipment
- 1.3 Introduction of hydrostatics and hydrodynamics
- 1.4 Basic principles of hydraulics and pneumatics
- 1.5 Advantages and disadvantages
- 1.6 Applications of hydraulic and pneumatic system

Unit 2. Industrial Hydraulics [16 hrs]

- 2.1 Hydraulic system
  - 2.1.1 Types of hydraulic system and their properties: Open center system, closed center system
  - 2.1.2 Major and auxiliary components and their purposes
- 2.2 Hydraulic Fluid
  - 2.2.1 Function of hydraulic oil
  - 2.2.2 Types of hydraulic fluids: Petroleum base fluids, Synthetic base fluids, Water
  - 2.2.3 Properties of hydraulic oil
  - 2.2.4 Basic requirements of hydraulic oil

2.3 Hydraulic Components
- 2.3.1 Pumps: Introduction to hydraulic pumps and their types
- 2.3.2 Gear pump: principle, uses, trouble shooting
- 2.3.3 Vane pump: principle, uses, trouble shooting
- 2.3.4 Piston pump: principle, uses, trouble shooting

2.4 Hydraulic Cylinders
- 2.4.1 Introduction to hydraulic cylinders and its types
- 2.4.2 Piston types: single and double acting
- 2.4.3 Vane type cylinder
- 2.4.4 Miscellaneous cylinder

2.5 Hydraulic Valves and its types
- 2.5.1 Purpose and function of Pressure control valves, flow control valve and direction control valve

2.6 Hydraulic Motor
- 2.6.1 Introduction to hydraulic motor and types
- 2.6.2 Gear motor: construction and working
- 2.6.3 Vane motor: construction and working
- 2.6.4 Piston motor: construction and working
- 2.6.5 Selection of motor

2.7 Accumulator
- 2.7.1 Purpose and functions of accumulator
- 2.7.2 Spring loaded accumulator: construction and working
- 2.7.3 Weight loaded accumulator: construction and working
- 2.7.4 Pneumatic accumulator: construction and working

2.8 Hydraulic Filters
- 2.8.1 Purpose and functions
- 2.8.2 Contaminants
- 2.8.3 Types of filters

2.9 Reservoir
- 2.9.1 Function
- 2.9.2 Basic features of reservoir

2.10 Oil Cooler
- 2.10.1 Functions
- 2.10.2 Types of oil cooler

Unit 3. Industrial Pneumatics [12 hrs]

3.1 Pneumatic system
- 3.1.1 Introduction and types of pneumatic system
- 3.1.2 Components of pneumatic system and working principle

3.2 Compressed air
- 3.2.1 Properties of compressed air
- 3.2.2 Preparation of compressed air

3.3 Compressors
- 3.3.1 Piston type compressors: components and working principle
- 3.3.2 Vane type compressors: components and working principle
- 3.3.3 Helical compressors: components and working principle
- 3.3.4 Centrifugal compressors: components and working principle

3.4 Air Cylinder and Air Motors
- 3.4.1 Introduction
- 3.4.2 Types and construction

3.5 Valves
- 3.5.1 Pressure control valve: function and construction
- 3.5.2 Flow control valve: function and construction
- 3.5.3 Direction control valve: function and construction

3.6 Working principle of After Coolers
3.7 Working principle of Dryers
3.8 Working principle of Receiver
3.9 Filters
- 3.9.1 Contaminants in a pneumatic system
- 3.9.2 Types and purpose
- 3.9.3 Selection of filters

Unit 4. Hydraulic and Pneumatic Circuits [5 hrs]

4.1. Hydraulic and pneumatic symbols
4.2. Drawing of hydraulic and pneumatic circuits: open and closed center system
4.3. Basic requirement for pipeline and layout

Unit 5. Introduction to General Maintenance of Hydraulic System and Pneumatic System [8 hrs]

5.1. Preventive Maintenance
- 5.1.1 Flow pipe lines cleaning
- 5.1.2 Overhauling of system
- 5.1.3 Preventing leaks, air-in-oil problems
- 5.1.4 Prevention on pipe line and fittings

5.2. Diagnosis and Testing of Hydraulic system and Pneumatic system
- 5.2.1 Introduction
- 5.2.2 Basic steps
- 5.2.3 Inspection format

Practical/Laboratory: ***[30 hrs]***

1. Components identification and operation on hydrostatic and pneumatic work bench
2. Understanding the layout and operation of open and closed hydraulic system
3. Components identification and operation of different hydraulic pumps
4. Components identification and operation of hydraulic cylinder and motors
5. Components identification and operation of different valves
6. Components identification and operation of accumulator
7. Components identification and operation of different Compressors
8. Identification of hydraulic and pneumatic symbols and basic circuit
9. Demonstration of speed control of hydraulic and pneumatic cylinder/motor
10. Exercises on hydraulic and pneumatic pipe fittings

References:

1. Andrew Parr, "Hydraulics and Pneumatics: A Technicians and Engineers Guide", Butterworth-Heinemann, ISBN-10: 0750644192
2. Anthony Esposito, "Fluid Power with Applications", Prentice Hall
3. "Hydraulics", John Deere service publications", Molino, Illions
4. G. P.Gorkhali, "First Course in Hydraulics"
5. S. Ilango, V. Soundarayan, "Introduction to Hydraulics and Pneumatics",
6. S. R. Majumdar, "Oil hydraulic Systems, Principles and Maintenance", McGrawHill Education, India.
7. S. R. Majumdar, "Pneumatic Systems, Principles and Maintenance", McGrawHill Education, India

Marks Specification for final examination:

Unit	Content	Course Hour	Marks
1	Fundamental of Hydraulics and Pneumatics	4	4
2	Industrial Hydraulics	16	32
3	Industrial Pneumatics	12	20
4	Hydraulic and Pneumatic Circuits	5	8
5	Introduction to General Maintenance of Hydraulic System and Pneumatic System	8	16
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Machine Design, Estimating and Costing

EG 3104 ME

Total: 4 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: I **Tutorial: 1 Hrs/week**
Practical: Hrs/week
Lab: Hrs/week

Course Description:

This course deals with the basic design of common machine element along with estimating and costing of different mechanical operations. It also explains briefly about the documentation process for a tender.

Course Objectives:

After completing this course the students will be able to

1. Analyze the factors affecting choice of material, assuming knowledge of materials as covered in material science and strength of materials.
2. Design the simple machine elements for axial and torsional loading.
3. Calculate the total cost of manufacturing of simple machine element.
4. Basic knowledge of writing specification and concept of tender document.

Course contents:

Unit 1. Introduction [6 Hrs]

1.1 Introduction to Machine Design
1.2 Design procedure, Gathering information and formulating design problems.
1.3 Manufacturing considerations in design
1.4 Concept of mechanism, machine element, and machine.
1.5 Basic requirements of machine elements, strength, stiffness, rigidity, wear resistance
1.6 Types of loads (axial, bending, torsion and combined load)
1.7 Mechanical properties of material
1.8 Bearing stress and Stress concentration.
1.9 Failures and their cause and effect (Ductile, Brittle, Fatigue, Creep)

Unit 2. Design Consideration in Machine Element (types of failures and remedies) [10 Hrs]

2.1 Riveted joints lap and butt
2.2 Welded connections (lap and butt weld)
2.3 Turn buckle
2.4 Rectangular sunk key
2.5 Rigid flange coupling
2.6 Straight armed cast iron pulley

Unit 3. Design of the Machine Element [10 Hrs]

3.1 Shaft

- Torsion in shaft
- Power transmitted by shaft
- Simple problem of shaft under torsional loading using torsion equation.

3.2 Bearing

- Selection criteria of bearing of different types.
- Bearing life and equivalent bearing load
- Simple problem related to bearing life and reliability

3.3 Spring

- Close coil and open coil helical spring
- Simple problem of deflection and proof load of close coil helical spring.

Unit 4. Estimating and Costing [8 Hrs]

4.1 Introduction – Purpose of estimating and costing.
4.2 Difference of estimating and costing.
4.3 Types of costs.
4.4 Ladder of costs.
4.5 Allocating of overheads.
4.6 Problem related to calculate selling price form ladder of cost.

Unit 5. Estimation of Cost [12 Hrs]

5.1 Estimation of material cost by volume and weight.
5.2 Factor to be considered in estimation in cost in welding, casting and forgoing shop.
5.3 Related problem of material cost estimation of simple combined shapes (cylinder, conical, circular, Tapered, Truncated, Rectangular Shape)
5.4 Related problem in welding cost estimation in welding shop (gas welding and arc welding)
5.5 Related problem in welding cost estimation in welding shop (gas welding and arc welding)
5.6 Related Problem in cost estimation in foundry shop (Casting and forging)

Unit 6. Estimation in Machine Shop [10 Hrs]

6.1 Concept of Set up time, machining time, down time.
6.2 Estimation of operation time: machine time for various operations – turning, facing, threading, drilling, milling and shaping.
6.3 Related problem of estimation in various operation such as turning, step turning, facing, milling, drilling and shaping.

Unit 7. Documentation [4 Hrs]

7.1 Writing of specification of welding and machining shop.

7.2 Practices on preparing Bill of Quantities (BoQ), calculating the total cost, including tax and profit for given mechanical project.
7.3 Basic concept of tender document.
7.4 Essential components of tender document.

References:

1. Banga and Sharma, "Estimating and Costing", Khanna Publishers Delhi.
2. TTTI Madras, "Mechanical Estimating and Costing".
3. R.S. Khurmi: A Text Book of Machine Design,
4. V.B. Bhandari, "Design of Machine Elements"
5. P.C. Sharma and D.K. Agrawal, "Machine Design"

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	8
2	Design Consideration in Machine Element (types of failures and remedies)	10	12
3	Design of the Machine Element	10	8
4	Estimating and Costing	8	12
5	Estimation of Cost	12	18
6	Estimation in Machine Shop	10	14
7	Documentation	4	8
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks

Project II

EG 3105 ME

Total: 4 Hrs/week

Year: III **Lecture: Hrs/week**

Part: I **Tutorial: Hrs/week**

Practical: 4 Hrs/week

Lab: Hrs/week

Course Description:

This subject is the continuation of Project-I and also includes the fabrication of any basic component(s) on the basis of the knowledge and the skill learnt during the previous courses in a team. A small team of the students will be given an outline of device/item/tool/mechanism for the purpose. The finished product along with the final project report and viva voce will be conducted for final evaluation.

Course Objective:

The main objective of this course are:

1. To develop basic hand on skills.
2. To use skills and knowledge that they have acquired.
3. Get exposure on industrial work environment and work ethics.
4. To play role on a team work.
5. To prepare a BOQ of the materials used.
6. To prepare collaborative edition of the final project report.

Course content:

- A small team should be selected at the initial of the semester.
- Each team should be given a different group work regarding the simple fabrication of a functional/ daily life product. Product should be of higher level than that of Project-I.
- Each team should submit a project report including the following.
    - Introduction to the content of the project.
    - Objective
    - Application and working of the component
    - Methodology used for the completion of the project
    - Process and Material selection.
    - Part and Assembly drawing including Bill of Quantity (BOQ).
    - Testing data (if any)
    - Discussion
    - Conclusion and recommendation
    - References

Note: The student will be allocated a team of guides comprising of the theory teacher and the practical teacher for the project work. The student shall also consult the library and internet for completion of the work.

Evaluation Scheme:

Examination	Content	Marks
Internal	Attendance and job performance	20
	Product demonstration	20
	Report	10
	Presentation	10
Final	Group Report and Viva voce	40
Total		**100**

Industrial Attachment

EG 3106 ME

Total: 6 Hrs/week
Year: III **Lecture: Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: 6 Hrs/week
Lab: Hrs/week

Course description:

The students will be deputed to various mechanical workshop/service stations on a full time basis as a trainee or intern. At the end of the course, students will submit a report conforming to a standardized format along with the daily diary. Industrial attachment shall consist of exposure of world of work to learn skills and techniques in design, operation, diagnosis, maintenance and repair of mechanical sector based on the nature of the organization available locally or at national level.

Course objectives:

After completing the course, the students will be able to:

- Develop the technical skills learn in the institute with the needs of the employer.
- Increase self-confidence to face the real world of work.
- Develop a space for the future career.
- Ensure the standard of the training as per the market demand.
- Sensitize with modern and new technologies applied in the industry.
- Present the contents in front of a concerned mass of people.

Course contents:

- A small team of student and suitable industry should be selected at the initial of the semester.
- Each team should be given an orientation before releasing from the institute.
- Each team should prepare a dairy of daily activities.
- Each team should submit a project report including the following.
    - Page of approval from the industry
    - Profile of the industry
    - Layout of the industry.
    - List of machines and material handling equipment.
    - Process flow chart within the industry
    - Special technological aspect learnt during the internship/attachment.
    - General problems of the workshop/industry
    - Suggestions for improvement of selected aspect of the problems (store management, layout improvement, work study etc).
    - List of daily activities performed
    - Photographs of major involvement

Evaluation Scheme:

Examination	Content	Marks
Internal (100 marks)	Evaluation from Industry • Attendance • Job performance • Report	 15 50 15
	Evaluation from institute	20
Final (50 marks)	Group Report and Viva voce on Institute	50
Total		**150**

Sixth Semester

Year III Part II

Subjects:

1. EG 3201 ME Advanced Manufacturing Technology
2. EG 3202 ME Basic Refrigeration and Air Conditioning
3. EG 3203 ME Occupational Hygiene & Safety
4. EG 3201 MG Entrepreneurship Development
5. EG 3204 ME Project III
6. Elective (One of the followings)
   - EG 3205 ME.1 a. Product Design
   - EG 3205 ME.2 b. Hydropower Engineering
   - EG 3205 ME.3 c. Renewable Energy Technology
   - EG 3205 ME.4 d. Planning of Mechanical Job Shop

Advanced Manufacturing Technology

EG 3201 ME

Total: 7 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: 4 Hrs/week
Lab: Hrs/week

Course Description:

This course aims to impart the knowledge and skill of the students by introducing modern trends in manufacturing processes, and it deals with current aspects of manufacturing technology.

Course Objectives:

After completion of the course, the student shall be able to

1. Demonstrate knowledge and skill on non-conventional machining methods
2. Produce simple metal components and articles using NC and CNC machines
3. Supervise advanced mechanical works in the subject related field
4. Demonstrate knowledge and skill on advanced manufacturing technologies.

Course contents:

Unit 1. Non-Conventional Machining Processes [6 hrs]

- 1.1. Limitations of conventional Machining
- 1.2. Introduction to non-conventional machining
- 1.3. Classification of non-traditional Machining processes
- 1.4. Non-conventional machining processes: Working principle, operating parameters and application
  - 1.4.1. Electro Chemical Machining
  - 1.4.2. Chemical Machining
  - 1.4.3. Electric Discharge Machining
  - 1.4.4. Abrasive jet Machining
  - 1.4.5. Ultrasonic Machining
  - 1.4.6. Electron Beam machining
  - 1.4.7. LASER Beam Machining
  - 1.4.8. Plasma Arc Machining

Unit 2. Introduction to CAD, CAM and CIM [6 hrs]

- 2.1 Definition of CAD, CAM and CIM
- 2.2 Computers: The Foundation of CAD/CAM
- 2.3 General Design procedure and application of computer in design
- 2.4 Computer integrated manufacturing systems (CIMS)
- 2.5 Basic components of CIMS
- 2.6 Benefits of CAD/CAM and CIMS

2.7 Programmable Controllers
2.8 Adaptive controller
2.9 Automation
    2.9.1 Objectives of Automation
    2.9.2 Types of Automation
    2.9.3 Applications of Automation

Unit 3. Numerical Control and Computer Numerical Control of Machine Tools [16 hrs]

3.1 Introduction
3.2 Basic Components of NC systems
3.3 Classification of NC systems
3.4 Working Principles of NC Machines
3.5 Advantages and Limitations of NC Machine Tools
3.6 Applications of NC Machine Tools
3.7 Introduction to Computer Numerical Control Machine tools
3.8 Brief History of CNC Machine tools
3.9 Major Elements of CNC Systems
3.10 Functions of CNC Machine Tools
3.11 Comparison of NC systems and CNC systems
3.12 Types of CNC systems
3.13 Advantages of CNC Machines
3.14 Applications of CNC Machines
3.15 CNC Manual Part Program (3 axis CNC Milling)

Unit 4. Shaping Processes for Plastics [12 hrs]

4.1 Properties of Polymer Melts
4.2 Extrusion processes
    5.2.1 Extrusion process equipment
    5.2.2 Die Configuration and extrusions
    5.2.3 Extrusion defects
4.3 Injection Molding
    5.3.1 Process and equipment
    43.2 Injection molding Machines
    4.3.3 Defects in Injection molding
4.4 Blow Molding and Rotating Molding
    4.4.1 Blow Molding Machine
    4.4.1 Rotating Molding

Unit 5. Rapid Prototype Technology [5 hrs]

5.1 Introduction
5.2 Basic procedure of RP technology
5.3 Methods of RP technology
5.4 Working procedure of Fuse Deposition Method (FDM)
5.5 Applications

Practical/ Laboratory ***[60 Hrs]***

1. To be get acquainted with construction, principle and operation of NC and CNC machine tools [5]
2. To perform machining operation in NC and CNC machine tool [10]
3. To make CNC code (Milling for the following attributes: [45]
    a) Absolute and Incremental Co-ordinates
    b) Spot and Peck Drill
    c) Circular interpolation
    d) Interpolation planes
    e) Tool change operation
    f) Subroutines

References:

1. Mikell P. Groover, "Fundamentals of Modern Manufacturing, materials, processes and systems",John Wiley and Sons, Inc , Singapore.
2. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) P. Ltd.
3. P. C. Pandey and Dr. C. K. Singh, "Production Engineering and Science", Standard Publishers Distributors, Delhi, India.
4. H. S. Bawa, "Manufacturing Processes II", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
5. C. Elanchezhian, T. Sunder Selwyn and G. Shanmuga Sundar, "Computer Aided Manufacturing", Laxmi Publications (P) Ltd, New Delhi, India.
6. M. Adithan and A. B. Gupta, "Manufacturing Technology", New Age International (P) Limited, Publishers, New Delhi, India.
7. Marthin, "Numerical Control", E.L.B.S.
8. D.J. Bowman, and R.N. MC-Douglas, "Understanding of CAD/CAM- Design with computer", BPB Publication.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Non-Conventional Machining Processes	6	12
2	Introduction to CAD, CAM and CIM	6	12
3	Numerical Control and Computer Numerical Control of Machine Tools	16	28
4	Shaping Processes for Plastics	12	20
5	Rapid Prototype Technology	5	8
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Basic Refrigeration and Air Conditioning

EG 3202 ME

Total: 6 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: II **Tutorial: 1 Hrs/week**
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course deals with the study of refrigeration and air-conditioning systems, main components, and functions of refrigeration and air-conditioning systems. It also describes the uses and types of refrigeration and air-conditioning applications and incorporates the study of refrigerants and psychometric charts.

Course Objectives:

After completion of this course the students will be able to:
1. Describe the uses of various kinds of refrigeration and air conditioning (RAC) systems
2. Explain the operation of components of conventional RAC systems
3. Installation, testing and diagnosis of RAC components/ system

Course contents:

Unit 1. Introduction to Refrigeration [8 hrs]

1.1 Introduction, History and Units of Refrigeration
1.2 Types of Refrigeration: Ice Refrigeration, Air Refrigeration, Thermo-electric Refrigeration, Evaporative Refrigeration, Absorption Refrigeration, Liquid Nitrogen Refrigeration, Vapor Compression Refrigeration.
1.3 Comparison between heat pump & refrigerator
1.4 Performance related problem of heat pump and refrigerator

Unit 2. Vapor Compression Refrigeration Cycle [8 hrs]

2.1 Description of cycle
2.2 Diagrams & Representation on P-V, T-S & P-H diagrams
2.3 Factors affecting the performance of a simple vapor compression refrigeration cycle
2.4 Deviation of actual vapor compression cycle from theoretical cycle

Unit 3. Vapor Compression Refrigeration System & Controls [10 hrs]

3.1 Basic components: Function, types and specification: Compressor, Condenser, Evaporator, Liquid receiver, Accumulator, Sight glass, Oil separator, Filter drier, Vibration eliminator, Service valve, Check Valve, Pressure Relief valve (PRV)
3.2 Flow control devices: Capillary Tube, Automatic Expansion Valve (AEV), Thermostatic Expansion Valve (TEV/TXV)

Unit 4. Vapor Absorption Refrigeration System [3 hrs]

4.1 Principles of absorption system
4.2 Absorption System using Lithium Bromide Solution
4.3 Comparison between vapor compression and vapor absorption system

Unit 5. Refrigerants [4 hrs]

5.1 Definition
5.2 Primary & Secondary Refrigerants
5.3 Designation of refrigerants
5.4 Desirable properties of refrigerants
5.5 Properties and applications of commonly used refrigerants: R12, R22, R134a and R410
5.6 Montreal protocol.

Unit 6. Psychometry [6 hrs]

6.1 Psychometric terms-Dry and wet bulb temperatures, Saturation, sub- cooled, Super-heat, Dew point, Relative humidity, absolute humidity, humidity ratio.
6.2 Psychometric chart and its uses
6.3 Psychometric processes-Sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychometric chart.
6.3 Related common numerical problems

Unit 7. Basics of Air Conditioning [4 hrs]

7.1 Introduction and need of air conditioning.
7.2 Factor affecting air conditioning.
7.3 Human comfort

Unit 8. Air Conditioning System [12 hrs]

8.1 Introduction
8.2 Air conditioning system type (Operation and application)
- Window Air Conditioning system
- Split Air Conditioning system
- Central Air Conditioning system
- Automotive Air-conditioning system

8.3 Air conditioning components: Filter, Fan, Radiator, Damper, four-way valve.
8.4 Evaporative cooling and Desert cooler

Unit 9. Inverter Based Variable Refrigerant Flow/Volume (VRF/VRV) Types of Air-Conditioning System [5 **hrs**]

9.1 Principle of operation of inverter system
9.2 Operation and application of VRV system
9.3 Limitation of VRF system
9.4 Comparison of 1:1 Split and VRV system

Practical/ Laboratory: ***[30 Hrs]***

Lab 1: Practice on: Tube cutting, Flaring, Swaging, Bending and Joining [8 hrs]
Lab 2: Demonstration and identification of components of Domestic Refrigerator [2 hrs]
Lab 3. Demonstration and identification of components of Split and Window AC and VRF system [4 hrs]
Lab 4. Physical detection of leakage of refrigerant by various methods [4 hrs]
Lab 5. Charging refrigerant in an open as well as hermetically sealed units. [4 hrs]
Lab 6. Repair & maintenance of Domestic Refrigerator [4 hrs]
Lab 7. Repair & maintenance of Split type room air conditioner [4 hrs]

References

1. R.S Khurmi and J.S Gupta, "A text book of Refrigeration and Air Conditioning", Eurasia Publishing house (P) Ltd. Ramnagar, New Delhi
2. Domkundwar, Arora, "A course in Refrigeration and Air-conditioning", S.C Dhanpat rai and Sons, India.
3. E. G. Pita, "Air-conditioning Principles and System", Prentice-Hall of India Pvt. ltd., new Delhi-110006 , India

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Refrigeration	8	10
2	Vapor Compression Refrigeration Cycle	8	10
3	Vapor Compression Refrigeration System & Controls	10	12
4	Vapor Absorption Refrigeration System	3	5
5	Refrigerants	4	8
6	Psychometry	6	10
7	Basics of Air Conditioning	4	5
8	Air Conditioning System	12	12
9	Inverter Based Variable Refrigerant Flow/Volume (VRF/VRV) Types of Air-Conditioning System	5	8
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks

Occupational Hygiene and Safety

EG 3203 ME

Total: 3 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: Hrs/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. Understand statutory requirements regarding industrial hygiene and safety
4. Manage industrial safety

Course contents:

Unit 1: Introduction to Industrial Hygiene and Safety [4 Hrs]

1.1 Scope of industrial hygiene and safety
1.2 Cost and liability of industrial hygiene and safety
1.3 Accident, causes of accident and accident prevention methods
1.4 Principles and practices of safety management

Unit 2: Occupational Safety and Health [4 Hrs]

2.1 Legal Provisions by ILO, National Acts, labour laws for safety and health
2.2 Occupational Safety Rights
2.3 Industrial Hazard record system
2.4 Hazard Management system

Unit 3: Industrial Environment [4 Hrs]

3.1 Sanitation in industry
3.2 Ventilation system
3.3 Lighting system
3.4 Heating system

Unit 4: Electrical Safety **[4 Hrs]**

4.1 Effects of electric current on health
4.2 Electrical accidents
4.3 Electrical safety standards and regulations
4.4 Prevention of electrical accidents
4.5 Safety requirements for electric installation
4.6 Protective equipment for electrical safety

Unit 5: Fire Prevention and Control **[3 Hrs]**

5.1 Fire hazards
5.2 Accident prevention principle
5.3 Fire control methods

Unit 6: Noise Pollution and It's Control **[4 Hrs]**

6.1 Effect of noise on health
6.2 Standard requirements for industrial noise levels
6.3 Noise control principle and methods
6.4 Personal protective equipment

Unit 7: Air Pollution **[3 Hrs]**

7.1 Classification of pollutants in industry
7.2 Sources of pollutants
7.3 Permissible limits
7.4 Control of the environment

Unit 8: Electromagnetic Radiation **[4 Hrs]**

8.1 Health hazards due to electromagnetic radiation
8.2 Permissible limits of electromagnetic radiation
8.3 Electromagnetic radiation protection principle
8.4 Personal protective equipment

Unit 9: Industrial Vibration **[2 Hrs]**

9.1 Causes of vibration
9.2 Vibration minimizing techniques

Unit 10: Material Handling **[4 Hrs]**

10.1 Factors affecting selection of means for handling of materials
10.2 Mechanical material handling
10.3 Handling of dangerous chemicals

Unit 11: Machine Guarding **[4 Hrs]**

11.1 Legal requirements

11.2 Assessment of guards
11.3 Types of guards
11.4 Design aspect of guards

Unit 12: Physical and Chemical Hazards and Safety Measures in Various Operations [5 Hrs]

12.1 Arc welding and gas welding
12.2 Forging
12.3 Casting
12.4 Machining
12.5 Automotive works

Suggestions for instructions:

1. Demonstration of protective devices
2. Visit to industries
3. Demonstration of using various instruments and equipment

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

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Industrial Hygiene and Safety	4	6
2	Occupational Safety and Health	4	6
3	Industrial Environment	4	8
4	Electrical Safety	4	8
5	Fire Prevention and Control	3	4
6	Noise Pollution and It's Control	4	8
7	Air Pollution	3	4
8	Electromagnetic Radiation	4	8
9	Industrial Vibration	2	4
10	Material Handling	4	8
11	Machine Guarding	4	8
12	Physical and Chemical Hazards and Safety Measures in Various Operations	5	8
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Entrepreneurship Development

EG 3201 MG

Year: III **Total: 5 Hrs. /week**
Semester: II **Lecture: 3 Hrs./week**
Tutorial: Hr./week
Practical: 2 Hrs./week
Lab: Hrs./week

Course Description:
This course is designed to provide the knowledge and skills on formulating business plan and managing small business. The entire course deals with assessing, acquiring, and developing entrepreneurial attitude; skills and tools that are necessary to start and run a small enterprise.

Course Objectives:
After completion of this course students will be able to:
1. Understand the concept of business and entrepreneurship;
2. Explore entrepreneurial competencies;
3. Analyze business ideas and viability;
4. Learn to formulate business plan with its integral components and
5. Manage small business.

Course Contents:

Theory

Unit 1: Introduction to Business & Entrepreneurship: [9 Hrs.]
- 1.1 Overview of entrepreneur and entrepreneurship
- 1.2 Wage employment, self- employment and business
- 1.3 Synopsis of types and forms of enterprises
- 1.4 Attitudes, characteristics & skills required to be an entrepreneur
- 1.5 Myths about entrepreneurs
- 1.6 Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and Developing Entrepreneurial Competencies: [9 Hrs.]
- 2.1 Assessing individual entrepreneurial inclination
- 2.2 Assessment of decision-making attitudes
- 2.3 Risk taking behavior and risk minimization
- 2.4 Creativity and innovation in business
- 2.5 Enterprise management competencies

Unit 3: Business identification and Selection: [4 Hrs.]
- 3.1 Sources and method of finding business idea(s)
- 3.2 Selection of viable business ideas
- 3.3 Legal provisions for MSMEs in Nepal

Unit 4: Business plan Formulation: **[18 Hrs.]**

4.1 Needs and importance of business plan

4.2 Marketing plan

- Description of product or service
- Targeted market and customers
- Location of business establishment
- Estimation of market demand
- Competitors analysis
- Estimation of market share
- Measures for business promotion

4.3 Business operation plan

- Process of product or service creation
- Required fix assets
- Level of capacity utilization
- Depreciation & amortization
- Estimation office overhead and utilities

4.4 Organizational and human resource plan

- Legal status of business
- Management structure
- Required human resource and cost
- Roles and responsibility of staff

4.5 Financial plan

- Working capital estimation
- Pre-operating expenses
- Source of investment and financial costs
- Per unit cost of service or product
- Unit price and profit/loss estimation of first year

4.6 Business plan appraisal

- Return on investment
- Breakeven analysis
- Risk factors

Unit 5: Small Business Management: **[5 Hrs.]**

5.1 Concept of small business management

5.2 Market and marketing mix

5.3 Basic account keeping

Practical

Unit 1: Overview of Business & Entrepreneurship [2 Hrs.]

1. Collect business information through interaction with successful entrepreneur

Unit 2: Exploring and Developing Entrepreneurial Competencies [2 Hrs.]

- Generate innovative business ideas

Unit 3: Product or service Identification and Selection [2 Hrs.]

1. Analyze business ideas using SWOT method

Unit 4: Business Plan Formulation [22 Hrs.]

1. Prepare marketing plan
2. Prepare operation plan
3. Prepare organizational and human resource plan
4. Prepare financial plan
5. Appraise business plan
6. Prepare action plan for business startup

Unit 5: Small Business Management [2 Hrs.]

1. Prepare receipt and payment account
2. Perform costing and pricing of product and service.

Project III

EG 3204 ME

Total: 12 Hrs/week

Year: III **Lecture: Hrs/week**

Part: II **Tutorial: Hrs/week**

Practical: 12 Hrs/week

Lab: Hrs/week

Course Description:

This subject is the continuation of Project-II and includes the fabrication of any simple mechanism or machine on the basis of the knowledge and the skill learnt during the previous courses in a team. A small team of the students will be given an outline of mechanism/small machine for the purpose. The finished product along with the final project report and presentation with viva voce will be conducted for final evaluation.

Course Objective:

The main objective of this course are:

1. To develop basic hand on skills.
2. To use skills and knowledge that they have acquired.
3. Get exposure on industrial work environment and work ethics.
4. To play role on a team work.
5. To prepare a BOQ.
6. To prepare collaborative edition of the final project report.
7. To develop the presentation skill in presence of examiners.

Course content:

- A small team should be selected at the initial of the semester.
- Each team should be given a different group work regarding the simple fabrication of a functional/ daily life product that they can complete.
- Each team should submit a project report including the following.
    - Introduction to the content of the project.
    - Objective
    - Application and working of the component
    - Methodology used for the completion of the project
    - Basic design (if any) and material selection
    - Fabrication process
    - Part and Assembly drawing
    - Bill of Quantity (BOQ) including costing.
    - Testing of the product
    - Result and discussion
    - Conclusion and recommendation
    - References

Note: The student will be allocated a team of guides comprising of the theory teacher and the practical teacher for the project work. The student shall also consult the library and internet for completion of the work.

Evaluation Scheme:

Examination	Content	Marks
Internal (200 marks)	Attendance and job performance	100
	Product demonstration	50
	Report	30
	Presentation	20
Final (100 marks)	Product performance, Group Report and Viva voce	100
Total		**300**

Product Design (Elective)

EG 3205 ME.1

Total: 7 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 4 Hrs/week

Course Description:

This course deals with the product design process in the necessities of industrial design aspects in product design for customers' requirements. It also covers the knowledge of evaluating the existing design.

Course Objectives:

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

1. Identify major faces of the design activities.
2. Analyze the functional requirements of the design to determine the priorities.
3. Understand the ergonomic factors involved in design.
4. Able to appraise the designs for economical use of material and processes.
5. Able to compile a specification for the design.

Course contents:

Unit 1. Design Process **[3 hrs]**

1.1 Introduction – definition of product design.
1.2 Design by evolution.
1.3 Design by innovation.
1.4 The design problem – identification and formulation.
1.5 Physical reliability and economic worthiness.
1.6 Examination of design in relation to safety, service life, environmental factors, cost etc.
1.7 Examination of the detailed design for manufacturability.

Unit 2. Functional Analysis in Product Design **[4 hrs]**

2.1 Importance of product function, behavior and performance.
2.2 Main function and sub-function and methods of prioritization.
2.3 Converting function into design.

Unit 3. Production Process [8 hrs]

3.1 Role of processing in design.
3.2 Classification of manufacturing process.
3.3 Basic factors to be considered to simplify in designing machining process and machine operations.
3.4 Factors affecting the form of casting webs, section changes, radii, draft…. Etc.
3.5 Factors to be considered for design of forged components.
3.6 Main factors to be considered for design of a welded structure.
3.7 Comparing fabricated, cast, or forged products for economic production.

Unit 4. Assemble Process [8 hrs]

4.1 Definition, identification of machine components for mechanical assembly.
4.2 The assembly process: mechanical fastening, joining methods, adhesive bonding.
4.3 Assembly systems – full manual assembly, mechanical aided manual assembly, and automated assembly.
4.4 Design for assembly.
4.5 Important guide lines for cost reduction and ease of assembly.

Unit 5. Ergonomic Factors [6 hrs]

5.1 Meaning of ergonomics in terms of man-machine relationship.
5.2 The human in the work place.
5.3 The human as source of power.
5.4 The human as sensor and controller.
5.5 Analysis of ergonomic factors involved in the use of simple instruments, example: microscope, micrometer, lamp, lathe machine … etc.

Unit 6. Design Specification [8 hrs]

6.1 Necessity of development of engineering specification.
6.2 Specific requirements in terms of customer need principle markets, performance, environment, similar products, equipment, and expected life.
6.3 Specific study for common products used in machine design, example: electric plug, foot pump, leather shoe, bicycle, writing pen, note pad.
6.4 Compile and compare specification of different types of product design

Unit 7. Examination of Simple Products, Fully Documented with Hardware, Model Drawing, etc. in Terms of :- [8 hrs]

7.1 Specification and definition of the problem
7.2 The various factors such as function, manufacture, material, cost, etc. influence in design.

Practical: Case Studies ***[60 hrs]***

1. Case study and class presentation: identify the obsolete and or existing product and draw the product life cycle with necessary parameters of product failure and present it in your class. **[20 hrs]**
2. Case study and class presentation: Modify the previous product and present in your class. **[20 hrs]**
3. Consider a product, analyze its ergonomic, aesthetic and manufacturing factors involved and present in your class. **[20 hrs]**

References:

1. A.K. Chilate and R.C. Gupta, "Product Design and Manufacturing", Prentice Hall of India.
2. David G. Ullman, "Mechanical Design Process", The McGraw-Hill Co. Inc.
3. P.C. Sharma, "A Text Book of Production Engineering", S Chand & Company Ltd.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Design Process	3	4
2	Functional Analysis in Product Design	4	4
3	Production Process	8	16
4	Assemble Process	8	16
5	Ergonomic Factors	6	8
6	Design Specification	8	16
7	Examination of Simple Products, Fully Documented with Hardware, Model Drawing, etc. in Terms of	8	16
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Hydropower Engineering (Elective)

EG 3205 ME.2

Total: 7 Hrs/week
Year: III **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 4 Hrs/week

Course Description:

The course deals with hydropower mechanical systems, including features, classification, and the basic working principle of hydro turbines, governor, and mechanical joints and valves.

Course Objectives:

After completion of the course, the student shall be able to:

1. Understand the operation of different types of turbines
2. Understand the basic principle of governor
3. Develop concept of repair and maintenance of mechanical systems used in hydropower

Course contents:

Unit 1. Introduction [3 hrs]

1.5. Brief historical background of hydropower development in Nepal
1.6. Hydropower potential in Nepal, technical and economic potential in Nepal
1.7. Hydropower development policy of Nepal
1.8. Challenges and opportunities of hydropower development in context of Nepal
1.9. General Layout of a hydropower plant

Unit 2. Fundamental of Hydro Turbine [4 hrs]

2.1 General layout of a hydropower plant

2.2 Definition of head, power and efficiencies used in hydropower plant

2.4 Classification of hydro turbine

2.4.1 According to direction of flow

2.4.2 According to specific speed

2.4.3 According to the action of water

2.5 Selection of hydro turbine using hydro turbine selection charts

Unit 3. Pelton Turbine [6 hrs]

3.1 Basic concept of velocity triangle
3.2 Working principle
3.3 Selection of Pelton turbine using selection chart
3.4 Parts identification of Pelton Turbine

Unit 4. Francis Turbine **[6 hrs]**

4.1 Basic concept of velocity triangle
4.2 Working principle
4.3 Simple selection of Francis turbine using charts
3.4 Parts identification of Francis Turbine

Unit 5. Cross-Flow Turbine **[6 hrs]**

5.1 Basic concept of velocity triangle
5.2 Working principle
5.3 Simple selection of Cross-flow turbine using charts
5.4 Parts identification of Cross-flow Turbine

Unit 6. Propeller Turbine **[6 hrs]**

6.1 Basic concept of velocity triangle
6.2 Working principle
6.3 Simple selection of Propeller turbine using charts
6.4 Parts identification of Propeller turbine

Unit 7. Penstock, Joints, Valves and Governor **[6 hrs]**

7.1 Penstock expansion joints, supports and Anchor
7.2 Types of joints spigot and sockets
7.3 Types of valve, gates and their components
7.4 Basic working principle of Mechanical governor
7.5 Component identification of oil pressure governor

Unit 8. Repair and Maintenance **[8 hrs]**

8.1 Routine inspection and maintenance of hydro turbine and Auxiliaries (daily, weekly, monthly)
8.1.1 Annual Inspection and Maintenance
8.1.2 Capital Maintenance
8.2 Typical Problems in the maintenance of hydro turbines
8.3 Routine maintenance of Hydro Mechanical Equipment
8.3 Maintenance of Pelton (spear valve and splitter), Francis (guide vane and runner), and Cross-Flow runner (Guide vane/deflector and runner) due to sand erosion

Practical/Laboratory: ***[60 Hrs]***

- Dismantle and assemble of Cross flow turbine used in micro hydro [15 hrs]
- Dismantle and assemble of Pelton turbine used in micro hydro [15 hrs]
- Field visit in repair and maintenance shop [15 hrs]
- Mechanical components repair in workshop [15 hrs]

References:

1. R.K. Bansal, "A text of Fluid Mechanics and Hydraulics Machines", Laxmi Publication (P) LTD. India.
2. Adam Harvey, "Micro-Hydro Design Manual: A Guide to Small-Scale water power schemes", Practical Action Publishing.
3. "Guidelines Operation and Maintenance of Hydropower Plants, Substations and Transmission lines", Government of Nepal Ministry of Energy Department of Electricity Development Kathmandu, January 2017.

Marks specification for final examination

Unit	Content	Course Hours	Marks
1	Introduction	3	4
2	Fundamental of Hydro Turbine	4	8
3	Pelton Turbine	6	12
4	Francis Turbine	6	12
5	Cross-Flow Turbine	6	12
6	Propeller Turbine	6	12
7	Penstock, Joints, Valves and Governor	6	8
8	Repair and Maintenance	8	12
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Renewable Energy Technology (Elective)

EG 3205 ME.3

Total: 7 Hrs/week

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

Part: II **Tutorial: Hrs/week**

Practical: Hrs/week

Lab: 4 Hrs/week

Course Description:

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

Course Objectives:

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

1. Understand energy basics, unit conversion and energy scenarios
2. Understand the different types of renewable energy technology
3. Operate, repair & maintenance of equipment and systems of renewable energy technology

Course contents:

Unit 1: Introduction **[4 hrs]**

- 1.1 Definition, units and conversion of energy and power
- 1.2 Law of energy conservation
- 1.3 National and global energy production and consumption scenarios
- 1.4 Classification of energy resources: Primary and secondary; Conventional and non-conventional; Renewable and non–renewable
- 1.5 Environmental aspects of Renewable and non-renewable energy resources
- 1.6 Importance of renewable energy resources in Nepal.

Unit 2: Solar Energy **[13 hrs]**

- 2.1 Solar resources: Solar radiations, components of radiations, geometry of sun- earth, measurement of solar radiations and measuring devices
- 2.2 Solar thermal
  - 2.2.1 Domestic hot water system: Working principle, Components, Installation Practices
  - 2.2.2 Concept of Solar dryer and cooker
  - 2.2.3 Solar collectors: concentrating and flat plate collectors
- 2.3 Solar electricity
  - 2.3.1 Semiconductors and principle of solar cells
  - 2.3.2 Analysis of Photovoltaic cells: IV and PV characteristics, Effect of irradiance and temperature on IV and PV curve.
  - 2.3.3 Types of Photovoltaic cells: Crystalline and Amorphous
  - 2.3.4 Solar Charge controller: Function, Types (series and shunt)
  - 2.3.5 Storage battery: Principle, types and applications

2.3.6 Components and installations practices of Solar Home System (SHS) and Institutional Solar PV Systems (ISPS)
2.3.7 Solar water pumping: Basic components and installation layout
2.3.8 Concept of PV grid connection system and net metering

Unit 3: Hydropower **[10 hrs]**

3.1 Introduction
3.2 Principles, classification and assessing the resource for small installations
3.3 Components of hydropower, power output calculations
3.4 Basic concept of hydro-turbines (impulse, reaction)
3.5 Flow measurement: Bucket, Float and Salt Gulp Method
3.6 Head measurement: Abney Level, Dumpy Level / Auto Level, GPS device
3.7 Improved water mill and peltric sets in small scale hydroelectric
3.8 Concept of micro-hydro transmission and distribution system (layout and components only)

Unit 4: Wind Energy **[5 hrs]**

4.1 Introduction
4.2 Turbine types
4.3 Power extraction by a turbine
4.4 Electricity generation
4.5 Mechanical power
4.6 Scope and potential in Nepal

Unit 5: Bio Energy **[9 hrs]**

5.1 Introduction, bio energy resources in Nepal
5.2 Types: Solid, Liquid and Gaseous bio fuels with examples
5.3 Methods of biomass conversion (Thermo-chemical: pyrolysis and gasification; Biochemical: anaerobic digestion, composting; Physiochemical: Oil extraction, Bio-briquetting)
5.4 Bio-gas plant: principle, construction and working
5.5 Improved cook stoves: basic design layout and types

Unit 6: Geothermal Energy **[2 hrs]**

6.1 Introduction
6.2 Potential sites in Nepal
6.3 Introduction to components of geothermal energy systems

Unit 7: Hydrogen and Fuel-Cell **[2 hrs]**

7.1 Properties of hydrogen gas, basic concepts of hydrogen generation from natural gas, electricity and biomass
7.2 Basic concept of hydrogen fuel utilization in Fuel Cell Vehicle

Practical/Laboratory: ***[60 Hrs]***

1. Measurement of solar radiation [4 hrs]
2. Installation practices of domestic solar water heater [12 hrs]
3. Basic Design and Installation practices of Solar Home System (SHS) [16 hrs]
4. Head/pressure measurement of micro hydro power project by different methods [8 hrs]
5. Discharge measurements of small streams by different methods [8 hrs]
6. Wind velocity measurement [4 hrs]
7. Biogas installation visit [8 hrs]

References:

1. G.D. Rai,"Non-Conventional Energy Sources, Khanna Publisher", New Delhi, India
2. "Manual on Solar PV Systems for engineers", Alternative Energy Promotion Center (AEPC), 2015
3. "Manual on Solar Water Pumping", Alternative Energy Promotion Center, 2015
4. "Manual on Biogas plant", Alternative Energy Promotion Center, 2013
5. "Handbook on Solar Thermal Application", Alternative Energy Promotion Center, 2013
6. John W. Twidell and Anthony D. Weir, "Renewable Energy Resources", English Language Book Society, ISBN 0419144706.
7. Philip G. Hill, "Power Generation, Resources", Hazarch Technology and Costs, MIT Press,
8. A. Thumann, "Fundamentals of Energy Engineering", Fairmount Press, Prentice Hall Inc.,
9. A.W. Culp, "Principles of Energy Conversion".

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	4	8
2	Solar Energy	13	24
3	Hydropower	10	16
4	Wind Energy	5	8
5	Bio Energy	9	16
6	Geothermal Energy	2	4
7	Hydrogen and Fuel-Cell	2	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Planning of Mechanical Job Shop (Elective)

EG 3205 ME.4

Total: 7 Hrs/week

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

Part: II **Tutorial: Hrs/week**

Practical: Hrs/week

Lab: 4 Hrs/week

Course description:

This course includes the fundamental principle of job shop layout development and machine installation. Students will be able to know the basics of mechanical job shop environment, workshop layout, machinery cost estimation and installation procedures.

Course objectives:

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

- Know the mechanical workshop available at local level
- Know the machinery required for different repair job shop
- Know the basic concept and importance of job shop layout.
- Conduct the cost estimation of machinery equipment.
- Handle the basic leveling equipment
- Install the basic machinery equipment (static or motorized)
- Conduct the basic metal painting operation

Course contents:

1. Career in Mechanical Workshop [2 Hrs]

1.1. Opportunities in different mechanical trade/ field work

1.2. Mechanical workshops in Nepal

2. Machine Equipment in Mechanical Workshop [8 Hrs]

2.1. Equipment on fitting shop: Work bench, Bench and machine vice, V-block with clamp, drilling machine, pipe bending machine, surface plate with stand

2.2. Equipment on sheet metal shop: Hand riveting machine, shearing machine, folding machine, rolling machine

2.3. Equipment on welding shop: Arc welding machine and accessories, gas welding and cutting accessories, fume extractor, portable abrasive cutting machine

2.4. Equipment on machine shop: center lathe, shaper, milling, bench/ portable grinder, power hacksaw, chain pulley block

2.5. Metal Painting: types of paint, surface preparation, manual and spray painting components and process

2.6. Safety equipment: personnel and workplace safety

3. **Development of Workshop Layout** **[8 Hrs]**
   3.1. Collection of requirement: job focus sector, machine tools, target work volume, work flow pattern
   3.2. Consideration factors for a new typical job shop
      3.2.1. Site selection
      3.2.2. Floor plan
      3.2.3. Workshop structure: types, space for different units, flooring, doors and windows
      3.2.4. Services: electricity, lighting, ventilation, signage, lifting and safety equipment, waste management
   3.3. Layout of typical job shop

4. **Estimation for New Mechanical Workshop** **[15 Hrs]**
   4.1. Basic requirement
   4.2. Machine specification: definition of general terminologies used in Electric motor, Lathe, Shaper, Arc welding set, Oxyacetylene Gas welding and cutting, drill, grinder, vice, shearing, rolling, chain pulley
   4.3. Identification of cost related to workshop set up
   4.4. Preparation of bill of quantity: machinery and services
   4.5. Cost estimation for job shop: general machining, metal grill works (welding), sheet metal

5. Machine Installation **[12 Hrs]**
   5.1. Need of proper installation and proper alignment of plant machinery.
   5.2. Factors of site preparation in consideration of the floor.
   5.3. Space requirement for: machine, operator, tools and material
   5.4. Drawing for installation
   5.5. Leveling equipment: spirit level, water level, dial indicator
   5.6. Foundation preparation
   5.7. Procedure of installing machines: motor on base foundation with belt drive/coupling, Lathe machine, surface table
   5.8. Electrical connection and earthing on motor

Practical/ Laboratory: ***[60 Hrs]***

1. **Practice on metal surface preparation and painting** **[10 hrs]**
2. **Machine installation Practice:** **[20 hrs]**
   - Handling of leveling equipment
   - Foundation preparation
   - Handling of tripod stand, Chain pulley block and loading belt, Steel rope and its accessories.
   - Alignment of machines
   - Installation of equipment without motor: Working tables, mechanical press, rolling/shearing machine.
   - Installation of motorized equipment: Electric motor, Lathe/Shaper/Pillar Drill,
   - Electrical connection: motor, earthing
   - Testing of installed machine

3. **Visit to different mechanical workshops at local level [10 hrs]**
    - Overview of general tasks/operations performed in the workshop
    - Overview of available machineries
    - Overview of general safety measures taken in workshop
    - Use of CAD for drafting of the existing workshop layout and workshop shade

4. **Cost Estimation of job shop machinery [10 hrs]**
    - Visit to machinery dealers/retailers/suppliers at local level/ website to collect price list of machinery for different job shop as per specification.

5. **Layout and shade development of new job shop [10 hrs]**
    - Collection of requirement
    - Drafting of Layout and job shop shade in AutoCAD for general machining, metal grill works (welding), sheet metal type job shop.

References:

1. James Anderson, Earl E Tatro, "Shop Theory", Tata McGraw-Hill Edition, India
2. S.K. Choudhary, A.K. Choudhary, "Elements of workshop technology, Vol.-I and Vol.-II", Media Promoters and Publishers, India.
3. T.R. Banga, S.C. Sharma, "Mechanical estimating and costing", Khanna Publishers, India
4. "A text book of Automobile Service Management, Principles into Practice", Andrew A. Rezen, Pearson.
5. Russell Gamblin, "Machine Tools: Specification, Purchase, and Installation", 2014, McGraw-Hill Education, ISBN: 9780071812221
6. Rod Davis and Ross Stafford, "Machinery Workshops", Feedlot Design and Construction.
7. R. K. Jain and R. S. Khurmi, "Plant Engineering and Maintenance".
8. Hyundai Heavy Industries, "Installation procedure for rotating equipment".
9. Rodger Talbert, "Paint Technology Handbook, CRC Press", Taylor and Francis Group, ISBN 978-1-57444-703-3.
10. , M. S. Mahajan, "Industrial Engineering and Production Management", Dhanapat Rai and Co. P. (L). India.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Career in Mechanical Workshop	2	4
2	Machine Equipment in Mechanical Workshop	8	12
3	Development of Workshop Layout	8	12
4	Estimation for New Mechanical Workshop	15	32
5	Machine Installation	12	20
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks.

Experts Involved in Curriculum Revision, 2022

S.N.	Name	Position	Organization
1	Dr. Mahesh Chandra Luintel	Professor	IOE, Pulchowk Campus
2	Dr. Surya Prasad Adhikari	Assoc. Professor	IOE, Pulchowk Campus
3	Dr. Krishna Prasad Shrestha	Asst. Professor	SoE, Kathmandu University
4	Dr. Daniel Tuladhar	Asst. Professor	SoE, Kathmandu University
5	Laxman Motra	Lecturer	IOE, Pulchowk Campus
6	Dr. Khem Gyanwali	Lecturer	IOE, Thapathali Campus
7	Raj Kumar Chaulagain	Lecturer	IOE, Thapathali Campus
8	Dharma Maharjan	Lecturer	IOE, Thapathali Campus
9	Subodh Kumar Ghimire	Lecturer	IOE, Thapathali Campus
10	Debendra Bahadur Raut	Lecturer	IOE, Thapathali Campus
11	Laxman Palikhel	Instructor	IOE, Thapathali Campus
12	Bishwaram Parajuli	Instructor	IOE, Thapathali Campus
13	Rajan Sharma	Instructor	CTEVT, BSET
14	Chandrika Nanda Adhikari	Instructor	CTEVT, Shakharapur