CURRICULUM

DIPLOMA
Mechatronics Engineering

(Three Years Program- Semester System)

Council for Technical Education and Vocational Training

Curriculum Development & Equivalence Division

Sanothimi, Bhaktapur

2019

First Revision 2022

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Introduction

This 3 years Diploma in Mechatronics Engineering curricular programme is designed for producing skilled mechatronics personnel equipped with required knowledge, skills and attitude. **Mechatronics**, which is also called **Mechatronic Engineering**, is a multidisciplinary branch of engineering that focuses on the engineering of both electrical and mechanical systems, and also includes a combination of robotics, electronics, computer, telecommunications, systems, control, and product engineering. This course of Mechatronics Engineering is based on the job required to perform by Mechanical, electrical and computer technician at different related industries and organizations in Nepal and abroad. The course aims at producing middle level technical human resource equipped with knowledge and skills related to the Mechanical as well as electrical Engineering and computer science. The graduates of Mechatronics Engineering have ample opportunities of employment and self-employment in the field of Mechanical as well as Electronics related industries.

Diploma in Mechatronics Engineering program extends over three years. Each year is divided into two semesters. There are six semesters in total within the period of three years. The first year course focuses on foundational subjects like Physics, Chemistry, and Mathematics applicable in the field of mechatronics engineering. It also includes languages like Nepali and English applicable for the communication in the same area. The second year course focuses on the basic disciplinary subjects of Mechatronics Engineering like mechanical and electrical measurement, Circuit Analysis and Prototyping, CAD, Manufacturing Technology and so on.

Similarly, third year comprises of the disciplinary subjects like Advance Manufacturing Technology, Advanced Electronics, Actuators and Programmable logic, Industrial Management, Microprocessor, Plant Maintenance, Robotics and Industrial Automation and so on. The third year courses emphasize the application of learned skills and knowledge by making the provision of major and minor projects. As per the demand of the market, Specific areas of mechatronics like Micro Controller and PIC, Internet of things, Automotive Mechatronics and smart manufacturing have been suggested.

The course structure and the subject wise contents reflect the details of this curriculum. In short, this curriculum will guide its implementers to produce competent and highly employable middle level technical workforce in the field of Mechatronics Engineering.

Rationale of Revision

Diploma in Mechatronics Engineering curriculum was developed in 2007. This is the First revision after the implementation of its Development. The rationales behind its revision are as follows:

- It crossed the 3 years maturity period of its implementation after the Development 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.

Furthermore, technology of Mechatronics 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 Mechatronics Engineering (DMxE).

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:

- Prepare mid-level competent workforce in the related field.
- Prepare such technicians who are able to work in the automobile sector related local workshop and industrial settings of the country.
- Meet the demand of such technical workforce for the automobile 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 of 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. Each year consists of two semesters of six months each. Moreover, one semester consists of 19.5 academic weeks including evaluation period. Actual teaching learning hours will be not less than 15 weeks in each semester.

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

Pattern of Attendance
Minimum of 90% 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
- 1:6 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**
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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 both in 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 course 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 instructor 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 or affiliating institute led by external evaluator nominated by CTEVT. Question for practical exam is managed by ECD, 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 Mechatronics 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.

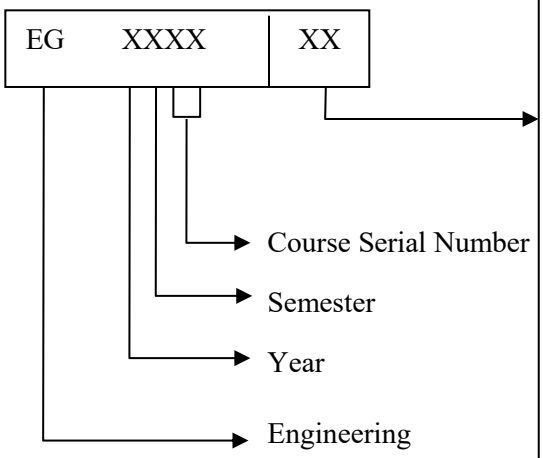
General Attitudes Required

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 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 Mechatronics Engineering

YEAR: I **PART I**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Asst Marks	Final Marks	Exam Hours	*Asst Marks	Final Marks	Exam Hours		
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				60	40	4	100	
7	EG 1101 CT	Computer Application	2		2		4	3	10	40	1.5	30	20	3	100	
TOTAL			**17**	**8**	**10**	**5**	**40**	**28**							**700**	

YEAR: I **PART II**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Asst Marks	Final Marks	Exam Hours	*Asst Marks	Final Marks	Exam Hours		
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**								**600**	

Diploma in Mechatronics Engineering

YEAR: II **PART: I**

Teaching Schedule			Mode						DISTRIBUTION OF MARKS						Total Marks	Remark
									Theory			Practical				
SN	Course Code	Course Title	L	T	P	Lab	Weekly Hours	Credit Hours	*Assmt Marks	Final Marks	Time Hours	*Assmt Marks	Final Marks	Time Hours		
1	EG 2101 MX	Basic Electrical Engineering	3			2	5	4	20	80	3	25			125	*Continuous assessment
2	EG 2102 MX	Computer Programming in C	3	1		3	7	5	20	80	3	50			150	
3	EG 2103 MX	Computer Aided Drawing	1		3		4	3				60	40	4	100	
4	EG 2104 MX	Workshop Practice II	4		7		11	8	20	80	3	120	80	6	300	
5	EG 2105 MX	Electronic Fundamentals	4			3	7	6	20	80	3	50			150	
6	EG 2106 MX	Mechanical and Electronic Measurement	4			2	6	5	20	80	3	25			125	
		Total	**19**	**1**	**10**	**10**	**40**	**31**							**950**	

YEAR: II **PART: II**

Teaching Schedule			Mode						DISTRIBUTION OF MARKS						Total Marks	Remark
									Theory			Practical				
SN	Course Code	Course Title	L	T	P	Lab	Weekly Hours	Credit Hours	*Assmt Marks	Final Marks	Time Hours	*Assmt Marks	Final Marks	Time Hours		
1	EG 2205 ME	Strength of Material	3	1		2/2	5	4	20	80	3	25			125	*Continuous assessment
2	EG 2201 MX	Manufacturing Technology	3		5		8	6	20	80	3	100	50	4	250	
3	EG 2202 MX	Digital Electronics	3	1		2	6	4	20	80	3	25			125	
4	EG 2203 MX	Fluid and Thermal Engineering	3	1		2/2	5	4	20	80	3	25			125	
5	EG 2204 MX	Circuit Analysis and Prototyping				3	3	2				50			50	
6	EG 2205 MX	Fundamentals of Hydraulics and Pneumatics	3			2	5	4	20	80	3	25			125	
7	EG 2206 MX	Electrical Workshop			4		4	2				60	40	4	100	
8	EG 2207 MX	Electric Machine and Drives	3			2/2	4	4	20	80	3	25			125	
		Total	**18**	**3**	**9**	**10**	**40**	**30**							**1025**	

Diploma in Mechatronics Engineering

YEAR: III **PART: I**

Teaching Schedule			Mode						DISTRIBUTION OF MARKS						Total Marks	Remark
									Theory			Practical				
SN	Course Code	Course Title	L	T	P	Lab	Weekly Hours	Credit Hours	*Asst Marks	Final Marks	Time Hours	*Asst Marks	Final Marks	Time Hours		
1	EG 3101 MX	Advance Manufacturing Technology	3		4		7	5	20	80	3	60	40	4	200	*Continuous assessment
2	EG 3102 MX	Advanced Electronics	4		2		6	5	20	80	3	25			125	
3	EG 3103 MX	Machine Element and Mechanism	3				3	3	20	80	3				100	
4	EG 3104 MX	Actuators and Programmable Logic Control	4		2		6	5	20	80	3	25			125	
5	EG 3105 MX	Industrial Management	3				3	3	20	80	3				100	
6	EG 3106 MX	Microprocessor	4			2	6	5	20	80	3	25			125	
7	EG 3107 MX	Instrumentation and Control System	3			2	5	4	20	80	3	25			125	
8	EG 3108 MX	Project I			4		4	2				60	40	4	100	
		Total	**24**		**12**	**4**	**40**	**32**							**1000**	

YEAR: III **PART: II**

Teaching Schedule			Mode						DISTRIBUTION OF MARKS						Total Marks	Remark
									Theory			Practical				
SN	Course Code	Course Title	L	T	P	Lab	Weekly Hours	Credit Hours	*Asst Marks	Final Marks	Time Hours	*Asst Marks	Final Marks	Time Hours		
1	EG 3201 MX	Plant Maintenance	3		3		6	5	20	80	3	60	40	4	200	*Continuous assessment
2	EG 3202 MX	Industrial Attachment			7		7	4				120	80	6	200	
3	EG 3201 MG	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	
4	EG 3203 MX	Robotics and Industrial Automation	3			4	7	5	20	80	3	50			150	
5	EG 3204 MX	Project II			8		8	4				120	80	6	200	
6		Elective (One of the followings)	3			4	7	5	20	80	3	50			150	
	EG 3205 MX.1	a. Micro Controller and PIC														
	EG 3205 MX.2	b. Internet of Things (IOT)														
	EG 3205 MX.3	c. Automotive Mechatronics														
	EG 3205 MX.4	d. Smart Manufacturing														
		Total	**12**		**20**	**8**	**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 MX Basic Electrical Engineering
2. EG 2102 MX Computer Programming in C
3. EG 2103 MX Computer Aided Drafting
4. EG 2104 MX Workshop Practice II
5. EG 2105 MX Electronic Fundamentals
6. EG 2106 MX Mechanical and Electronic Measurement

Basic Electrical Engineering
EG 2101 MX

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 electrical circuit fundamentals.

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 general applications of electrical circuits.

Course contents:

Theory: **[45 Hrs]**

Unit 1: Introduction **[6 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 **[10 Hrs]**

- 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 Maximum power transfer theorem and its applications in electrical circuits

Unit 3: Alternating Quantities **[4 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

Unit 4: Single Phase AC Circuit Analysis **[12 Hrs]**

- 4.1 AC in resistive circuits (equation and waveform of current, voltage and average power, phasor representation)
- 4.2 AC in inductive and capacitive circuits (equation and waveform of current, voltage and average power, phasor representation)

4.3 AC in RL, RC and RLC series circuit (equation and waveform of current and voltage; analysis of power and power factor, phasor representation)
4.4 Types of power in AC, power factor, its practical importance and power factor improvement
4.5 Measurement of power in single phase AC circuit

Unit 5: Three-Phase Circuit Analysis [7 Hrs]

5.1 Basic concept and advantages of 3-phase system
5.2 Phase and line quantities in Star and Delta connections
5.3 Balance and unbalance 3-phase system
5.4 Power calculation in 3-phase system

Unit 6: Lighting Devices, Wiring System, Electrical Safety and Protection [6 Hrs]

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

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. [6 Hrs]
4. Measurement of AC circuit parameters using RLC series circuit. [3 Hrs]
5. Voltage, current and power measurements in 1-Ǿ and 3-Ǿ system [6 Hrs]
6. Measurement of power factor of 1-phase and 3-phase ac loads [6 Hrs]
7. Measurements of LUX for different lighting devices [3 Hrs]

References:

1. B. L. Thareja & A.K. Thareja, "A text book of electrical technology (Volume I)", 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.
4. R. K. Rajput, " Utilization of Electrical Power", Firewall Media, India

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	12
2	Electric Circuit and Theorem	10	16
3	Alternating Quantities	4	8
4	Single Phase AC Circuit Analysis	12	20
5	Three-Phase Circuit Analysis	7	12
6	Lighting Devices, Wiring System, Electrical Safety and Protection	6	12
	Total	**45**	**80**

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

Computer Programming in C

EG 2102 MX

Total: 7 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: I **Tutorial: 1 Hrs/week**
Practical: Hrs/week
Lab: 3 Hrs/week

Course Description:

This course deals with the computer fundamentals, problem solving method. It covers basic input and output, structured programming fundamentals, functions, arrays, strings, pointers, structures and file handling using C programming language.

Course Objective:

After the completion of this course the students will be able to:
1 Describe basic programming concepts and terms.
2 Explain and apply various data types and operators used in C.
3 Develop the working knowledge of problem solving by using the computer methods, systems and languages.
4 Apply conditional and looping statements while developing programs.
5 Create modular programs using function.
6 Make and apply programs using array, strings.
7 Apply pointers in developing programs.

Course Contents:

UNIT 1: Computer Programming Basics **[3 Hrs]**
- 1.1. Program, Programming, Programming language and its types
- 1.2. Language translators (Assembler, Compiler, Interpreter)
- 1.3. Program Design Tools (Algorithm, Flowchart and pseudo code)

UNIT 2: Introduction to C **[6 Hrs]**
- 2.1 History
- 2.2 Character Set, Tokens, Keywords, Identifiers
- 2.3 Constants and its types, Variables, Rules for naming Variables
- 2.4 Operators and its types
- 2.5 Expression
- 2.6 Data types
- 2.7 Precedence and Associativity
- 2.8 Escape Sequence

UNIT 3: Basic Input and Output **[3 Hrs]**
- 3.1 Formatted Input/ Output functions (scan (), print ())
- 3.2 Unformatted Input / Output functions (getchar (), putchar (), gets (), puts ())

UNIT 4: Structured Programming Fundamentals **[12 Hrs]**

4.1 Control Structure (Sequence, Selection, Loop)
4.2 Conditional Statements (if, if….else, if….else if, nested if…else, switch)
4.3 Loop (for, while, do – while)
4.4 Nested loop
4.5 Break and continue statement

UNIT 5: Functions **[8 Hrs]**

5.1 Introduction
5.2 Function Components (Function Prototypes, Call and Definition)
5.3 Types of function on the basis of return type and arguments
5.4 Call by value and call by reference
5.5 Recursion

UNIT 6: Arrays and Strings **[9 Hrs]**

6.1 Introduction to Array
6.2 Types of Array (One Dimensional, Multi-Dimensional, Static)
6.3 Dynamic Array (Introduction only)
6.4 Passing Array to Function
6.5 Introduction to String
6.6 Handling Functions (strcpy(), strlen(), strcmp(), strrev(), strlwr(), strupr())

UNIT 7: Pointer **[4 Hrs]**

7.1 Introduction to pointer
7.2 Pointer Arithmetic
7.3 Relation between pointer and Array
7.4 Dynamic Memory Allocation

Tutorials: ***[15 Hrs]***

Tutorials Sheet I **[3 Hrs]**

1. Write an algorithm and draw flowchart for finding sum of any two numbers.
2. Write an algorithm and draw flowchart for calculating Simple Interest.
3. Write an algorithm and draw flow chart to determine whether a number is positive or negative.
4. Write an algorithm and draw flow chart to test if a number is even or odd.
5. Write an algorithm and draw flow chart to find largest among two numbers.
6. Write an algorithm and draw flow chart to find larger number among three numbers.
7. Write an algorithm and draw flow chart to calculate factorial of given Number.
8. Write an algorithm and draw flow chart to check if given Number is prime or not.
9. Write an algorithm and draw flow chart to find square roots of quadratic equation (Both real and Imaginary)

Tutorials Sheet II **[3 Hrs]**

1. WAP to add two numbers.
2. WAP to find product of two numbers.
3. WAP to calculate area and circumference of a circle having radius r (input r from user).
4. WAP to convert temperature in Centigrade into Fahrenheit.

5. WAP to find sum and average of 5 numbers.
6. WAP to take marks of 5 subjects from student and calculate Total marks and percentage. W
7. WAP to convert Cartesian coordinates to polar coordinates.
8. WAP to calculate Simple Interest.
9. WAP to read height and base of triangle and calculate its area.
10. WAP to read three sides of triangle and calculate its area.
11. WAP for asking cost of pen in paisa. Convert it into nearest rupee and paisa.
12. WAP to enter 4- digit number and find the sum of first and last digit of the number.
13. WAP to enter 4-digit number and find the sum of its digits. Basic salary of Ram is input through the keyboard. His medical allowance is 10% of basic salary, house rent allowance is 8% of his basic salary and provident fund is 10% of basic salary. WAP to find his net salary.
14. WAP to find the area of triangle, if the length of sides of triangle a, b, c is given by user.
15. WAP to find area of circle. Ask radius to user and also define value of PI as symbolic constant.
16. Write conditional operator to evaluate the following functions

    y=2.4x + 3, for x<=2

    y=3x – 5, for x>2

Tutorials Sheet III **[3 Hrs]**

1. Give the output of the following program and justify your answer with reason

```
#include<stdio.h>
int main()
        {
        int x=3, y=5,z=7;
        int a, b;
        a=x*2+y/5-z*y;
        b=++x*(y-3)/2 - ++*y;
         printf("a=%d",a);
        printf("b=%d",b);
         return 0;
        }
```

2. Give the output of the following program and justify your answer with reason

```
#include<stdio.h>
int main()
   {
        int a=2, b=3, c;
        a=(b++)+(++b)+a;
        c=a>b?a:b;  b=(a++)+(b--)+a;
        c=c++*b--;
        printf("a=%d\n b=%d\n c=%d", a, b, c);
        return 0;
     }
```

3. Rewrite the following program by correcting any errors, if present and also write down the output of the corrected code.

```
Define MAX '5'
int main()
{
        int case[MAX]={2,3,5,4,10},i,sum=0;
       for(i=0, i<MAX, i+=1)
      {
            printf("Case %d = %3.2d\n", i, case[i]);
           sum += *case+i;
      };
       average = sum/MAX;
       printf("%06.2f", average);
      return 1;
}
```

4. Rewrite the following program by correcting any syntactical errors, if present. Also show the output of the corrected code.

```
#include<stdio.h>
int main ()
{
        float root, int i=1; // here after float root, semicolon must be written. //
            do
            {
                sum=2*i-1;
                printf("\t%d\n", sum);
                i *=5/3;
            } while (sum <= 15);
      root = pow (i, 1/2);
       printf("\n%.3f", root);
       return void;
}
```

5. WAP to generate following output

1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

6. WAP to generate following output

1
2 2
3 3 3
4 4 4 4
5 5 5 5 5

7. WAP to generate following output

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

8. WAP to generate following output

```
1
2       3
4       5       6
7       8       9       10
11      12      13      14      15
```

9. WAP to generate following output

```
        1
      1 1
    1 2 2 1
  1 2 3 3 2 1
1 2 3 4 4 3 2 1
```

10. WAP to generate following output

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

11. WAP to generate following output

```
1 2 3 4 5 4 3 2 1
  1 2 3 4 3 2 1
    1 2 3 2 1
      1 2 1
        1
```

Tutorials Sheet IV **[3 Hrs]**

1. WAP to check if a given number is even or odd
2. WAP to check if given number is +ve or –ve.
3. WAP to read three numbers from user and determine the largest number among them.
4. WAP to read the percentage of a student then determine the division using following condition
   Percentage greater than or equal to 80 -> Distinction
   Percentage between 60 and below 80 -> First Division
   Percentage between 45 and below 60 -> First Division
   Percentage between 32 and below 45 -> First Division
   Percentage less than 32 fail.
5. WAP to calculate factorial of a number.
6. WAP that asks an integer number n and calculate sum of all-natural numbers from 1 to n.
7. WAP to add two numbers and display their sum. The program must ask next two numbers and add until user wants.
8. WAP to read a number from keyboard until zero or negative number is keyed in. Finally, calculate the sum and average of entered numbers.
9. WAP to ask a number to user and add another number to it till user wants.
10. WAP to determine whether a number is prime or not.
11. WAP that reads two numbers and an arithmetic operator (+, -, *, /, %) and perform the operation as per operator supplied using switch case.
12. WAP to read a character from keyboard and convert it into uppercase if it is in lowercase and vice versa.
13. The monthly electricity bill is computed as follows:
    Minimum Rs. 80/- for up to 20 units
    Rs. 7.30 per units for next 100 units
    Rs 9.00 per units for any units beyond 120 units
    WAP to compute monthly bill for given numbers of units consumed by a customer.
14. A Bank has introduced an incentive policy. A bonus of 2% of the balance is given to everyone, irrespective of their balances and 5% is given to female account holder if their balance is more than 5000/-. WAP to represent this policy and calculate balance after bonus.
15. WAP to print ASCII value of all characters.
16. WAP to generate Fibonacci series of n terms enter by user using iteration.
17. WAP to compute the sum of digits of a given integer number. W
18. WAP to compute the sum of digits of a given integer number till single digit is obtained.
19. WAP to reverse the digits of a number.
20. WAP to find cubes and squares of first 10 natural numbers.
21. WAP to check whether entered number is perfect or not. (A perfect number is a positive number which sum of all positive divisor excluding that number is equal to that number).
22. WAP to check if the entered number is strong or not. (A number is strong if its sum of factorial to its digit is equal to number itself. E.g. 145= 1! + 4! +5!).
23. WAP to read a number and find prime factors of it.
24. WAP to read a number from keyboard and check it for palindrome.

25. WAP to check if the entered number is Armstrong or not.
26. WAP to convert decimal numbers to its equivalent binary numbers.
27. WAP to convert binary numbers to its equivalent decimal numbers.
28. WAP to read two numbers from user and compute hcf and lcm.
29. WAP to print all the prime numbers between n1 and nb2. Where n1 and n2 is entered by user.
30. WAP to print all the Armstrong numbers between n1 and n2. Where n1 and n2 is entered by user.
31. WAP to print all the perfect numbers between n1 and n2. Where n1 and n2 is entered by user.
32. WAP to print all the strong numbers between n1 and n2. Where n1 and n2 is entered by user.
33. WAP to read set of numbers and calculate its maximum and minimum value.
34. WAP to find roots of quadratic equation (both real and imaginary)
35. WAP to check whether an integer given from user is triangular or not
36. WAP to display all the prime factors of given number.
37. WAP to display all the triangular numbers in Range.

Tutorials V **[3 Hrs]**

1. Write a program using a function that returns the largest number from an array of numbers that is passed to the function.
2. Write a program to illustrate the "functions with no arguments and no return values".
3. Write a program to illustrate the "functions with arguments and no return values".
4. Write a program to swap the values of two variables using pass by reference.
5. Write a recursive function to generate particular term in Fibonacci series,
6. Write a program to display Armstrong numbers between the ranges entered by a user and also display their counts. You must use a function to check for Armstrong numbers and display them from main.
7. Write a program to calculate the sum of the series: 1+11+111+.....+up to N terms using recursive function. If N is read as 5, the series is: 1+11+111+1111+11111.
8. Write a C program to read two matrices from user, add them and display the result in matrix form.
9. Write a program to read name of five persons and sort them to display in ascending order.
10. Write a program to read a word from a main function, pass it into a function that will convert all of its characters into uppercase if the first character is in lower case and into lower case if the first character is in upper case. Display the converted string from main function.
11. A multinational company has hired 3 sales persons for marketing/selling its 3 different products in Kathmandu. Each sales person sells each of these products. Write a program to read number of each product sold by all sales-persons. Calculate total sells of each item and the total sells of each sales-person. Use array.
12. Write a program to read a string and check whether it is palindrome or not.

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

Perform the following tasks using C:

1. Write programs to implement sequential structure.
2. Write programs to implement conditional and iterative structure.
3. Write programs using array and strings.
4. Write programs using pointer.
5. Write programs using functions.

Note: Practical lab programs can be selected from tutorials sections

References:

1. Y. P. Kanetkar. "Let us C", BPB Publication, New Delhi.
2. D.S. Baral, D. Baral & S.K. Ghimire, "The secretes of C programming language". Kathmandu, Bhundi Purana Prakasan.
3. E. Balagurusamy," Programming in ANSI C", Tata McGraw-Hill, New Delhi, India.
4. R. Raman, "Computer programming in C", PHI, New Delhi, India
5. B.S. Gottfried, "Schaum's Outline Series for Programming with C", Tata McGraw Hill Publishing Company, New Delhi
6. R.D. Bhatta, "A Text Book of C Programming", Vidyarthi Prakashan, Kathmandu

Mark Specification for final examination:

Unit	Content	Course Hours	Marks
1	Computer Programming Basics	3	6
2	Introduction to C	6	9
3	Basic Input and Output	3	6
4	Structured Programming Fundamentals	12	22
5	Functions	8	14
6	Arrays and Strings	9	16
7	Pointer	4	7
	Total	**45**	**80**

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

Computer Aided Drawing

EG 2103 MX

Total: 4 Hrs/week

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

Part: I **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 SolidWorks. It also deals with the advanced part modeling and component assembly.

Course objectives:

After completing this course the students will be able to:

1. draw two dimensional objects using Solid Works
2. draw three dimensional objects using solid modeling, sweep and loft techniques.
3. produce workshop drawing with bill of materials.

Course contents:

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

1.1 Using the Interface/Loading SolidWorks
1.2 Using the
1.3 Running Programs
1.4 Exit Programs
1.5 Searching for a file or folder
1.6 Wild card searches
1.7 Saving and copying files
1.8 Resizing windows
1.9 Toolbars
2.0 Getting helps

Unit 2: Basic SolidWorks Essentials **[4 Hrs]**

2.1 Feature based, parametric solid modeling
2.2 Sketched Features and Operation Features, Example of shape features
2.3 SolidWorks terminology: Feature Manage design tree Graphics Area, parametric, Driving dimensions, geometric relations, solid modeling, Associative feature, Design intents, and SolidWorks model
2.4 Creating New files using temples
2.5 User Interface, tools bars, customize toolbars, view control
2.6 Basic geometry terminology: Axis, plane origin, face edge vertex
2.7 Document properties, system options

Unit 3: Introduction to Sketching **[4 Hrs]**

3.1 Introduction to sketching
3.2 Default Planes
3.3 Creating a 2D sketch
3.4 Status of a sketch, governing rules in sketches
3.5 Design Intent
3.6 Sketch Relations, add sketch relations, dimensions
3.7 Dimensions: smart dimensions, adding dimensions, modify tool
3.8 Sketch fillet
3.9 Sketch tips

Unit 4: Part Modeling **[10 Hrs]**

4.1 Basic modeling terminology: Feature plane, sketches, extrusion, boss cut
4.2 Choosing a sketch plane
4.3 view ports,
4.4 Hole wizards
4.5 Fileting: Fillet types, Filleting rules, Fillet property Manager, constant radius fillet
4.6 Edit color
4.7 Make a drawing from a part: Creating drawing, drawing template
4.8 General procedure for creating a drawing
4.9 Model views: Insert a model view, drawing views, isometric view added to drawing
4.10 Dimensions: Driven dimensions, dimensioning drawings, general drawing rules for dimensions, dimensions guidelines, import dimension into a drawing, manipulating dimensions

Unit 5: Advanced Part Modeling **[11 Hrs]**

5.1 Sweeps:
  5.1.1 Overview of revolve feature,
  5.1.2 Creating a revolve feature
5.2 Loft
  5.2.1 Loft feature overview,
  5.2.2 Creating an offset plane for loft,
  5.2.3 Setting up planes
  5.2.4 Sketch profile for loft
  5.2.5 Move a sketch to a different plane
  5.2.6 Examples

Unit 6: Assembly Modeling **[5 Hrs]**

6.1 Types of assembly: Top down assembly modeling and bottom up assembly modeling

6.2 Manual assembly configurations
6.3 Assembly design tables
6.4 Assembly editing

Unit 7: Plotting Drawings **[10 Hrs]**

7.1 Drawing Sheets and Views
7.2 Dimensions
7.3 Annotations
7.4 Sheet formats and Templates
7.5 Assembly drawing views
7.6 Bill of Materials and tables

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

Unit 1: Introduction **[3 Hrs]**

1.1 Familiarization with Software Environment, Setting up Drawing

Unit 2: Basic Drawing Commands **[6 Hrs]**

2.1 2D Sketching using Straight Lines
2.2 2D Sketching using Circle and Arc
2.3 2D Sketching using Ellipse, spline and Polygon

Unit 3: Add relation on 2D sketching g **[3 Hrs]**

3.1 2D sketching with fully constrained

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 **[4 Hrs]**

5.1 3D Drawing: Solid Modeling
5.2 3D Drawing: using sweeps and loft

Unit 6: Plotting drawings **[3 Hrs]**

6.1 Plotting 2D and 3D Drawings

Project:

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]**
Project 3: Drawing of an electrical distribution in two story housed design **[4 Hrs]**
Project 4: Drawing of pipe line connection in a household refrigerator system **[4 Hrs]**

References:

1. James D. Bethune, "Engineering Design and Graphics With Solid Works", Pearson
2. Matt Lombard, "Solid Works 2010", Wiley Publishing, Inc
3. “Solid Works User's Guide”, Autodesk

Marking Scheme:

Examination	Content	Marks
Internal (60 marks)	Attendance	10
	Job performance	30
	Practical exam	20
Final (40 marks)	Practical exam	40
Total		**100**

Marks specification for final examination

1. 2D Sketching including drawing setup by using 2D Draw tools [15 marks]
2. Isometric drawings of five different machine components [10 marks]
3. Assembly drawing composed by minimum 10 families and produce bill of material for the fabrication drawing [15 marks]

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

Workshop Practice II
EG 2104 MX

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 manufacturing process. The course deals with further new and advanced methods such as foundry and welding of work performances. Technicians need to acquire advanced techniques and performance standard so as to be competent in the mechanical engineering field.

Course Objectives:

After completing this course the students will be able to

1. Define the basic properties of engineering material
2. Understand the selection criteria of material
3. Understand the fundamental concept of material testing
4. Differentiate ferrous and non-ferrous metal
5. Understand and perform plumbing work
6. Explain and perform different welding techniques

Course contents:

Unit 1: Engineering Materials **[10 Hrs]**

1.1 Introduction

1.2 Classification of Engineering Material and their uses: Metal, Polymer, Ceramics and composites

1.3 Properties of Material

- Physical Properties: Density, Color, Luster
- Mechanical Properties: Ductility, Brittleness, Toughness, Stiffness, Resilience, Malleability, Hardness
- Electrical Properties: Resistivity, conductivity
- Thermal Properties
- Magnetic Properties

1.4 Selection criteria of Engineering material.

1.5 Process of selecting material

1.6 Testing of material

- Destructive test: Hardness test, Impact test, tensile test, fatigue test and creep test
- Non-destructive test: Ultrasonic test, Radiography Test and Magnetic Particle test

Unit 2: Ferrous and Non-Ferrous Metal **[4 Hrs]**

2.1 Ferrous materials

2.2 Common ferrous materials, their engineering characteristics and Industrial applications: Steel (HSLA steel, stainless steel, tool steel) and Cast Iron (grey, white, malleable, ductile)

2.3 Corrosion: cause, effect and methods of prevention

2.4 Non-ferrous materials

2.5 Common non-ferrous materials, Application and engineering characteristics: copper, aluminum, brass, bronze, silver, gold.

Unit 3: Metal Forming Process **[6 Hrs]**

3.1 Introduction and its types:

- Bulk deformation: Rolling Process, Forging Process, Extrusion, wire and bar drawing
- Sheet Metal Working: Bending operation, Deep or Cup drawing, Shearing process, riveting

3.2 Hot Working and Cold Working

3.3 Heat Treatment: Purpose and types (Annealing, Normalizing, Hardening and empering, Case Hardening.

Unit 4: Plumbing Works **[3 Hrs]**

4.1 Introduction

4.2 Plumbing tools: types, materials, use and care.

4.3 Pipes types: polythene, GI, CI

- Operations (bending, thread cutting, joining)

4.4 Pipe fittings: types and uses

Unit 5: Welding **[10 Hrs]**

5.1 Introduction, classification and selection of different types of welding process

5.2 Arc Welding:

5.2.1 Introduction

- Arc column theory
- Power sources for arc welding
- Types of welding: SMAW, GMAW, GTAW
- Condition of welding table and welding machine
- Influencing factors in arc welding
- Safety precautions in arc welding

5.2.2 Arc Welding equipment and accessories

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

5.2.3. Arc welding electrode: classification, application and care

5.2.4. Welding joints: types and application

5.2.5. Defects on welding process, cause and their possible remedies

Unit 6: Gas Welding **[18 Hrs]**

6.1 Introduction to oxyacetylene (Gas) welding:
- Oxy-acetylene welding principle
- Advantages and application of oxy-acetylene welding
- Safety precaution in oxy-acetylene welding

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

6.3 Oxyacetylene welding equipment and accessories

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

6.5 Oxy-acetylene flame: types, properties and use

6.6 Welding joints, welding position and types of welds
- Welding joints, their types and application
- Welding positions, their types and application
- Types of weld and their applications

6.7 Brazing
- Brazing principle, application and advantages
- Difference between welding and brazing
- Brazing equipment and materials
- Brazing procedures

6.8 Distortion in welding: types and their control

6.9 Testing of welding joints: types and process

Unit 7: Advanced Welding Techniques **[4 Hrs]**

7.1 Plasma Arc Welding: Introduction, Working Principle and Applications

7.2 TIG and MIG: Introduction, Working Principle and Applications

7.3 Laser Beam Welding: Introduction, Working Principle and Applications

7.4 Projection Welding: Introduction, Working Principle and Applications

Unit 8: Gas Cutting **[5 Hrs]**

8.1 Gas cutting principle

8.2 Major influencing factors of gas cutting
- Composition of steel
- Temperature of work-piece
- Thickness of work- piece
- Surface defects
- Purity of oxygen
- Temperature of oxygen

8.3 Cutting methods
- Oxygen cutting (manual and machine)
- Oxygen de-seaming
- Oxygen gauging and lancing

8.4 Selecting of tip and working pressure in manual gas cutting

8.5 Cleaning of the cutting tips

8.6 Examples of correct and incorrect techniques in manual gas cutting

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

Practical 1. Identification of Material [2 Hrs]

Practical 2. Destructive test: Hardness test, Impact test, tensile test, fatigue test and creep test [8 Hrs]

Practical 3. Non Destructive Test: Ultrasonic test, Radiography Test and Magnetic Particle test [4 Hrs]

Practical 4. Plumbing Practice: Practice on Pipe Bending, Thread Cutting, Flaring, Swaging, etc. [8 Hrs]

Practical 5. Sheet Metal Practice: [16 Hrs]

1. Sheet metal working: Hands pipe bend plot, blow horn, groove and seaming
2. Sheet Developing: Patterns, templates, for the sheet boxes, book stand, scoop funnel, pipe and the machine guards

Practical 6. Welding **[54 Hrs]**

Arc welding exercise: **[30 Hrs]**

1. Safety precaution and familiarization with welding machine and accessories [2Hrs]
2. Striking an arc welding on plate [1 Hr]
3. Padding on flat surface [3 Hrs]
4. Closed and Square butt joint [3 Hrs]
5. Corner joint [3 Hrs]
6. Tee joint [3 Hrs]
7. Lap joint [3 Hrs]
8. V-butt joint [3 Hrs]
9. Vertical & Over Head Welding [6 Hrs]
10. Arc cutting on mild steel plate [3 Hrs]

Gas Welding Exercise: **[24 Hrs]**

1. Lining without filler rod [3 Hrs]
2. Lining with filler rod [3 Hrs]
3. Butt joint [3 Hrs]
4. Corner joint [3 Hrs]
5. Lap joint [3 Hrs]
6. Tee joint [3 Hrs]
7. Straight gas cutting [3 Hrs]
8. Circular gas cutting [3 Hrs]

Brazing Exercise: **[9 Hrs]**

1. Closed square butt joint brazing [3 Hrs]
2. Lap joint brazing [2 Hrs]
3. Tee joint brazing [2 Hrs]
4. Circular Brazing [2 Hrs]

Advanced Welding Exercise: **[12 Hrs]**

1. Basic Welding practice on TIG and MIG [6 Hrs]
2. Demonstration on Plasma Arc Welding and Laser beam welding [2 Hrs]
3. Simple joint from Projection Welding technique [4 Hrs]

References:

1. B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. II", Dhanpat Rai and Co. (P) Ltd, Delhi, India.
2. S. K. Hajra Choudhury, S.K. Bose and A. K. Hajra Choudhury, "Elements of Workshop Technology Vol. I", Media Promoters and Publishers Pvt Ltd, Bombay, India.
3. R. S. Khurmi and J. K. Gupta, "A text book of Workshop Technology", S. Chand and Company Ltd, New Delhi, India
4. B. S. Nagendra Parashar and R. K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India Pvt Ltd, New Delhi, India
5. Sunil Risal, Khem Gyanwali, "Material Science", Sigma Carts printing, Nepal

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	Engineering Materials	10	12
2	Ferrous and Non-Ferrous Metal	4	6
3	Metal Forming Process	6	8
4	Plumbing Works	3	6
5	Welding	10	12
6	Gas Welding	18	20
7	Advanced Welding Techniques	5	8
8	Gas Cutting	4	8
	Total	**60**	**80**

Note: There might be minor deviation on above specified marks

Electronic Fundamentals
EG 2105 MX

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

Course Description:

This course has designed to provide basic understanding of semiconductor devices and analog integrated circuits.

Course Objectives:

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

1 Understand the fundamentals of electronics components.
2 Understand the applications of electronics devices in industry.
3 Understand the working principle of DC power supply.

Course Contents:

Unit 1: Introduction [6 Hrs]

1.1. Definition of electronics, Branch of electronics, Importance of electronics in modern society
1.2. Basic electronics components and their application in the field of mechatronics engineering
1.3. Basic concept of semiconductors, atomic structure, intrinsic and extrinsic semiconductor, N type and P type semi-conductors
1.4. Energy band in conductors, semiconductors and insulators
1.5. Resistor: Types, characteristics and colour code, Combination of resistors, application of resistors
1.6. Capacitor: Types, characteristics and colour code, Combination of capacitors, application of capacitors
1.7. Inductor: Types, characteristics and colour code, Combination of inductor and application of inductor.
1.8. RC and LC Filter, their types and applications

Unit 2: Semiconductor Diode [13 Hrs]

2.1 Introduction to PN junction diode: Basic structure, forward and reverse biasing, working principle and VI characteristics
2.2 Types of diode and its applications: Zener diode, Photo diode, Light emitting Diode, Varactor diode
2.3 Zener diode: Basic construction, operational principle, V-I characteristics, Zener diode as a voltage regulator
2.4 Application of diode: Rectifier and types of rectifier (half wave, center tapped and bridge rectifier), DC power supply with filter

Unit 3: Bipolar Junction Transistors **[13 Hrs]**

3.1 Bipolar Junction Transistor: Physical structure and modes of operation, Types of BJT
3.2 Transistor configuration (CE, CB, CC): graphical representation of transistor characteristics, current gain and their relation; Comparison between three configurations
3.3 Graphical load line analysis and Q-point
3.4 Biasing method and stabilization of operating point
3.5 Transistor as an amplifier and switch
3.6 Multi stage transistor amplifier: concept and applications

Unit 4: Field Effect Transistor **[10 Hrs]**

4.1 Introduction to FET: Classification of FET (JFET and MOSFET)
4.2 MOSFET: construction, working and characteristics of n-channel D-MOSFET and E-MOSFET
4.3 Comparison between BJT and FET
4.4 MOSFET biasing
4.5 MOSFET applications

Unit 5: Output Stages and Power Amplifiers **[8 Hrs]**

5.1 Classification of Output Stages
5.2 Class A output stages
5.3 Class B output stages
5.4 Class AB Output Stages
5.5 Class C output stages
5.6 Tuned amplifiers
5.7 Heat Sink

Unit 6: Power Supplies and Voltage Regulators **[10 Hrs]**

6.1 Power Supplies: Unregulated Power Supply and Regulated Power Supply
6.2 Linear Voltage Regulator: Zener Voltage Regulator; Transistor series regulator
6.3 Protection of power supplies against overload and short circuit: basic circuit, working principle
6.4 Integrated circuit voltage regulator: Fixed (eg. IC 78XX and 79XXseries) and variable (eg. LM 317)
6.5 Introduction to Switched Mode Power Supply (SMPS) and UPS

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

1. Color coding of Resistor (4,5 and 6 Band), capacitor, inductor and their measurement using multi-meter [3 Hrs]
2. V-I characteristics of P-N junction diode and Zener diode [3 Hrs]
3. Half Wave and Full Wave Bridge Rectifier with/without capacitor filter [3 Hrs]
4. Input –output characteristics of Common Emitter BJT configuration [3 Hrs]
5. Calculation of practical voltage gain of single stage BJT CE amplifier [3 Hrs]
6. Transistor as a Switch [3 Hrs]

7. V-I characteristics of MOSFET [3 Hrs]
8. Efficiency calculation of class B complementary symmetry push pull configuration [3 Hrs]
9. IC voltage regulator practical (eg. 78XX series and LM317) [3 Hrs]
10. Fault finding and troubleshooting of diode and transistor related circuits. [3 Hrs]
11. Simple project work on DC regulated power supply [15 Hrs]

References:

1. Robert Boylested and Louis Nashelsky, "Electronics Devices and Circuit Theory", PHI
2. Thomas L. Floyd, "Electronics Devices", Pearson Education Inc.
3. Theodore F Bogart, Jeffrey S. Beasley and Guillermo Rico, "Electronics Devices and Circuits", Pearson Education India
4. J.B. Gupta, "An Integrated Course in Electronics Engineering", S.K Kataria & Sons
5. Bernard Grob, "Basic Electronics", New York: McGraw Hill

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	8
2	Semiconductor Diode	13	18
3	Bipolar Junction Transistors	13	18
4	Field Effect Transistor	10	12
5	Output Stages and Power Amplifiers	8	12
6	Power Supplies and Voltage Regulators	10	12
	Total	**60**	**80**

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

Mechanical and Electronics Measurement
EG 2106 MX

Total: 6 Hrs/week
Year: II **Lecture: 4 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course deals with the measurements of different measurable quantities both in mechanical and electronics engineering. It is mainly concerned with establishing units of measurements, developing methods of measurements, analyzing errors, accuracy of measurements, and principle of measurements.

Course Objectives:

After the completion of this course, the student will be able to:
1. Describe the principles of different types of mechanical and electronics measuring instruments
2. Understand the uses of various kinds of mechanical and electronics measuring instruments
3. Understand the use of oscilloscope, function generator, counter, etc.
4. Identify types of electrical and electronic measurements & explain their working principle

Course Contents: **(Theory)**

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 of errors)

Unit 2: Mechanical Measurement **[16 Hrs]**

2.1 Mechanical measurement and its type: linear, angular and surface measurement
2.2 Standard in Mechanical Measurement: Line and End Standard
2.3 Construction, working principle, type of Vernier caliper and Micrometer.
2.4 Linear measuring instrument basic concept: steel rule, calipers, divider, telescopic gauge, depth gauge, screw pitch gauge, radius and feeler gauge, slip gauges or gauge blocks, comparator, dial indicator.
2.5 Angular Measuring Instrument (basic concept): engineering square, combination set, protractor, adjustable bevel, spirit level
2.6 Surface Measuring Instrument (basic concept): Surface plate, surface gauge, Straight Edge.

Unit 3: Limit, Fit and Tolerance **[8 Hrs]**

3.1 Introduction

3.2 Terms: Tolerance, Allowance, Fit, Basic Size, Actual Size, Nominal Size

3.3 Classification of fits

3.4 Hole basis and Shaft Basis System

3.5 Interchangeability and Selective Assembly

3.6 ISO system of Limits, Fits and Tolerances

3.7 Simple problem of ISO system of Limits, fits and tolerance.

Unit 4: Introduction to Electrical Measurements **[16 Hrs]**

4.1 Electrical instruments: Types, Schematic symbols, Basic characteristics, Application

4.2 Introduction to Galvanometers,

- 4.2.1 Galvanometer damping mechanism
- 4.2.2 Galvanometer constant
- 4.2.3 Galvanometer selection
- 4.2.4 Galvanometer shunts

4.3 Introduction to Ammeters & Voltmeters

- 4.3.1 Types of instruments
- 4.3.2 Moving iron instruments
- 4.3.3 Moving coil instruments
- 4.3.4 Permanent Magnet moving coil (PMMC Instruments)
- 4.3.5 Dynamometer type instruments
- 4.3.6 Thermal instruments
- 4.3.7 Hot wire instruments

4.4 Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter

Unit 5: Measurements of Resistance and Power **[8 Hrs]**

5.1 Measurement of low, medium and high resistance: Ohm Meters, Wheatstone bridge, AVO meter, Megger

5.2 Measurement of power using voltmeter & ammeter

5.3 Wattmeter type

- 5.3.1 Energy meter (kWh meter), Operation &application
- 5.3.2 Dynamo type meter, Operation &application

5.4 Instrument Transformer

- 5.4.1 Introduction to potential transformer, operation and application
- 5.4.2 Introduction to current transformer, operation and application

Unit 6: Oscilloscopes and Signal Generators **[6 Hrs]**

6.1 Cathode Ray Oscilloscope (CRO), Specification of an Oscilloscope, Oscilloscope measurement Techniques, Digital storage Oscilloscope (DSO), Sampling Oscilloscope.

6.2 Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Pulse and square wave generators.

6.3 Function Generators.

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

1. Perform measurement test (linear, angular, and surface measurements) [4 Hrs]
2. Measure gap using slip gauges. [2 Hrs]
3. Measure angle of small and large components using sine bar and slip gauge [2 Hrs]
4. Perform alignment test with Lathe 84, Milling machine, and Drilling machine [4 Hrs]
5. Measure different electric parameters using multimeter (resistance, voltage, current, continuity, PN junction diode) [2 Hrs]
6. Measurement of resistance using Wheatstone Bridge [2 Hrs]
7. Measurement of high resistance and insulation resistance using Megger [2 Hrs]
8. Accuracy test of analog meter [2 Hrs]
9. Measure different waveform/signal parameters using oscilloscope; [6 Hrs]
   - Testing of probe, calibration of oscilloscope
   - Measure the dc-voltage of a source;
   - Measure the peak-to-peak voltage, time period and frequency of a sinusoidal waveform;
   - Measure the phase difference between two sinusoidal waveforms
10. Use of Function generator for generating different waveforms of different amplitude and frequencies. [4 Hrs]

Reference/Text Books:

1. R. K. Jain, "Engineering Metrology", Khanna Publishers.
2. J. F. W. Gayler and C. R. Shotbolt, "Metrology for Engineers", Cassell, London. SI Edition.
3. Manohar Mahajan, "A Text book of Metrology", DhanapatRai& Co. (P) Ltd., Delhi,
4. R. K. Rajput, "Engineering Metrology and Instrumentation", S. K. Kataria and Sons, Delhi.
5. Publications from Nepal Bureau of Standards and Metrology (NBSM).
6. Albert D.Helstrick and William D.Cooper, "Modern Electronics Instrumentation & Measurement Techniques", Pearson Education.
7. J.B. Gupta "A Course in Electronics & Electrical Measurement & Instrument"
8. A. K. Sawhney "A Course in Electrical & Electronics measurement & instrumentation", Dhanpat Rai & Co. (Pvt.) Ltd
9. Joshph J. Carr, "Elements of Electronics Instrumentation and Measurement", Pearson Education.

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Introduction to Metrology	6	8
2	Mechanical Measurement	16	20
3	Limit, Fit and Tolerance	8	12
4	Introduction to Electrical Measurements	16	20
5	Measurements of Resistance and Power	8	12
6	Oscilloscopes and Signal Generators	6	8
	Total	**60**	**80**

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

Fourth Semester
Year II Part II

Subjects:

1. EG 2205 ME Strength of Material
2. EG 2201 MX Manufacturing Technology
3. EG 2202 MX Digital Electronics
4. EG 2203 MX Fluid and Thermal Engineering
5. EG 2204 MX Circuit Analysis and Prototyping
6. EG 2205 MX Fundamentals of Hydraulics and Pneumatics
7. EG 2206 MX Electrical Workshop
8. EG 2207 MX Electric Machine and Drives

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

Manufacturing Technology

EG 2201 MX

Total: 8 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: 5 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's 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 [5 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 [4 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 [10 Hrs]

4.1 Introduction and Classification of lathe machine
4.2 Working Principle and construction of Engine lathes
4.3 Lathe Operations: Turning, Facing, Taper turning, Threading, Drilling, Boring, Reaming and Knurling
4.4 Cutting variables: Cutting Speed, Feed and Depth of Cut
4.5 Machining Time

Unit 5: Milling Machines [10 Hrs]

5.1 Introduction and Working Principle
5.2 Classification of Milling Machines
5.3 Principal Parts of Universal Milling Machine
5.4 Milling Cutters: types, nomenclature and uses
5.5 Milling Operations: Plain, Face, Angular, Form, Gang and Keyway Milling
5.6 Milling Methods: Peripheral, Up, Down, Face and End Milling
5.7 Indexing Methods: Direct, Plain, Compound and Differential Indexing
5.8 Cutting Speed, Feed and Depth of Cut
5.9 Machining Time

Unit 6: Drilling Machines [6 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 Cutting speed and Machining Time

Unit 7: Shaping Machines [6 Hrs]

7.1 Introduction and Working Principle
7.2 Classification of Shaping Machines
7.3 Shaper Mechanism – Quick Return Mechanism
7.4 Shaper Tools
7.5 Work holding devices and tool holding devices
7.6 Shaper Operations – Horizontal, Vertical and Angular cutting
7.7 Cutting Speed, Feed and Depth of Cut
7.8 Machining Time

Unit 8: Grinding Machines [6 Hrs]

8.1 Introduction and Working Principle
8.2 Grain, Grade and Structure
8.3 Specification of Grinding Wheels
8.4 Grinding Operations: Cylindrical, Internal, Surface, Face, Form, Center less Grinding and Sharpening of Cutting Tools
8.5 Cutting Speed, Feed and Depth of Cut
8.6 Machining Time

Unit 9: Capstan and Turret Lathe [3 Hrs]

9.1 Introduction
9.2 Working Principle and Operation

Practical/Laboratory: ***[75 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. [2 Hrs]
2. Grinding of single point (H.S.S.) tools. [2 Hrs]
3. Preparation of soluble oil cutting fluid and its use for improving the surface [2 Hrs]
4. Practice of various operations on Lathe (Facing, turning, step turning, knurling) [12 Hrs]
5. Practice of taper turning and Thread cutting on a center lathe [8 Hrs]
6. Practice of drilling, boring and reaming on a lathe. [8 Hrs]
7. Practice of mounting cutters on the milling m/c and setting of m/c up milling and down milling operation. [22 Hrs]
8. Practice on shaper machine. [8 Hrs]
9. Practice on grinding machine. [4 Hrs]
10. Practice on Drilling machine. [4 Hrs]
11. Practice on Capstan and Turret Lathe [3 Hrs]

References:

1. R. S. Khurmi and J. K. Gupta, "A text book of Workshop Technology", S. Chand and Company Ltd, New Delhi. India
2. B. Kumar and S. Kumar, "Manufacturing Processes and Technology", Khanna Publishers, New Delhi, India.
3. 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.
4. 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.
5. H. S. Bawa, "Workshop Technology, Vol. I", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
6. H. S. Bawa, "Workshop Technology, Vol. II", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
7. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. Ltd.
8. Mikell P. Groover, "Fundamentals of Modern Manufacturing, materials, processes and systems", John Wiley and Sons, Inc , Singapore.

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	General Safety Considerations on Machining Workshop	1	4
2	Metal Cutting	5	10
3	Cutting Fluids	4	8
4	Lathe Machine	10	16
5	Milling Machines	10	16
6	Drilling Machines	6	10
7	Shaping Machines	6	10
8	Grinding Machines	3	6
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Digital Electronics
EG 2202 MX

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

Course Description:

This course presents an introduction to Digital logic techniques and its practical application in computer and digital system for the students of diploma level.

Course Objective:

After completing this course, the students will be able to:
1. Explain conversion of different number systems and codes
2. Explain logic functions and gates
3. Perform combinational logic design
4. Perform sequential logic design
5. Perform Industrial application of logic system.

Course contents:

1. Introduction **[3 Hrs]**
- 1.1. Analog versus Digital Signals
- 1.2. Logic Level Diagram
- 1.3. Digital Integrated Circuits (ICs)
- 1.4. Clock Triggering Systems
- 1.5. Digital Logic Applications

2. Digital Codes **[6 Hrs]**
- 2.1 Decimal, Binary, Octal and Hexadecimal Codes and their conversion
- 2.1. BCD Code and its applications
- 2.2. Excess-3 Code and its applications
- 2.3. Gray Code and its applications
- 2.4. ASCII and EBCDIC Codes and its applications

3. Arithmetic Logic Operations **[6 Hrs]**
- 3.1 Binary Arithmetic Operators
- 3.2 Binary Addition
- 3.3 Binary Subtraction
- 3.4 9's and 10's Complement Method
- 3.5 9's Complement Subtraction
- 3.6 10's Complement Subtraction
- 3.7 1's Complement and 2's Complement Method
- 3.8 1's Complement Subtraction
- 3.9 2's Complement Subtraction

4. Logic Gates **[7 Hrs]**

4.1 Basic Gates and Equivalents
4.2 Universal Gates and Equivalents
4.3 Exclusive Gates and Equivalents
4.4 Positive and Negative Logic
4.5 De' Morgan's Theorems and its verification
4.6 Applications of Universal Gates

5. Logic Simplifications **[7 Hrs]**

5.1 Boolean Algebra and its Laws
5.2 Simplifications of Boolean Expressions
5.3 Truth Tables and Karnaugh's Map
5.4 Cell, Pairs, Quads and Octets
5.5 Rolling, Envelop Effects and Redundant Groups
5.6 Don't Care Conditions
5.7 Sum-of- Product and Product-of-Sum Methods

6. Combinational Logic Circuits **[8 Hrs]**

6.1 Design Procedures
6.2 Adders: Half-Adder and Full-Adder
6.3 Subtractors: Half-Subtractor and Full-Subtractor
6.4 Multiplexers and De-multiplexers
6.5 Encoders and Decoders
6.6 BCD-to-Decimal Decoders
6.7 Seven-Segment Decoders

7. Sequential Logic Circuits **[7 Hrs]**

7.1 Latches and Flip-Flops
7.2 Excitation Tables
7.3 Characteristic Equations
7.4 Flip-flop Timing Diagrams
7.5 Flip-Flops as State Machines
7.6 Flip-Flop Classifications based on Triggering Systems

8. Registers and Counters **[8 Hrs]**

8.1 Register and its types
8.2 SISO, SIPO, PISO and PIPO Registers
8.3 Data Transfer Timing Diagrams
8.4 Asynchronous Counters
8.5 Asynchronous Up, Down, Up/Down and Mod-Counters
8.6 Decade/BCD Counters
8.7 Synchronous Counters
8.8 Synchronous Up, Down, Up/Down and Mod-Counters

9. Logic Families **[4 Hrs]**

9.1 Logic specifications
9.2 Logic level diagram
9.3 Introduction to logic circuit equivalent to switching circuit
9.4 Introduction to logic families (RTL, DTL, TTL, CMOSL)

10 **Memory Devices** **[4 Hrs]**

10.3 Volatile and Non-Volatile Memories
10.4 Read Only Memory (ROM)
10.5 ROM Family
10.6 Random Access Memory (RAM)
10.7 RAM Family

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

Lab 1: Verify the truth table of different gates [2 Hrs]
Lab 2: Verify De' Morgan's Law, familiarization with NAND and NOR gates and realization of universal gates [2 Hrs]
Lab 3: Verify half-adder/ half subtractor and full-adder/full-subtractor [2 Hrs]
Lab 4: Verify encoders and decoders [2 Hrs]
Lab 5: Verify multiplexers and demultiplexers [2 Hrs]
Lab 6: Verify latches, RS, master-slave and T flip-flops [2 Hrs]
Lab 7: Verify D and JK type flip-flops [2 Hrs]
Lab 8: Verify various types of shift register circuits [2 Hrs]
Lab 9: Verify ripple counter and synchronous counters [4 Hrs]
Lab 10: Simple project work using logic circuits [10 Hrs]

References:

1. T. Floyd, "Digital Fundamentals", John Willy & Sons Pvt. Ltd.
2. M. M. Mano, "Digital Design", McGraw-Hill Publication, Delhi.
3. Donald P. Leach, Albert P. Malvino and Goutam Saha, "Digital Principles and Applications," Tata McGraw-Hill.
4. William H. Gothmann, "Digital Electronics- An Introduction to Theory and Practice", PHI.

Marks Specification for Final Examination:

Units	Content	Course Hours	Marks
1	Introduction	3	4
2	Digital Codes	6	8
3	Arithmetic Logic Operations	6	8
4	Logic Gates	7	10
5	Logic Simplifications	7	10
6	Combinational Logic Circuits	8	12
7	Sequential Logic Circuits	7	8
8	Registers and Counters	8	12
9	Logic Families	4	4
10	Memory Devices	4	4
	Total	**60**	**80**

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

Fluid and Thermal Engineering

EG 2203 MX

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 two different streams of engineering as fluid and thermodynamics respectively. The first five unit deals with the general theories and equations of fluid mechanics with application. It also describes losses in pipe and flow measuring devices. From unit six, it deals with fundamental laws of thermodynamics, basic thermodynamics processes and introduction to heat transfer phenomenon. It also covers laboratory works and tutorial section for different topics.

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 conditions
3. Basic theories and equations of fluid mechanics with their applications
4. Basic calculation on pipe losses and fluid flow measurement
5. Laws of thermodynamics
6. Basic thermodynamics processes
7. Heat transfer phenomenon

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

Unit 2: Fluid Static **[6 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 Introduction to Buoyancy, flotation and stability

Unit 3: Basics of Fluid Flow in Pipes [10 Hrs]

3.1 General types of fluid flow
3.2 Continuity equation: Statement and application
3.3 Bernoulli's equation: Statement and application
3.4 Momentum equation: Statement and application
3.5 Losses on pipe flow:
  3.5.1 Major loss: Darcey-Weisbach Equation and Moody diagram
  3.5.2 Minor losses: contraction, expansion, bend, obstruction

Unit 4: Flow Measurement [4 Hrs]

4.1 Coefficients: velocity, contraction, discharge
4.2 Flow measuring devices: orifice, venturi-meter, notches (construction and working principle)

Unit 5: Basic Concept of Thermodynamics [6 Hrs]

5.1 Definition and importance of thermodynamics
5.2 Thermodynamic system (closed, open and isolated system)
5.3 Properties of system (intensive and extensive properties)
5.4 Thermal equilibrium
5.5 Thermodynamic state
5.6 Thermodynamic process, cycle: Constant volume, pressure, temperature, adiabatic, polytropic
5.7 Forms of energy
5.8 Sensible heat and latent heat

Unit 6: Laws of Thermodynamics [10 Hrs]

6.1 Zeroth law: Definition and applications
6.2 Different types of thermometer and their applications.
6.3 First law of thermodynamics:
  6.3.1 Statement of first law, mathematical representation
  6.3.2 Application of first law; closed system only
  6.3.3 General energy equation, internal energy, enthalpy, relationship between heat transfer and change in internal energy
6.4 Second law of thermodynamics:
  6.4.1 Limitation of first law
  6.4.2 Statements of second law: Kelvin Planck and Clausius statement
  6.4.3 Concept of Carnot cycle, heat engine, heat pump and refrigerator; thermal efficiency and COP
  6.4.4 Reversible and irreversible processes, entropy, T-S diagram

Unit 7: Heat Transfer [6 Hrs]

7.1 Modes of heat transfer (conduction, convection and radiation)
7.2 Fourier's law of heat conduction (Temperature gradient, Thermal conductivity)
7.3 Newton's law of heat transfers by convection, free and forced convection

7.4 Heat transfer by radiation, Stefan- Boltzmann law of thermal radiation
7.5 Cooling system of different electronic devices: nature cooling, fins, fans and cooling using liquid

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

Assist students for conceptual & critical problem solving

1. Properties of fluid: Density, specific volume, specific weight, specific gravity, surface tension [2 Hrs]
2. Fluid Static: pressure measurement, simple manometers [2 Hrs]
3. Basics of fluid flow in pipes: Continuity and Bernoulli's equation for pipe flow cases, major loss [3 Hrs]
4. Flow measurement [2 Hrs]
5. Problems related to properties and process of system [4 Hrs]
6. Problems related to energy conservation equation for closed system [2 Hrs]

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

1) Study of properties of fluid on hydrostatic bench [1 hr]
2) Use of manometers and pressure gauge for Pressure measurement [2 Hrs]
3) Validity of Bernoulli's theorem [2 Hrs]
4) Losses on pipe and fittings [3 Hrs]
5) Coefficient of discharge of rectangular notch [3 Hrs]
6) Compare different types of thermometers. [2 Hrs]
7) Determine thermal conductivity of given specimen. [2 Hrs]

References:

1. R. K. Rajput, "Fluid Mechanics and Hydraulics Machines", S Chand and Company Ltd., New Delhi, India
2. Jagdish Lal, "Fluid Mechanics and Hydraulics", Metropolitan Book Co. Private Ltd., New Delhi, India
3. Jagdish Lal, "Hydraulic Machines", Metropolitan Book Co. Private Ltd., New Delhi, India.
4. F.M. White, "Fluid Mechanics", McGraw-Hill Book Company, Singapore
5. M. C. Luintel, "Fundamentals of Thermodynamics and Heat Transfer", Heritage Publishers & Distributors Pvt. Ltd., Nepal
6. R.S. Khurmi and J.K. Jupta, "A text book of Thermal Engineering", S. Chand Publishing, India
7. R.K. Rajput, "Thermal engineering", Laxmi Publications, New Delhi.

Marks Specification for final evaluation:

Unit	Content	Course Hours	Marks
1	Properties of Fluid	5	8
2	Fluid Static	8	12
3	Basics of Fluid Flow in Pipes	13	16
4	Flow Measurement	6	8
5	Basic Concept of Thermodynamics	10	12
6	Laws of Thermodynamics	12	16
7	Heat Transfer	6	8
	Total	**60**	**80**

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

Circuit Analysis and Prototyping
EG 2204 MX

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

Course Description:

The subject is oriented to a PBL (Project Based Learning) methodology. Subsequently develops the theoretical material necessary for the justification of the electronic designs to be made during the course. It is a methodology of collaboration in small groups with which students implement, supervised by the teacher, the work project (or projects) in progress.

In this course, students are assigned to do a project work including the components like resistors, capacitors, diodes, transistors, ICs (analog or digital), relays etc. During the project work, the students shall follow the design steps given in following units:

Course Objectives:

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

1. Design circuit boards using simulation tools
2. Design and prepare printed circuit boards for a given project task
3. Develop skills required to successfully implement the design projects

Course contents:

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

Unit 1: Introduction to Electronic Prototyping **[4 Hrs]**

1.1. Introduction to the design of printed circuit boards (PCB)
1.2. Introduction to simulation tools and software

Unit 2: Simulation for electronic prototyping **[6 Hrs]**

2.1. Selection of simulation tools and design of electronic circuits
2.2. Use simulation tools to find out the functionality and optimization of the chosen circuit and its component.

Unit 3: Mounting on Proto board/bread board and/or perforated plates **[7 Hrs]**

3.1. Design and optimization of the circuit by using proto boards or perforated plates.
3.2. Testing and troubleshooting of the mounted circuit

Unit 4: Design and Printing of PCB plates **[10 Hrs]**

4.1. PCB design methods and guidelines
4.2. PCB printing methods and uses: etching, laminating, layering, drilling etc.
4.3. Design of the printed circuit board using the methods.
4.4. Presentation of the boards and troubleshooting

Unit 5: PCBs Construction **[18 Hrs]**

5.1. Components mounting and soldering.

5.2. Verification and testing errors

5.3. Final inspection and functional test

5.4. Placement in an enclosure

5.5. Study of the critical points of design and its possible improvement

References:

- Simon Monk, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards", McGraw Hill.
- Peter Wilson, "The Circuit Designer's Companion", Newnes.
- R.S. Khandpur, "Printed Circuit Boards: Design, Fabrication, Assembly and Testing", Tata McGraw Hill.

Marks Specification for Internal Evaluation:

Examination	Content	Marks
Internal	Attendance	10
	Job performance	20
	Report	10
	Practical Exam	10
Total		**50**

Fundamentals of Hydraulics and Pneumatics

EG 2205 MX

Total: 5 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **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. Standard symbols and its' use in basic hydraulic and pneumatic circuit is explained to have control of the 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. Identify the basic symbols and circuit of hydraulic and pneumatic system
4. 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 [8 Hrs]

4.1. Standard Symbols in Hydraulic and pneumatic systems

4.2. Hydraulic circuits: Velocity control, Meter-in, Meter-out and bypass control

4.3. Pneumatic circuits: impulse operation, speed control, sequencing of motion

4.4. Basic requirement for pipeline and layout

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

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

Electrical Workshop
EG 2206 MX

Total: 4 Hrs/week

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

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

Practical: Hrs/week

Lab: 4 Hrs/week

Course Description:

This course deals with the selection and uses of basic electrical tools and their safety measures along with electrical measuring equipment. This course is focus on the wiring and control of 1-phase and 3-phasae electrical machines used in household and industrial applications

Course Objectives:

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

1. Understand electrical hazards and safety.
2. Identify, use and care of electrical tools required for wiring Installation.
3. Identify different types and size of wires and cable
4. Perform different types of cable joints and termination.
5. Identify various wiring accessories and install them with PVC duct.

Course contents:

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

Unit 1: Electrical Safety [4 Hrs]

L: Electrical hazards, safety rules and practice, conditions and cause of electric shocks removal of casualties and artificial respiration.

P: Type and size of wire, forming stripping and termination of various wires and cable with eyelet, cable shoe, soldering and crimping

Unit 2: Electrical Protection Devices [4 Hrs]

L: Introduction and identification of wiring accessories switches, sockets, plugs, fuse, MCB, MCCB, RCD and RCCB, ELCB holders, ceiling rose, J.B etc. Introduction of mutual, gang call system.

P: Installation of 220 V bell with push button switch. Draw symbol – lay out diagram – connection diagram. Installation of six-gang indicator call bell system– understand connection diagram.

Unit 3: Switches and Relay [4 Hrs]

L: Introduction to relay, contactor and different types of switches

P: Demonstration of different types of relay, contactor and switches.

Unit 4: Electric Lamp Installation [4 Hrs]

L: Method of lamp controlled from multi places

P: Installation of a lamp controlled by two numbers of alternate switches (two way switches) from two separate places. Using live line is one of the common terminals of one switch.

Unit 5: Ring Circuit **[4 Hrs]**

L: Introduction of ring circuit.

P: Installation of four numbers of 15 Amp power switch socket in ring circuit with 16 Amp SP MCB

Unit 6: Dimmer Switch **[4 Hrs]**

L: Introduction of dimmer switch

P: Install fan, LED lamp with dimmer switch

Unit 7: 1-phase Motor Control **[4 Hrs]**

L: Introduction to power and control diagram in 1-phase system

P: 1-phase motor control using push button switch from two station

Unit 8: 3-phase Motor Control using Switches **[4 Hrs]**

L: Introduction to power and control diagram in 3-phase system, contactor/relay, Over Load Protection/Overload Relay (OLR)

P: 3-phase motor control using push button switch from two station

Unit 9: 3-phase Motor Direction Control **[4 Hrs]**

L: Basic concept of contactor interlocking, draw power and control diagram to operate 3-phase motor in forward and reverse direction

P: 3-phase motor direction control using push button switch

Unit 10: Star-Delta Connection **[4 Hrs]**

L: Concept of star/delta connection in 3-phase system, draw power and control diagram

P: Connection of 3-phase motor in star, delta connection.

Unit 11: Star-Delta Conversion using Push Button Switches **[4 Hrs]**

L: Concept of star/delta connection in 3-phase system, draw power and control diagram

P: Star to delta conversion of 3-phase motor using push button and gang switch

Unit 12: Star-Delta Conversion using Timer Circuit **[4 Hrs]**

L: Concept of star/delta connection in 3-phase system, draw power and control diagram

P: Star to delta conversion of 3-phase motor using timer circuit

Unit 13: Variable Frequency Drive (VFD) **[4 Hrs]**

L: Introduction of Variable Frequency Drive (VFD) system

P: 3-phase motor control using VFD

Unit 14: Grounding and Earthing **[4 Hrs]**

L: Introduction to grounding and earthing system (system ground, equipment ground)

P: Connection of 3-phase motor with proper grounding and earthing.

Unit 15: Energy Meter **[4 Hrs]**

L: Introduction of Energy Meter, working principle, application

P: Installation of Energy meter along with four numbers of lights and two power socket

References:

1. J. Folay, "Electrical wiring Fundamentals", McGraw-Hill Inc., US
2. F.G. Thompson and H. E. MacDonnell, "Electrical installation and workshop technology", Harlow: Longman Scientific & Technical.
3. Conductor Technical manual – Cable manufacturer

Marks Specification for final examination:

Examination	**Content**	**Marks**
Internal (60 marks)	Attendance	10
	Job performance	30
	Report and viva	20
Final (40 marks)	Practical exam	30
	Report and viva	10
Total		**100**

Electric Machine and Drives

EG 2207 MX

Total: 4 Hrs/week
Year: II **Lecture: 3 Hrs/week**
Part: II **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:

This course provides a basic framework for understanding the fundamental concept of single and three phase electric machines and drive systems.

Course Objectives:

After completing this course, the students will be able to:
1. Understand the principle and applications of transformers.
2. Understand the DC and AC electrical machines.
3. Understand the principle and applications of actuators and drives used in electrical applications.
4. Understand the selection and sizing of electrical motors

Course contents:

Unit 1: Transformer [6 Hrs]

1.1 Operating Principle, Basic construction, emf. equation and transformation ratio
1.2 Concept of ideal transformer
1.3 Basic concept on transformer operation with load and no-load
1.4 Capacity of transformer: Definition, basic factors affecting the capacity of transformer.
1.5 Basic concept of transformer efficiencies and losses
1.6 Introduction to auto-transformer, current transformer and potential transformer with their applications
1.7 Basic construction and operation of 3-phase transformer

Unit 2: DC Generator [6 Hrs]

2.1 Constructional: Yoke, Field poles, Field winding, Armature and its winding
2.2 Principle of operation and emf equation
2.3 Types of dc generator: Separately excited and self-excited, Shunt, series and compound generators, their circuit diagrams, relation between emf generated and load terminal voltage, and applications

Unit 3: DC Motor [6 Hrs]

3.1 DC Motor: operating principle, torque equation, back emf, roles of back emf
3.2 Types of dc motor: Shunt, series and compound, their characteristics and applications.
3.3 Losses and efficiency
3.4 Concept and needs of DC motor starter

Unit 4: AC Machines **[13 Hrs]**

4.1 Construction of AC machine

4.2 Synchronous Machine:

4.2.1 Synchronous Generator: Construction and operating principle, application and advantages and dis advantages.

4.2.2 Synchronous Motor: Synchronous speed, construction and operating principle, application and advantages and disadvantages.

4.3 Induction motor: Introduction and construction, operating principle, application, advantages and dis-advantages.

Unit 5: Electric Actuator **[8 Hrs]**

5.1 Needs of motor driver circuits, block diagram and major components

5.2 Types of motor driver circuit: transistor based, H-bridges, using ICs (L293D, ULN2003), using relays.

5.3 Speed, direction and position control and braking of DC motor using H-bridge under PWM mode (circuital analysis)

5.4 Single and three phases AC drives

5.5 Speed control of three-phase induction motor

5.6 Chopper drives

5.7 Need for V/F drives (brief introduction)

5.8 Stepper Motor – Drive circuits for speed and position control

5.9 Servo motors, Linear motors

5.10 Introduction of Power converter

Unit 6: Selection of Motor **[6 Hrs]**

6.1 Relationship between force, torque, rpm and power of motors

6.2 Factors governing selection of electric motors.

6.3 Application of DC and AC motor for control systems

6.4 Sizing and selection of motors for industrial applications

6.5 Practical applications with examples.

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

1. Transformer operation, voltage and current measurement in primary and secondary side [1 Hr]
2. Demonstration of DC Motor/Generator [1 Hr]
3. Demonstration of single phase AC Motor/Generator [1 Hr]
4. Demonstration of 3-phase induction Motor [1 Hr]
5. Calculation of DC motor sizing for simple application and develop a motor driver circuits [4 Hrs]
6. Design and development to control Speed, Position and direction of (a)Permanent DC motor (b) Servomor [5 Hrs]
7. Circuit analysis of H-bridge driver for DC and Steeper motors [2 Hrs]

References:

1. B.L. Thareja," A Textbook Of Electrical Technology: Volume II", S Chand & Co Ltd, India
2. R.K. Rajput, " A Text Book of Electrical Machines", Firewall Media.
3. Stephen Chapman, "Electric Machinery Fundamentals", McGraw Hill Education.
4. W. Bolton, Mechatronics, " Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education.
5. Andre Veltman, Duco W.J. Pulle, R.W. De Doncker, "Fundamentals of Electrical Drives", Springer.
6. A. K. Gupta, S. K. Arora, "Industrial Automation and Robotics, University Science Press.

Mark Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Transformer	6	10
2	DC Generator	6	12
3	DC Motor	6	12
4	AC Machines	13	20
5	Electric Actuator	8	16
6	Selection of Motor	6	10
	Total	**45**	**80**

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

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

Fifth Semester
Year III Part I

Subjects:

1. EG 3101 MX Advance Manufacturing Technology.
2. EG 3102 MX Advanced Electronics
3. EG 3103 MX Machine Element and Mechanism
4. EG 3104 MX Actuators and Programmable Logic Controller
5. EG 3105 MX Industrial Management
6. EG 3106 MX Microprocessor
7. EG 3107 MX Instrumentation and Control System
8. EG 3108 MX Project I

Advanced Manufacturing Technology

EG 3101 MX

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 aims to impart the knowledge and skill of the students by introducing modern trends in production processes of integrated circuits (IC), and it deals with current aspects of additive manufacturing and CNC 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. Understand production processes of integrated circuit and its packaging
3. Produce simple metal components and articles using NC and CNC machines
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. Process of Integrated Circuit and Packaging [10 Hrs]

- 2.1 Overview of IC Processing
- 2.2 Silicon Processing: Production of Electronic grade silicon, crystal growing, shaping of silicon into wafers
- 2.3 Lithography: Optical Lithography

2.4 Layer process used in IC Fabrication: Thermal oxidation, chemical vapor deposition, metallization and etching
2.5 Integrated Fabrications Steps
2.9 IC Packaging
2.9.1 Electronics Packaging
2.9.2 Printed Circuit Boards
2.9.3 Printed Circuit Boards Assembly
2.9.4 Electrical Connector Technology

Unit 3. Numerical Control and Computer Numerical Control of Machine Tools [14 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 [10 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 and Additive Manufacturing [5 Hrs]

5.1 Introduction
5.2 Additive Manufacturing Processes

5.2.1 Liquid Based System: Stereolithography
5.2.2 Powder Based System: Selective laser Sintering, Three-Dimensional Printing
5.2.3 Molten Material System: Fused Deposition Modeling
5.2.4 Solid Sheet Based System: Laminated-Object Manufacturing
5.3 Applications

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

1. To be get acquainted with construction, principle and operation of NC and CNC machine tools [5 Hrs]
2. To perform machining operation in NC and CNC machine tool [15 Hrs]
3. To make CNC code (Milling for the following attributes: [30 Hrs]
    a) Absolute and Incremental Co-ordinates
    b) Spot and Peck Drill
    c) Circular interpolation
    d) Interpolation planes
    e) Tool change operation
4. To demonstrate parts used in basic CNC machine [10 Hrs]

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) Pte. Ltd.
3. C. Elanchezhian, T. Sunder Selwyn and G. Shanmuga, "Computer Aided Manufacturing", Sundar, Laxmi Publications (P) Ltd, New Delhi, India.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Non-Conventional Machining Processes	6	12
2	Process of Integrated Circuit and Packaging	10	16
3	Numerical Control and Computer Numerical Control of Machine Tools	14	24
4	Shaping Processes for Plastics	10	16
5	Rapid Prototype Technology and Additive Manufacturing	5	12
	Total	**45**	**80**

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

Advanced Electronics
EG 3102 MX

Total: 6 Hrs/week
Year: III **Lecture: 4 Hrs/week**
Part: I **Tutorial: Hrs/week**
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This subject is the continuation of Electronic Fundamental that is included in Diploma in Mechatronics II Year I Part with emphasize on operational amplifier, oscillators, data conversion and power electronics.

Course Objectives:

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

1. Analyze op-amp and oscillator related circuits
2. Understand different data conversion techniques
3. Understand working of power electronics and optoelectronics devices

Course content:

Unit 1: Operational Amplifier [10 Hrs]

1.1 Ideal characteristics of Op-amp
1.2 Practical Op-amp and its applications
1.3 Inverting and Non–inverting configuration of Op-Amp
1.4 Op-amp as Adder, differentiator, integrator, comparator, buffer
1.5 Instrumentation Amplifier: Single op-amp
1.6 Practical op-amp (eg 741) characteristics

Unit 2: Feedback and Oscillators [12 Hrs]

2.1 Feedback: Definition, Types and their applications
2.2 Introduction to Oscillator and applications
2.3 Basic Principle of sinusoidal oscillator, Conditions for Oscillation (Barkhausen Criterion)
2.4 Classification of Oscillator: LC Oscillator, Hartley Oscillator, Colpitts Oscillator,
2.5 RC Oscillator: RC Phase Shift and Wien Bridge Oscillator
2.6 Crystal Oscillator and applications

Unit 3: Multi-Vibrators [8 Hrs]

3.1 Introduction of Astable, Mono-stable and Bi-stable Multi-vibrator
3.2 Transistor based Actable multi-vibrator
3.3 Generation of square and triangular waveform using Astable multi-vibrator
3.4 IC 555 based Multi-vibrators

Unit 4: Analog to Digital and Digital to Analog Converter [8 Hrs]

4.1 Introduction to D/A Conversion and applications
4.2 Introduction to A/D Conversion: Sampling theorem, Sample and Hold Circuit
4.3 Types of D/A converter: Binary Weighted Resistor, R-2R Ladder Network DAC
4.4 Types of A/D converter: Flash and Successive Approximation ADC
4.5 Basic Characteristics of A/D and D/A Converters

Unit 5: Introduction to Power Electronics and Optoelectronics [14 Hrs]

5.1 Silicon Controlled Rectifier (SCR) and its applications
5.2 Diac and Triac: Characteristics and applications
5.3 Photo Transistor: Characteristics and applications
5.4 Opto-Coupler: principle and applications
5.5 Solar cell, LDR: principle and application
5.6 Inverters: single phase Half Bridge and Full Bridge Inverter
5.7 DC to DC conversion: Basic principle of step down and step-up conversion

Unit 6: Switched Power Supplies [8 Hrs]

6.1. Voltage Step-down regulator
6.2. Voltage Step-up regulator
6.3. Step up/Step down Regulator
6.4. Control circuit (PWM)

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

1. Inverting and Non inverting op-amp configuration [4 Hrs]
2. Single Op-amp instrumentation amplifier [4 Hrs]
3. Generation of sinusoidal wave using RC oscillator and LC oscillator [4 Hrs]
4. Generation of square waveform using 555 time IC and BJT [4 Hrs]
5. Observe output of R-2R ladder DAC and any one of ADC [4 Hrs]
6. V-I characteristics of Silicon Controlled Rectifier and TRIAC circuit [4 Hrs]
7. V-I characteristics of optocoupler and solar cell [4 Hrs]
8. Demonstrate switched voltage regulator [2 Hrs]

References:

1. Robert Boylested and Louis Nashelsky, “Electronics Devices and Circuit Theory”, PHI
2. Thomas L. Floyd, “Electronics Devices”, Pearson Education Inc.
3. Theodore F Bogart, Jeffrey S. Beasley and Guillermo Rico, “Electronics Devices and Circuits”, Pearson Education India
4. J.B. Gupta, “An Integrated Course in Electronics Engineering”, S.K Kataria & Sons
5. B.W. Williams, “Power Electronics: Devices, Drivers and Applications”, Mc Graw Hill
6. Muhammad H Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education India

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Operational Amplifier	10	14
2	Feedback and Oscillators	12	16
3	Multi-Vibrators	8	10
4	Multi-Vibrators	8	10
5	Introduction to Power Electronics and Optoelectronics	14	20
6	Switched Power Supplies	8	10
	Total	**60**	**80**

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

Machine Elements and Mechanism

EG 3103 MX

Total: 3 Hrs/week

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

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

Practical: Hrs/week

Lab: Hrs/week

Course Description:

This course deals with the basic mechanical 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 **[18 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 Permanent 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: Configuration of Mechanism [4 Hrs]

4.1 Introduction: Link, joint, Kinematic chain
4.2 Types of link: Binary, Ternary, Quaternary
4.3 Joint pairs: Higher, lower, Prismatic, revolute
4.4 Concept of degree of freedom
4.5 Grubler's Equation: definition and use

Unit 5: Introduction to Balancing [3 Hrs]

5.1 Introduction
5.2 Static: principle and application
5.3 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
2.9 Application of Degree of freedom in 4 bar/ slider crank 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	18	32
2	Joints/Connection	12	20
3	Working of Mechanisms	8	16
4	Configuration of Mechanism	4	8
5	Introduction to Balancing	3	4
	Total	**45**	**80**

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

Actuators and Programmable Logic Control

EG 3104 MX

Total: 6 Hrs/week

Year: III **Lecture: 4 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 basic actuator, drive and PLC programming and the application of PLC with the use of actuator and drive on different field of automation

Course Objectives:

After completion of this course students will able to

1. Understand the fundamental concepts of electro-mechanical and fluid power (hydraulics and pneumatics) systems
2. Understand the actuators in the area of hydraulics, pneumatics, electro-mechanical systems and associated equipment's used for the same.
3. Understand the basic PLC Programming and architecture.
4. Understand the application of PLC with the use selective actuator and drive in field of automation.

Course Contents:

Unit 1: Actuator-Hydraulic and Pneumatic [10 Hrs]

1.1 Introduction of actuator and its application
1.2 Classification of actuators
1.3 Hydraulic pumps and supply sources
1.4 Hydraulic actuators - Linear actuator – Types - Single acting, double acting cylinders – tandem, rotary actuators, accumulators.
1.5 Pneumatic characteristics and applications
1.6 Basic concepts of Air generation, treatments and distribution
1.7 Pneumatic Components - Air filter, regulator, lubricator, Pneumatic motors, Linear Actuators, etc
1.8 Basic concept of Stroke Speed Regulation of Pneumatic Actuators

Unit 2: Control and Regulation Elements [8 Hrs]

2.1 Control and regulation Elements – Basics of Direction control valves, flow and pressure control valves
2.2 Basic structure of pneumatic and hydraulic systems – Electro pneumatic and electrohydraulic systems and controls
2.3 Flapper valve, Time delay valve: Introduction and application
2.4 Basic Concept and application of Proportional and Servo valves

Unit 3: Micro and Smart Material Actuator **[6 Hrs]**

3.1 Basic principles and working of micro-actuators
3.2 Thermal actuators, SMA actuators, Electrostatic actuators
3.3 Micro grippers-micro motors
3.4 Smart materials and their application for sensing and actuation
3.5 Piezoelectric actuator, linear actuators, Hybrid actuators – Applications
3.6 Introduction of shape memory alloys actuator

Unit 4: Introduction to Programmable Logic Controllers **[8 Hrs]**

4.1 PLC architecture, Input Output modules,
4.2 PLC interfacing with plant memory structure of PLC, types of relays, ladder symbols.
4.3 Methods of Programming - Ladder diagram, STL, functional block diagram
4.4 Creating ladder diagram from process control description
4.5 Various Communication Protocols in PLC

Unit 5: PLC programming Methodologies and Application **[12 Hrs]**

5.1 Ladder logic methodology
5.2 Bit logic instructions, interlocking, latching, inter dependency and logical functions
5.3 PLC Timer & Counter functions on-delay timer, off-delay timers, Retentive on-delay timers, pulse timers, timer examples
5.4 Up-counter, down-counter and up-down counter, counter examples, Register basic
5.5 PLC ladder diagram for various circuits, motion controllers, Servo systems – fundamentals
5.6 Applications in Process and Assembly line, etc

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

1. Demonstration of Solenoid valve on different application [2 Hrs]
2. Demonstration of different actuator and drive used in CNC [2 Hrs]
3. Demonstration of actuation of robotic hand using shape memory alloys [2 Hrs]
4. Diagram analysis of sheet cutting machine using pneumatic actuators [2 Hrs]
5. Selection of actuators and its associated drivers for several working conditions [2 Hrs]
6. Demonstrate the working of PLC [2 Hrs]
7. Develop sequence control system in lifting a device for packaging and counting with PLC ladder logic [6 Hrs]
8. Draw a ladder logic diagram for water flow control and traffic light control [6 Hrs]
9. Write enter and test programs using a hand-held programmer for the following operations: [6 Hrs]
   - Ladder Logic
   - Timers
   - Counters

References:

1. Antony Esposito, "Fluid Power Systems and Control", Prentice-Hall.
2. A. K. Gupta, S. K. Arora, "Industrial automation and Robotics", University Science Press.
3. W. Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education
4. Frank D. Petruzella, "Programmable Logic Controller"
5. J. Webb, "Programmable Logic Controllers Principles & applications, PHI
6. C. D. Johnson, "Process Control Instrumentation".

Mark specification for final Examination:

Unit	Content	Course Hours	Marks
1	Actuator-Hydraulic and Pneumatic	10	18
2	Control and Regulation Elements	8	16
3	Micro and Smart Material Actuator	7	10
4	Introduction to Programmable Logic Controllers	12	20
5	PLC programming Methodologies and Application	8	16
	Total	**45**	**80**

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

Industrial Management

EG 3105 MX

Total: 3 Hrs/week

Year: III **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, engineering economics and capital management 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 engineering economics and capital management

Course contents:

Unit 1: Organization and Management **[12 Hrs]**

1.1 Introduction to Organization

1.2 Classification of Organization (basic concept, advantages and disadvantages)

- Single ownership
- Partnership
- Joint stock company
- Cooperative
- Public

1.3 Organization Structure

- Line organization
- Line and staff organization
- Functional organization
- Departmentalization

1.4 Management

- Introduction
- Functions of management
- Level of management
- Managerial skills
- Theory of management (Scientific, Administrative, Behavioral, Contingency)

Unit 2: Leadership and Motivation **[4 Hrs]**

2.1 Definition of leadership and motivation
2.2 Qualities of good leaders
2.3 Difference between manager and leader
2.4 Leadership styles
2.5 Theories of motivation (Theory X and Y, Maslow's hierarchy of needs)

Unit 3: Introduction to Production System **[10 Hrs]**

3.1 Introduction to a manufacturing plant
3.2 Classification of manufacturing processes
3.3 Plant location
- Importance of plant location
- Factors affecting plant location

3.4 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)

3.5 Material handling
- Factors affecting material handling (engineering and economics)
- Classification of material handling equipment

3.6 Store management: meaning, objectives, function of store

Unit 4: Production Planning and Control (PPC) **[10] Hrs**

4.1 Introduction
4.2 Principle and objectives and functions of PPC
4.3 Types of production system (job, batch, continuous)
4.4 Forecasting methods, techniques and types
4.5 Inventory control (economic order quantity, ABC analysis)
4.6 Basic concept of Network techniques
- Critical path method (CPM)
- Program evaluation and review technique (PERT)

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

Unit 5: Marketing of Product or Services **[3 Hrs]**

5.1 Definitions of market and marketing
5.2 Concept of marketing mix: product, price, place, promotion
5.3 Understanding consumer behavior
5.4 Functions of marketing

Unit 6: Engineering Economics **[6 Hrs]**

5.5 Introduction to engineering economic decision
5.6 Concept of time value of money
5.7 Concept of Simple and compound interest rates, effective interest
5.8 Depreciation methods, straight line, declining balance method
5.9 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	Organization and Management	12	20
2	Leadership and Motivation	4	10
3	Introduction to Production System	10	16
4	Production Planning and Control (PPC)	10	16
5	Marketing of Product or Services	3	8
6	Engineering Economics	6	10
	Total	**45**	**80**

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

Microprocessors
EG 3106 MX

Year: III **Total: 6 Hrs/week**
Part: I **Lecture: 4 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

This course deals with fundamentals of the microprocessor, basic low-level microprocessor programming, interfacing, and introduction to basic programmable devices.

Course Objectives:

After completing this course, the students will be able to

1. Understand the working principle of microprocessor
2. Understand the process of writing and executing machine level language
3. Know how to interface different I/O devices with a microprocessor

Course Contents:

Unit 1: Introduction to Microprocessor **[6 Hrs]**

1.1. Microprocessor, microcomputer, microcontroller
1.2. Block diagram of a typical microprocessor and microcontroller
1.3. General architecture of a microcomputer system

Unit 2: Microprocessor Architecture **[16 Hrs]**

2.1. Internal architecture of 8085 microprocessor
2.2. Instruction and data formats
2.3. Instruction classifications
2.4. 8085 Instruction set
2.5. Addressing modes in 8085

Unit 3: Assembly Language Programming for 8085 **[16 Hrs]**

3.1. Introduction to assembly language and assemblers
3.2. Assembly language code
3.3. Using loops, counters, delays
3.4. Table processing
3.5. Subroutine and stack
3.6. Code conversion ASCII/BCD/Binary

Unit 4: Interfacing I/O and Memory Devices **[11 Hrs]**

4.1. Introduction to Machine cycles
4.2. Introduction to Address Decoding

4.3. Introduction to Interfacing I/O Devices, Address decoding using block decoders, Interfacing Memory-mapped I/O
4.4. Memory Interfacing introduction, Memory structure and its requirement, RAM and ROM chips
4.5. Address decoding using NAND and block decoders, Direct memory access

Unit 5: 8085 Interrupt Processing [7 Hrs]

5.1. Importance of interrupt processing
5.2. Programmed I/O
5.3. Interrupt Driven I/O
5.4. The 8085 Interrupt
5.5. Restart and software interrupt

Unit 6: Advanced Microprocessors [4 Hrs]

6.1. Architecture of 8086 microprocessors
6.2. Addressing modes and programming features
6.3. Comparison with 8085 microprocessor

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

1. Demonstrate basics of microcomputer system through the 8085 microprocessor trainer kit [2Hrs]
2. Write and test programs that uses data transfer instructions [2Hrs]
3. Write and test programs that uses arithmetic instructions [2Hrs]
4. Write and test programs that uses logical instructions [2Hrs]
5. Write and test programs with conditional and unconditional branching [2Hrs]
6. Write and test programs with conditional and unconditional subroutine call and stack [2Hrs]
7. Write and test programs involving loops and counters [2Hrs]
8. Write and test programs that involves masking and checking numbers [2Hrs]
9. Write and test programs to manipulate table of numbers [2Hrs]
10. Write and test program for BCD and ASCII manipulation [2Hrs]
11. Write and test programs to perform multiplication and division [2Hrs]
12. Simple project work using microcontroller (e.g. 8051, Arduino, PIC) [8 Hrs]

References:

1. Amesh S. Gaonkar, "8085 Microprocessor programming and interfacing", New Age International.
2. John Uffenbeck, "The 8080, 8085 & Z-80 Programming, Interfacing and Troubleshooting", PHI
3. Albert Paul Malvino, Jerald A. Brown, "Digital Computer Electronics", McGraw- Hill
4. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications", Prentice Hall.

Marks Specification for final Examination:

Units	Content	Courses Hours	Marks
1	Introduction to Microprocessor	6	8
2	Microprocessor Architecture	16	20
3	Assembly Language Programming for 8085	16	20
4	Interfacing I/O and Memory Devices	11	16
5	8085 Interrupt Processing	7	12
6	Advanced Microprocessors	4	4
	Total	**60**	**80**

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

Instrumentation and Control System

EG 3107 MX

Total: 5 Hrs/week

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

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

Practical: Hrs/week

Lab: 2 Hrs/week

Course description:

This course deals with the various components of Instrumentation System along with different control system techniques.

Course objectives:

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

1. Understand instrumentation system
2. Understand the working of various transducers
3. Understand the principle of feedback control system

***Course Contents*:**

Unit 1: Instrumentation System **[3 Hrs]**

1.1. Principle, Needs and Application of Instrumentation System

1.2. Functions of components of Instrumentation System

Unit 2: Transducers **[12 Hrs]**

2.1 Introduction and classification of Transducer

2.2 Resistive Transducer: Potentiometer, Strain Gauge and Resistor Temperature Dependent- working and their applications

2.3 Inductive Transducer: Linear Variable Differential Transformer (LVDT)- working and its applications

2.4 Capacitive Transducer: By varying overlapping area, distance and permittivity of dielectric between plates- working and applications

2.5 Piezoelectric and Hall Effect Transducers- working and applications

2.6 Thermistors and Thermocouples-working and applications

Unit 3: Grounding and Shielding **[3 Hrs]**

3.1 Noise, Noise coupling mechanism and prevention

3.2 Single point grounding and ground loop

3.3 Decoupling capacitors

3.4 Different kinds of shielding mechanism

3.5 Protecting against electrostatic discharge

Unit 4: General Concept of Control System **[5 Hrs]**

4.1 Open loop and Closed Loop Control System with examples

4.2 Types of control system: Cascade, Ratio, Feed-forward and Split range

4.3 Effect of Feedback on System gain, stability, noise and sensitivity

4.4 Servomechanism: DC Closed loop control system and AC closed loop control system

Unit 5: Component Modeling **[10 Hrs]**

5.1 Introduction to Laplace Transform
5.2 Differential equation and transfer function
5.3 Solution of system of first order differential equation using Laplace Transform
5.4 Modeling of Mechanical (mass, spring, damper) and Electrical components (Inductance, capacitance, resistance, DC and AC motor, transducer and op-amp)

Unit 6: System Transfer Function and Response **[8 Hrs]**

6.1 Concept of time response
- 6.1.1 Types of test signal (Impulse, Step, Ramp, Parabolic)
- 6.1.2 Time response of first order system (step input)
- 6.1.3 Time response of second order system (step input)
- 6.1.4 Rise time, peak time, peak overshoot, settling time and steady state error and their significance

6.2 Response of Proportional(P), Derivative(D), Integral (I)and Proportional Plus Integral Plus Derivative control (PID) controller
6.3 Effect of varying K_d, K_i and K_p on the performance of control system
6.4 Practical applications of control system to control position,velocity,temperature

Unit 7: Stability **[4 Hrs]**

7.1 Stability: Relative and Absolute stability
7.2 Need of stability in control system
7.3 Necessary conditions for the stability
7.4 Routh- Hurwitz stability criterion

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

1. Sensitivity calculation of any one of resistive transducer [2Hrs]
2. Sensitivity calculation of capacitive transducer [2Hrs]
3. Sensitivity calculation of LVDT [2Hrs]
4. Characteristics observation of Piezoelectric transducer [2Hrs]
5. Op-amp integrator and differentiator [2Hrs]
6. Test the performance of open loop and closed loop control system with suitable example [2Hrs]
7. Test the performance of servomechanism [2Hrs]
8. Plot the step response of first order system [2Hrs]
9. Plot the step response of a second order system. [2Hrs]
10. Test response of control system with P,I,D and PID control [4Hrs]
11. Construct of PID controller circuits using operational amplifiers. [4Hrs]
12. Prepare mathematical model of AC and DC servo motor [2Hrs]
13. Find out stability for given control system using R-H criterion [2Hrs]

References:

1. A.K. Sawhney, “A Course in Electrical and Electronics Measurement and Instrumentation”, Dhanpat Rai & Co
2. J.B. Gupta,”ACourse in Electrical and Electronics Measurement and Instrumentation”, SK Kataria& Sons
3. Ogata K,” Modern Control Engineering”, PHI Learning, New Dheli
4. Nagrath J.J., Gopal M.,” Control System Engineering”, New Age Publications, New Dheli
5. M. Gopal,“Control System: Principle and Design,” Tata McGraw- Hill Education
6. G.T. Brayan, "Control System for Technicians", Hodder and Stoughton Educational, Great Britain

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Instrumentation System	3	8
2	Transducers	12	20
3	Grounding and Shielding	3	8
4	General Concept of Control System	6	8
5	Component Modeling	9	16
6	System Transfer Function and Response	8	12
7	Stability	4	8
	Total	**45**	**80**

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

Project I

EG 3108 MX

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 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:

1. A team should be selected at the initial of the semester with maximum 4 students in each group.
2. Each team should be given a different group work to make a product applicable in functional/daily life.
3. Project should have some basic control mechanism using sensors, actuators electronic components.
4. Each team should submit a project report including the following.
    - Title of the project
    - Introduction to the content of the project.
    - Objective
    - Application and working principle of system
    - Methodology
    - Manufacturing Process and Material selection (if any).
    - Block diagrams, functional diagrams and circuit diagrams (if any)
    - 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.

Marks Specification for final examination:

Examination	**Content**	**Marks**
Internal (60 marks)	Attendance and job performance	20
	Product demonstration	20
	Report	10
	Presentation	10
Final (40 marks)	Group Report and Viva voce	40
Total		**100**

Sixth Semester
Year III Part II

Subjects:

1. EG 3201 MX Plant Maintenance
2. EG 3202 MX Industrial Attachment
3. EG 3201 MG Entrepreneurship Development
4. EG 3203 MX Robotics and Industrial Automation
5. EG 3204 MX Project II
6. Elective (One of the followings)

EG 3205 MX.1	a.	Micro Controller and PIC
EG 3205 MX.2	b.	Internet of Things (IOT)
EG 3205 MX.3	c.	Automotive Mechatronics
EG 3205 MX.4	d.	Smart Manufacturing

Plant Maintenance

EG 3201 MX

Total: 6 Hrs/week

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

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

Practical: 3 Hrs/week

Lab: Hrs/week

Course Description:

This course deals with the necessity of maintenance of equipment and machines in the production plant and various types of maintenance works that are performed. It insight different types of maintenance strategies and their application part in production plant. Basic fundamental of maintenance such as fault tracing, basic preventive maintenance technique and industrial safety are also included in this course.

Course Objectives:

1. After the completion of the course, the student shall be able to
2. Understand the term maintenance and its importance.
3. Classify the wear and identify proper lubrication system
4. Understand the fault tracing technique in plant machinery and equipment
5. Be aware about the industrial safety in maintenance work
6. Understand the concept of Recovery, reconditioning and retrofitting

Course contents:

Unit 1: Fundamentals of Plant Maintenance [8 hrs]

1.1. Definition and aim of maintenance engineering.
1.2. Primary and secondary functions and responsibility of maintenance department.
1.3. Types of maintenance: Breakdown, Preventive, Condition based, RCM and Risk Based maintenance.
1.4. Types and applications of tools used for Mechanical and Electrical Maintenance.
1.5. Maintenance cost & its relation with replacement economy.
1.6. Service life of equipment.
1.7. Difference between Repair and Maintenance.
1.8. Challenges of maintenance management in Nepal.

Unit 2: Wear and Corrosion and Their prevention [4 hrs]

2.1. Wear- types, causes, effects
2.2. Wear reduction methods
2.3. Lubricants-types and applications.
2.4. Lubrication methods –General sketch, working and applications.
   i. Screw down grease cup.
   ii. Pressure grease gun.

iii. Splash lubrication.
iv. Gravity lubrication.
v. Wick feed lubrication.
vi. Side feed lubrication.
vii. Ring lubrication.

2.5. Corrosion, types of corrosion and factor affecting corrosion
2.6. Corrosion Prevention method

Unit 3: Fault Tracing **[10 hrs]**

3.1. Fault tracing-concept and importance.
3.2. Decision tree-concept, need and applications.
3.3. Sequence of fault finding activities, show as decision tree.
3.4. Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment like:
i. Lathe/ Milling/Drilling.
ii. Pump
iii. Air compressor.
iv. Internal Combustion engine.
v. Boiler.
vi. Electrical motors.
3.5. Root Cause Analysis: Concept and 5-why Methods
3.6. Techniques of fault tracing in Mechatronics System

Unit 4: **[4 hrs]**

4.1. Periodic inspection-concept and need.
4.2. Concept of Degreasing, cleaning and repairing schemes
4.3. Factor to be considered in overhauling of mechanical components.
4.4. Factor to be considered in overhauling of electrical motor.
4.5. Common troubles and remedies of different types of Electric motor.
4.6. Repair complexities and its use

Unit 5: Preventive and Predictive Maintenance **[8 hrs]**

5.1. Definition, need, and advantages of preventive maintenance.
5.2. Steps/procedure for preventive maintenance of:
i. Machine tools.
ii. Pumps.
iii. Air compressors.
iv. Diesel generating (DG) sets.
v. Boiler
5.3. Program and schedule of preventive maintenance of mechanical and electrical equipment's.
5.4. Repair cycle-concept and importance.
5.5. Definition, need, advantages and techniques of predictive maintenance.

Unit 6: Quality and Workplace Safety **[4 hrs]**

6.1. Concept and need for Quality maintenance processes, Post maintenance testing.
6.2. Accident - causes, types, results and control.
6.3. Mechanical and electrical hazards types, causes and preventive steps/procedure

6.4. Describe salient points of Labor law for health and Safety-Working Environment, Occupational Safety and health, Working Hours, Fire Safety, Compensation on Accident, Provision of Basic facilities in Industry, guarding, pressure vessels, etc.
6.5. Safety color codes.
6.6. Fire prevention and fire-fighting equipment and methods.

Unit 7: Reliability **[4 Hrs]**

7.1. Introduction of Reliability
7.2. Reliability Measure - MTBF, MTTR
7.3. Basic concept of Fault tree analysis and Failure mode effect analysis

Unit 8: Installation, Erection and Commissioning of Equipment **[3 hrs]**

8.1. Design and planning of foundation.
8.2. Erection and commissioning of equipment.
8.3. Alignment and testing of equipment.

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

1. **Preparatory Activity:** **[4 hrs]**
   Study and demonstrate use of various types of tools. (Fix spanners, box spanners, ring spanners, allen keys, types of pliers, screw drivers, bearing puller, multi meter, Clamp meter, etc.).
2. **Fault Tracing and Decision Tree:** **[8 hrs]**
   Develop decision tree for location of fault for any two items from following a. Internal combustion (IC) engine. b. Boiler. c. Pump. d. Machine tool. e. Air compressor. f. Electric motor g. Hydraulic and Pneumatic system h. Air Conditioner
3. **Maintenance of Electro-Mechanical and Hydraulic and Pneumatic Based Equipment/Device/Machine:** **[20 hrs]**
   - Dismantle of given case, observe rules, follow sequence of dismantling operations, cleaning, inspection, measuring deviations, recovery methods, testing and assembling
   - Boot and Reboot Program in any automatic system
4. **Preventive Maintenance:** **[5 hrs]**
   Prepare a preventive maintenance schedule of any workshop having- air compressors, Hydraulic and Pneumatic system, lifts, welding machines, and machine tools
5. **Safety:** Demonstrate use of fire fighting and safety related equipment. **[4 hrs]**
6. **Test Chart:** Prepare test chart of newly installed or repaired machine tool from manual or log book. **[4 hrs]**

References:

1. S.N. Bhattacharya, "Installation Servicing and Maintenance", S. Chand & Company Ltd., New Delhi – 110055, India. ISBN: 81-219-0831-0.
2. S. K. Srivastava, "Industrial Maintenance Management", S. Chand & Company Ltd., New Delhi – 110055, India. ISBN: 81-219-1663-1.
3. P. Gopala krishnan & A. K. Banerji, "Maintenance and Spare Parts Maintenance, Prentice-Hall of India Pvt. Limited, New Delhi – 110001. ISBN:0-87692-669-3.

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	Fundamentals of Plant Maintenance	8	14
2	Fundamentals of Plant Maintenance	4	8
3	Fault Tracing	10	14
4	Periodic Maintenance	4	8
5	Preventive and Predictive Maintenance	8	14
6	Quality and Workplace Safety	4	8
7	Quality and Workplace Safety	4	8
8	Installation, Erection and Commissioning of Equipment	3	6
	Total	**45**	**80**

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

Industrial Attachment

EG 3202 MX

Total: 7 Hrs/week

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

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

Practical: 7 Hrs/week

Lab: Hrs/week

Course description:

The students will be deputed to various industry having automation 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 field automation 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:

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

Course contents:

1. A manufacturing industry should be selected for each team of students at the beginning of the semester.
2. Each team should be given an orientation before releasing from the institute.
3. Each team should maintain a log book of daily activities in the industry.
4. Each team should submit a report including the following not limited to:
    - Letter of completion 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	 20 50 10
	Evaluation from institute	20
Final (50 marks)	Group Report and Viva voce on Institute	50
Total		**150**

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.]
a. Overview of entrepreneur and entrepreneurship
b. Wage employment, self- employment and business
c. Synopsis of types and forms of enterprises
d. Attitudes, characteristics & skills required to be an entrepreneur
e. Myths about entrepreneurs
f. Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and Developing Entrepreneurial Competencies: [9 Hrs.]
a. Assessing individual entrepreneurial inclination
b. Assessment of decision-making attitudes
c. Risk taking behavior and risk minimization
d. Creativity and innovation in business
e. Enterprise management competencies

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

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

a. Needs and importance of business plan
b. 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
c. Business operation plan
    - Process of product or service creation
    - Required fix assets
    - Level of capacity utilization
    - Depreciation & amortization
    - Estimation office overhead and utilities
d. Organizational and human resource plan
    - Legal status of business
    - Management structure
    - Required human resource and cost
    - Roles and responsibility of staff
e. 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
f. Business plan appraisal
    - Return on investment
    - Breakeven analysis
    - Risk factors

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

a. Concept of small business management
b. Market and marketing mix
c. 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.]

1. 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

.

Robotics & Industrial Automation
EG 3203 MX

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

Course Description:

Today's industrial assembly line is equipped with robots and man vs. machine interface has been replaced by automation. Most of the machines including our automobiles are available with variety of models and controls. This course provides the student with basic knowledge of the robotics as well as industrial automation systems.

Course Objectives:

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

1. Identify a Robot for a specific application.
2. Interface various Servo and hardware components with Controller based projects.
3. Identify parameters required to be controlled in a Robot.
4. Develop small automatic applications with the help of Robotics.
5. Test the robotics circuit.
6. Describe working of various blocks of basic industrial automation system
7. Use various industrial motor drives for the Industrial Automation

Course contents:

Unit 1: Robotics **[12 Hrs]**

1.1. Introduction: History, Laws, Application, Advantages and Disadvantages
1.2. Characteristics of an Industrial Robot
1.3. Components of an Industrial Robot
1.4. Comparison of the Human and Robot
1.5. Manipulator Robot Wrist and End of Arm Tools
1.6. Robot Terminology
1.7. Robotic Joints
1.8. Classification of Robots: Co-Ordinate Systems, Power Source, Method of Control, Programming Method
1.9. Robot Selection
1.10. Robotics and Machine Vision
1.11. Robotic Accidents
1.12. Robotics and Safety
1.13. Concept of Degree of freedom for serial and parallel manipulator.

Unit 2. Robotic Sensor **[3 Hrs]**

2.1 Introduction to robotic sensors

2.2 Types of Sensors in Robots: Extero ceptors or External Sensors, Tactile Sensors, Proximity Sensors (Position Sensors), Range Sensors, Machine Vision Sensors, Velocity Sensors, Proprioceptors or Internal Sensors

Unit 3. Robotic End Effectors **[4 Hrs]**

3.1 Introduction to End Effector
3.2 Classification of End Effectors
3.3 Grippers
3.4 Selection of Gripper
3.5 Gripping Mechanisms
3.6 Tools and their types
3.7 Characteristics of End-of-Arm Tooling
3.8 Elements of End-of-Arm Tooling
3.9 Types of Grippers: Finger Grippers, Mechanical Grippers, Vacuum/Suction Grippers, Magnetic Grippers

Unit 4. Robotic Programming **[3 Hrs]**

4.1 Introduction Robot Programming
4.2 Robot Programming Techniques
4.3 Basic concept of Online Programming, Lead-Through Programming, Walk-Through Programming

Unit 5. Mobile Robot (Component, Types, Challenges, Manipulator) **[3 Hrs]**

5.1 Tele- operated Robot
5.2 Master and Slave
5.3 Autonomous robot

Unit 6. Locomotion **[4 Hrs]**

6.1 Introduction, Types, Issues
6.2 Wheeled mobile robot: Introduction, types of wheel, wheel stability
6.3 Biomimetic locomotion

Unit 7. Industrial Automation **[3 Hrs]**

7.1 Introduction to Industrial automation, Advantages and Goals of automation.
7.2 Mechanization vs Automation
7.3 Types of Automation: Fixed, Programmable, Flexible
7.4 Low Cost Automation (LCA): Introduction, Application and Advantages.
7.5 Social Issues of Automation

Unit 8. Assembly Automation Equipment **[3 Hrs]**

8.1 Introduction to assembly automation equipment: Transfer devices and Feeders
8.2 Fundamentals of Production Lines
8.3 Types of Assembly Lines
8.4 Reasons for Using Automated Assembly Lines

Unit 9. Classification of Material Handling System **[4 Hrs]**

9.1 Transportation system: Transfer system, Transfer machine, Transfer devices
9.2 Feed system: Introduction, characteristics and types
9.3 Random access transport Systems-Automated guided vehicles (AGVs)
9.3.1 General aspects and types
9.3.2 AGVs equipments
9.3.3 Applications of AGVs

Unit 10. Automated Storage Systems **[2 Hrs]**

10.1 General aspects
10.2 Objectives of automated storage systems
10.3 Automatic storage/retrieval systems

Unit 11. Flexible Manufacturing System (FMS) **[4 Hrs]**

11.1 Introduction FMS
11.2 Flexible manufacturing cell (FMC) and FMS
11.3 Components of FMS
11.4 Requirements of FMS
11.5 Advantages and limitations of FMS
11.6 Characteristics and features of typical FMS

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

1. Demonstrate and Configure the robots used for practical [4 Hrs]
2. Demonstration and use the robot end effecters for movement [2 Hrs]
3. Demonstrate the use of different types of sensor in robotics. [4 Hrs]
4. Perform pick and place for action using robot trainer kit by walk through method [4] Hrs
5. Write and test a program for Line Follower Configuration. [4 Hrs]
6. Control robot test kit using Robot programming commands: Online Programming, Lead-Through Programming [8 Hrs]
7. Develop sequence control system in lifting a device for packaging and counting [8 Hrs]
8. Program the industrial robot to draw a given profile in plain [8 Hrs]
9. Program the industrial robot to draw a given profile in incline plain [8 Hrs]
10. Program the industrial robot to follow the counter surface [6 Hrs]
11. Measure the Tool center point for the given tool or gripper [4 Hrs]
12. Industrial visit for industrial automation [8 Hrs]

References:

1. Koren Yoram, "Robotics for Engineers", McGraw - Hill Education, NewDelhi.
2. Hedge, G S, "Textbook on Industrial Robotics", Laxmi Publications, New Delhi.
3. R.K. Rajput, "Robotics and industrial automation", S. Chand & Company, New Delhi
4. P. Groover Mikell, "Industrial Robotics: Technology, Programming and Applications, McGraw - Hill Education, New Delhi.
5. J. Webb, "Programmable Logic Controllers Principles & applications", PHI
6. T. A. Hughes," Programmable Controllers"
7. C. D. Johnson, "Process Control Instrumentation".

Marks specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Robotics	12	16
2	Robotic Sensor	3	4
3	Robotic End Effectors	4	8
4	Robotic Programming	3	6
5	Mobile Robot (Component, Types, Challenges, Manipulator)	3	6
6	Locomotion	4	8
7	Industrial Automation	3	6
8	Assembly Automation Equipment	3	6
9	Classification of Material Handling System	4	8
10	Automated Storage Systems	2	4
11	Flexible Manufacturing System (FMS)	4	8
	Total	**45**	**80**

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

Project II

EG 3204 MX

Total: 8 Hrs/week

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

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

Practical: 8 Hrs/week

Lab: Hrs/week

Course Description:

This subject is the continuation of Project-I and also includes the fabrication of any simple automation 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/system 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:

1. A team should be finalized at the beginning of the semester with maximum 4 students in each group.
2. Each team should be given a different group work to make a product applicable in functional/daily life.
3. Project should be a combination of mechanical and electronic system using actuators, electronic components, microcontroller, PLC, transducers, etc based on current technologies and trends.
4. Each team should submit a project report including the following.
    - Title of the project
    - Introduction to the content of the project.
    - Objective
    - Application and working principle of system
    - Methodology
    - Manufacturing Process and Material selection (if any).
    - Block diagrams, functional diagrams and circuit diagrams (if any)
    - 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 (60 marks)	Attendance and job performance	20
	Product demonstration	20
	Report	10
	Presentation	10
Final (40 marks)	Group Report and Viva voce	40
Total		**100**

Micro Controller and PIC (Elective)

EG 3205 MX.1

Year: III **Total: 7 hrs/week**
Part: II **Theory: 3 hrs/week**
Tutorial: hrs/week
Lab: hrs/week
Practical: 4 hrs/week

Course Description:

Familiarization of Architecture & Functionality of 8051 makes the work as a complete Engineer. Usage of interfacing helps them to do programming & take-up project works.

Course Objectives:

After completion of this course students will be able to:

1. Explain Architecture of 8051 Microcontroller.
2. Explain the functions of various registers.
3. Understand serial data communication concepts.
4. Understand the programming techniques.
5. Understand PIC Microcontroller

***Course Contents*:**

Unit 1: Architecture of 8051 **[10 hrs]**

1.1. Block diagram of Microcontroller
1.2. Comparison of Microprocessor and Microcontroller
1.3. Advantage of Microcontroller
1.4. Selection of Microcontroller
1.5. Pin details of 8051
1.6. ALU, Special function registers
1.7. ROM–RAM–RAM Memory Map (including registers and register banks)
1.8. Program Counter PSW register, Stack, I/O Ports
1.9. Timer, Interrupt, Serial Port
1.10. External memory, Clock, Reset, Clock Cycle, Machine Cycle, Instruction cycle, Instruction fetching and execution
1.11. Overview of 8051 family

Unit 2: Instruction Set and Programming **[10 hrs]**

2.1. Assembling and running 8051program
2.2. Instruction set of 8051, Different addressing modes
2.3. Data transfer instructions, Arithmetic Instructions
2.4. Logic and Compare instructions, Call instructions
2.5. Signed number concepts and arithmetic operations
2.6. Rotate instruction and data serialization

2.7. BCD, ASCII, Assembler directives–Sample programs.
2.8. Loop and jump instructions
2.9. Time delay routines, Program control

Unit 3: I/O, Timer, Interrupt and Serial Programming [10 hrs]

3.1 Bit addresses for I/O and RAM
3.2 I/O programming, I/O bit manipulation programming
3.3 Programming 8051, Timers, Counter programming
3.4 Basics of Serial programming
3.5 8051 connections to RS232, 8051 Serial Port Programming
3.6 8051 interrupt, Programming Timer Interrupt
3.7 Programming external hardware interrupts
3.8 Programming the serial communication interrupt
3.9 Interrupt priority in 8051

Unit 4: PIC [15 hrs]

2.1. Overview of PIC18 family-PIC18 Features-PIC Architecture
2.2. WREG Register in the PIC-PIC File Register
2.3. File register and access bank in PIC18
2.4. PIC Status Register
2.5. Program counter in the PIC-ROM memory map in the PIC18
2.6. Where the PIC wakes up when it is power dup
2.7. Placing code in Program ROM-Executing a program byte by byte-ROM Width in the PIC18
2.8. Harvard architecture in the PIC-RISC architecture in the PIC-Features of RISC, PIC Instructions
2.9. MOVWF instructions
2.10. COMF instruction
2.11. DECF instruction
2.12. MOVF instruction
2.13. ADDLW instruction and Status Register

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

Part–A

1. Write a program for Multi-Byte Addition and execute the same in the 8051 Kit. [3 hrs]
2. Write a program for Multiplication and Division of two numbers and execute the same in the 8051 Kit. [3 hrs]
3. Ascending order and execute thesame in the 8051 Kit. [3 hrs]
4. Write a program for BCD to Hex conversion and execute the same in the 8051 Kit. [3 hrs]
5. Write a program for Hex to BCD conversion and execute the same in the 8051 Kit. [3 hrs]
6. Write a program for ASCII to Binary and execute the same in the 8051 Kit. [3 hrs]
7. Write a program for Parity bit generation and execute the same in the 8051 Kit. [3 hrs]
8. Write a program for using timer / Counter and execute the same in the 8051 Kit. [3 hrs]

Part– B

Interfacing with application boards

1. Write a program for interfacing Digital I/O board and test it. [4 hrs]
2. Write a program for interfacing Matrix key board and test it [4 hrs]
3. Write a program for interfacing seven segments LED displays and test it. [4 hrs]
4. Write a program for interfacing Traffic light control and test it. [4 hrs]
5. Write a program for interfacing 8 bit ADC and test it. [4 hrs]
6. Write a program for interfacing 8 bit DAC and test it. [4 hrs]
7. Write a program for interfacing STEPPER MOTOR and test it. [4 hrs]
8. Write a program for interfacing DC motor and test it. [4 hrs]
9. Write a program for Sending data through serial port between controller kits and test it. [4 hrs]

References:

1. Mazidi, Mazidi and D. MacKinlay–"8051Microcontroller and Embedded Systems using Assembly and C", Pearson Education Low Price Edition.
2. R. Theagarajan, "Microprocessor and Microcontroller", Sci Tech Publication, Chennai
3. Kenneth J. Ayala –"8051 Microcontroller."
4. Muhammad Ali Mazidi, Rolind D. Mckinlay, Danny Causey, "PIC Microcontroller Embedded systems using Assembly and C for PIC 18".
5 Myke Predko, "Programming customizing the 8051 Microcontroller", Tata McGraw Hill"

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Flexible Manufacturing System (FMS)	10	18
2	Instruction Set and Programming	10	18
3	I/O, Timer, Interrupt and Serial Programming	10	18
4	PIC	15	26
	Total	**45**	**80**

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

Internet of Things (Elective)
EG 3205 MX.2

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

Course Description:

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

Course Objectives:

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

1. Understand general concepts of Internet of Things
2. Recognize various devices, sensors and applications
3. Apply design concept to IoT solutions
4. Analyze various M2M and IoT architectures
5. Evaluate design issues in IoT applications
6. Create IoT solutions using sensors, actuators and Devices

***Course Contents*:**

Unit 1: Introduction to IoT **[5 Hrs]**

1.1. Definition and characteristics of IoT
1.2. Design principles of IoT
1.3. IoT Protocols, Architectures
1.4. IoT functional blocks
1.5. IoT communication models,
1.6. IoT enabling Technologies: Wireless sensor networks, Big Data Analytics
1.7. Cloud computing (Introduction, architecture and application on sensor management)
1.8. IoT levels
1.9. IoT vs M2M

Unit 2: Sensors **[3 Hrs]**

2.1. Classification of Sensors
2.2. Working Principle of Sensors
2.3. Criteria to choose a Sensor
2.4. Generation of Sensors
2.5. Topologies on wireless sensor networks

Unit 3: IoT Design Methodology **[4 Hrs]**

3.1. Design methodology
3.2. Challenges in IoT Design
3.3. IoT System Management
3.4. IoT Servers

Unit 4: Basics of Arduino **[6 Hrs]**

4.1. Introduction to Arduino
4.2. Arduino IDE
4.3. Basic Commands for Arduino
4.4. LED and LCD interfacing with Arduino
4.5. Programming Arduino: LED, Reading Digital input, RELAY interfacing, LCD interfacing,
4.6. SPI (Serial Peripheral Interface) with Arduino

Unit 5: Basics of Raspberry Pi and MCU **[6 Hrs]**

5.1. Introduction to Raspberry pi
5.2. Terminal Commands
5.3. Basic programming using Raspberry Pi
5.4. Introduction ESP8266 node-MCU (Micro-Controller Unit): architecture and application and programming

Unit 6: Interfacing with Raspberry Pi and Arduino **[3 Hrs]**

6.1. Raspberry Pi and Arduino
6.2. Install Arduino IDE on Raspberry Pi
6.3. Interfacing Analog and Digital Sensor
6.4. Interfacing with Actuators

Unit 7: Python/Matlab and Arduino **[10 Hrs]**

7.1. Python/Matlab and Arduino
7.2. Controlling the Arduino with Python/Matlab
7.3. LED interfacing
7.4. Reading an Arduino Digital Input using Python/Matlab
7.5. Reading different sensor (temperature sensor, light, pulse-oximeter etc.) with Arduino and Python/Matlab
7.6. Reading an Analog Input with Python/Matlab
7.7. Line following robot with Arduino

Unit 8: Domain Specific Applications of IoT **[8 Hrs]**

8.1. Home automation: Smart lighting, smart appliances, smoke for gas detectors
8.2. Cities- Smart Parking, Smart Roads
8.3. Environmental application: Weather monitoring, forest fire detection, river flood's detection
8.4. Energy - Smart grids, renewable energy systems,
8.5. Retail- Inventory management, smart payments, smart vending machines;
8.6. Agriculture application- Smart Irrigation, Green house control;

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

1. Introduction to various sensors and various actuators and their application using Arduino, Raspbery Pi, Python (Students have to prepare Report for the same) [40 Hrs]
   1.1. PIR Motion Sensor
   1.2. Rain Drop Sensor
   1.3. Moisture Sensor
   1.4. Temperature Sensor
   1.5. Touch Sensor.
   1.6. Infrared Sensor.
   1.7. Servo Moto.
   1.8. RFID Sensor.
   1.9. Bluetooth Module.
   1.10. Wi-Fi Module.
2. Demonstrate NodeMCU and its working [10 Hrs]
3. Application of Zigbee/Xbee [10 Hrs]

References:

1. Arshdeep Bahga and Vijay Madisetti ,"Internet of Things – A Hands on Approach", Universities Press, ISBN: 9788173719547 (Unit I to V)
2. Adrian McEwen & Hakim Cassimality Wiley," Designing the Internet of Things", ISBN: 9788126556861 (Unit VI)
3. Olivier Hersent, David Boswarthick, Omar Elloumi," The Internet of Things – Key Applications and Protocols", Wiley Publication, ISBN: 9788126557653
4. Michael Miller," The Internet of Things", Pearson ISBN: 9789332552456

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Introduction to IoT	5	10
2	Sensors	3	4
3	IoT Design Methodology	4	8
4	Basics of Arduino	6	10
5	Basics of Raspberry Pi and MCU	6	12
6	Interfacing with Raspberry Pi and Arduino	3	4
7	Python/Matlab and Arduino	10	18
8	Domain Specific Applications of IoT	8	14
	Total	**45**	**80**

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

Automotive Mechatronics (Elective)

EG 3205 MX.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:

The course familiarizes of electronic control over mechanical systems and subsystems in Automobiles. Understand usage of mechatronics in engine management system, transmission control system, brake and steering system, so provides knowledge of modern automobiles and realize importance of electronic control over automobile systems. The course also provides knowledge on safety and security system used in today's automobiles.

Course Objectives:

After completion of this course students will be able to:

1. Explain use and importance of mechatronics in automobiles.
2. Explain the functions of various automobile sensors and actuators.
3. Understand architecture and function of electronic control unit.
4. Understand basics of controller area network (CAN), data communication concepts in CAN.
5. Understand use of mechatronics in automobile control, safety and security systems.
6. Diagnose faults using onboard diagnostic tools and equipment.

Course Contents:

Unit 1: [2 Hrs]

1.1 Short history of automotive mechatronics
1.2 Vehicle system architecture

Unit 2: Electronic Control Unit ECU [4 Hrs]

1.1 Operating conditions and design considerations
1.2 Data processing: input signals, signal conditioning, signal processing and output signals
1.3 Control unit internal communication
1.4 End of line programming EOL
1.5 Digital modules in the control unit: microcontroller, programming, semiconductor memories
1.6 Control unit software: requirements and software structure

Unit 3: Automotive Sensors [6 Hrs]

3.1 Engine speed sensor
3.2 Speed sensors for transmission control
3.3 Wheel speed sensors

3.4 Yaw-rate sensors
3.5 Pressure sensors
3.6 Temperature sensors
3.7 Accelerator position sensor
3.8 Steering angle sensors
3.9 Position sensor for transmission control
3.10 Axle sensors
3.11 Hot film air mass sensor
3.12 Torque sensor
3.13 Rain/light sensor
3.14 Oxygen sensor
3.15 Knock sensor

Unit 4: Automotive Actuators **[6 Hrs]**

4.1 Electro mechanical actuators
4.2 Electro hydraulic actuators
4.3 Electric machines

Unit 5: Electronic Transmission Control **[4 Hrs]**

5.1 Drive train management
5.2 Control of automated shift transmission AST
5.3 Control of automatic transmission

Unit 6: Antilock Brake **[2 Hrs]**

6.1 Major components and system overview
6.2 Requirements of ABS
6.3 ABS control loop
6.4 Electronic brake force distribution system

Unit 7: Active steering system **[2 Hrs]**

7.1 Components and system overview
7.2 Electronic stability program

Unit 8: Multipoint Fuel Injection System **[4 Hrs]**

8.1 Components and system overview
8.2 Fuel injection control
8.3 Open and closed loop control

Unit 9: Common Rail Fuel Injection System **[4 Hrs]**

9.1 Components and system overview
9.2 Fuel injection control
9.3 Closed loop control

Unit 10: Drive and Adjustment Systems **[2 Hrs]**

10.1 Power windows
10.2 Power sun roofs
10.3 Seat and steering column adjustments

Unit 11: Vehicle Security and Safety System **[4 Hrs]**

11.1 Acoustic signaling device
11.2 Central locking
11.3 Engine immobilizer
11.4 Biometric system
11.5 Air bag system
11.6 Seat belt restraint system

Unit 12: Controller Area Network and Onboard Diagnosis **[5 Hrs]**

12.1 Overview of CAN
12.2 CAN communication
12.3 Onboard diagnosis using scanner

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

1. Demonstration of conventional Petrol and Diesel Engine **[8 Hrs]**
2. Demonstration of Conventional Transmission System **[8 Hrs]**
3. Demonstration of Conventional Brake and Steering System. **[6 Hrs]**
4. **EFI/CRDI Engine Management System** **[16 Hrs]**
    - Parts identification and location
    - Circuit layout
    - Use of scanner
    - Diagnosis code reading using scanner and malfunction light
    - Inspect system and components
    - Testing of components and system
    - Safety measures

5. **Anti-lock brake systems (ABS), EBD, Electronic steering system and Air bags system** [8]
    - Parts identification and location
    - Circuit layout
    - Checking system and component
    - Testing of components and system
    - Safety measures

6. **Automatic Transmission System** **[8 Hrs]**
    - Diagnosis through Scanner and operation of
        - Solenoids
        - Transmission Control System

7. **Body Control Module** **[6 Hrs]**
    - Fault finding through Scanner in BCM
    - Basic CAN Structure overview

Instruction for Instructor: The pre requisites of this course is the basic knowledge about the automobile technology so it is recommended to start the theoretical course content after completion of practical no 1, 2 and 3.

References:

1. William B. Ribbens, "Understanding Automotive Electronics", Society of Automotive Engineers Inc.
2. Bosch, "Automotive Mechatronics", Konrad Reif
3. Robert Bosch Gmbh, "Automotive Electrics Automotive Electronics", John Wiley & Sons
4. Ronald K. Jurgen, "Automotive Electronics Handbook", McGraw Hill Company Ltd.
5. V.A. W. Hillers, "Hiller's Fundamentals of Automotive Electronics", The Institute of Motor Industry
6. S.K. Agarwal, "Automotive Pollution", Ashish Publishing House, New Delhi 110026
7. Willard W. Pulkrabek, "Engineering Fundamentals of Internal Combustion Engine", Prentice-Hall of India P. Ltd., New Delhi
8. Bosch, "Automotive Brake Systems", Society of Automotive Engineers (SAE), USA

Marks specification for final Evaluation:

Unit	Content	Course Hours	Marks
1	Introduction to Automotive Mechatronics	2	4
2	Electronic Control Unit ECU	4	8
3	Automotive Sensors	6	10
4	Automotive Actuators	6	8
5	Electronic Transmission Control	4	8
6	Antilock Brake	2	4
7	Active steering system	2	4
8	Multipoint Fuel Injection System	4	8
9	Common Rail Fuel Injection System	4	8
10	Drive and Adjustment Systems	2	4
11	Vehicle Security and Safety System	4	6
12	Controller Area Network and Onboard Diagnosis	5	8
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Smart Manufacturing (Elective)
EG 3204 MX.5

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

Course Description:

This course is designed to present the basic concepts of smart manufacturing on the basis of industry 4.0 and made student aware of basic smart technology used in industry. It encourages student's perspective towards the Smart and Empowered Workers and its application on Automated Control structures in manufacturing system.

Course Objectives:

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

1. Understand the general concept of Smart Manufacturing
2. To present a problem oriented in depth knowledge of Smart Manufacturing
3. To address the underlying concepts and methods behind Smart Manufacturing
4. Recognize the various smart design processes
5. Analyze different method to select Smart and empowered workers
6. Create smart solution on Smart factory on the basis of industry 4.0

***Course Contents*:**

Unit 1: Smart Factory [6 Hrs]

1.1 Concepts of Industry 4.0 standard
1.2 Real-time information based scheduling, capacity planning, material planning
1.3 Real-time production monitoring techniques with smart sensors
1.4 Configuration of smart shop floor, traceability and call back of defective products

Unit 2: Introduction to Smart Manufacturing [8 Hrs]

2.1 Smart manufacturing: definition and comparison with conventional/legacy manufacturing
2.2 Three Dimensions Converge on Smart Manufacturing of Digital Thread, Smart Factory, Value Chain
2.3 Basic introduction of Demand Driven and Integrated Supply chain
2.4 Basic introduction of dynamically optimized manufacturing Enterprises (plant+ enterprise operations)
2.5 Real time and Sustainable Resource Management (intelligent energy demand management, production energy optimization greenhouse gas)

Unit 3: Smart Design and Manufacturing [10 Hrs]

3.1 Basic introduction of Smart Design/Fabrication
3.2 Introduction and application of Digital Tools
3.3 Basic concept of the Product Representation, Exchange Technologies and their Standards in smart design
3.4 Concept of Agile (Additive) Manufacturing Systems and its Standards
3.5 Introduction and Application of mass customization and Smart Machine Tools
3.6 Robotics and Automation (perception, manipulation, mobility, autonomy)
3.7 Basic introduction of Smart Perception
3.8 Application of Sensor networks and Devices during smart manufacturing

Unit 4: Smart Application [6 Hrs]

4.1 Online Predictive Modeling
4.2 Monitoring and Intelligent
4.3 Control of Machining/Manufacturing and Logistics/Supply Chain Processes
4.4 Smart Energy Management of manufacturing processes and facilities

Unit 5: Smart and Empowered Workers [7 Hrs]

5.1 Basic method of Eliminating Errors and Omissions
5.2 Describe the technologies used in Deskilling Operations
5.3 Discuss different ways of improving Speed/Agility, information capture/traceability and intelligent
5.4 Study of decision making process under uncertainty assisted/augmented Production, assisted/augmented assembly, assisted/augmented quality, Assisted/Augmented Maintenance and Assisted/Augmented
5.5 Warehouse operations and assisted Training

Unit 6: Automated Control Structures in Manufacturing System [8 Hrs]

6.1 Discuss different methods of automated inspection and testing method
6.2 Introduction and application of sensor technologies
6.3 Basic introduction of coordinate measuring machines
6.4 Basic introduction of Machine vision system and its application on smart factory
6.5 Basic introduction and application of group Technology in smart manufacturing

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

1. Introduction to Smart Manufacturing, distinguish its signification in comparison to conventional manufacturing. [5 Hrs]
2. Case study on different tools used for Smart Manufacturing. [10 Hrs]
3. Discuss Smart Application on the basis of industry 4.0 [5 Hrs]
4. Case study about Smart Empowered working and deskilling operation with respect to industry. [10 Hrs]
5. Demonstrate an idea to implement smart energy management and environmental monitoring solutions for greening factories [10 Hrs]
6. Prepare the report on different smart manufacturing process used in the industry on the basis of industrial visit. [10 Hrs]
7. Prepare report on various International standard used for smart design [10 Hrs]

References:

1. K. Wang, Y. Wang, J.O. Strandhagen, T. Yu, "Advanced Manufacturing and Automation", V, WIT Press
2. M. Kuniavsky, "Smart Things: Ubiquitous Computing User Experience Design", Morgan Kaufmann, ISBN-10: 0123748992.
3. N. Vengurlekar and P. Bagal, "Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management", McGraw-Hill Education, ISBN-10: 0071790152.
4. Yingfeng Zhang, Fei Tao, "Optimization of Manufacturing Systems using the Internet of Things", Academic Press- Technology & Engineering.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Smart Factory	6	12
2	Introduction to Smart Manufacturing	8	14
3	Smart Design and Manufacturing	10	18
4	Smart Application	6	10
5	Smart and Empowered Workers	8	14
6	Automated Control Structures in Manufacturing System	7	12
	Total	**45**	**80**

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

Experts Involved in Curriculum Revision, 2022

S.N.	Name	Designation	Organization Address
1	Mahesh Chandra Luitel	Professor	Pulchowk Campus, IOE
2	Ram Krishna Maharjan	Professor	Pulchowk Campus, IOE
3	Dr. Krishna Prasad Shrestha	Assistant Professor	School of Engineering, KU
4	Shanta Maharjan	Associate Professor	Thapathali Campus, IOE
5	Raj Kumar Chaulagain	Lecturer	Thapathali Campus, IOE
6	Debendra Bahadur Raut	Lecturer	Thapathali Campus, IOE
7	Subodh Kumar Ghimire	Lecturer	Thapathali Campus, IOE
8	Subodh Nepal	Senior Lecturer	Himalaya College of Engineering, TU
9	Devendra Kathayat	Senior Lecturer	Himalaya College of Engineering, TU
10	Laxman Palikhel	Instructor	Thapathali Campus, IOE
11	Rajan Sharma	Instructor	Balaju School of Engineering and Technology, CTEVT
12	Akalesh Yadav	Mechatronics Engineer	Thapathali Campus, IOE
13	Rahul Gupta	Instrumentation Engineer	Bottlers Nepal Pvt. Ltd.