

CURRICULUM
OF
DIPLOMA OF ASSOCIATE ENGINEER
IN
Mechatronics
(3-Years)

Course Code-36AMCHT2024R3

Revised (July, 2024)

Curriculum Section, TEVTA

SCHEME OF STUDIES

DAE-Mechatronics Technology, Revised Aug. 2024

YEAR I				
CODE	TITLE	T	P	C
GEN-111	Islamiat & Pakistan Studies	1	0	1
TTQ-111/ Civic-111	Tarjumat-ul-Quran/ Civics	1	0	1
ENG-112	English	2	0	2
MATH-123	Applied Mathematics-I	3	0	3
PHY-122	Applied Physics	1	3	2
CH-112	Applied Chemistry	1	3	2
MECH-132	Basic Engineering Drawing & CAD	1	3	2
COMP-172	Computer Applications	1	3	2
MTR-142	Introduction to Mechatronics	1	3	2
MTRC-133	Electrical Essentials	2	3	3
MTR-153	Workshop Practice (a) Machining (b) Metal Fabrication (c) Electrical Wiring & PCB Making	1	6	3
MTRC-151	Occupational Health Safety & Environment	1	0	1
Total		16	24	24
YEAR II				
CODE	TITLE	T	P	C
GEN-201	Islamiat & Pakistan Studies	1	0	1
TTQ-211/ Civic-211	Tarjumat-ul-Quran / Civics	1	0	1
MATH-212	Applied Mathematics-II	2	0	2
MGM-252	Professional Ethics, Communication & Report writing	1	3	2
MTR-232	Engineering Materials	1	3	2
MTR-242	Engineering Mechanisms	1	3	2
MTR-243	Instrumentation & Measurements	2	3	3
COMP-212	Fundamentals of Computer Programming	1	3	2
MTR-273	Electronic Devices & Circuits	2	3	3
MTR-283	Digital Logic Design	2	3	3
MTR-293	Motors & Generators	2	3	3
Total		16	24	24
YEAR III				
CODE	TITLE	T	P	C
GEN-301	Islamiat & Pakistan Studies	1	0	1
MGMC-311	Intelligent Production and Management	1	0	1

MTR-313	Embedded Systems	1	6	3
MTR-302	Hydraulics & Pneumatics	1	3	2
MTR-322	Programmable Logic Controllers (PLCs)	1	3	2
MTR-332	Computerized Numerical Control (CNC)	1	3	2
MTR-342	Industrial Robotics	1	3	2
MTR-372	Emerging Technologies in Mechatronics & AI	1	3	2
MTR-382	Industrial Process Control and Troubleshooting	1	3	2
EPF-311	Entrepreneurship & Freelancing	0	3	1
MTRPJ-392	Project of Industrial relevance	0	6	2
Total		09	33	20

اسلامیات / مطالعہ پاکستان

ٹی پی سی	GEN III	حصہ اول اسلامیات
1 0 1		حصہ دوم مطالعہ پاکستان
کل وقت: 20 گھنٹے	سال اول	موضوعات حصہ اول اسلامیات
		کتاب و سنت

(ا) قرآن مجید

- 1- تعارف قرآن مجید 2- نزول قرآن 3- مکی و مدنی سورتوں کی خصوصیات 4- وحی کی اقسام 5- پندرہ منتخب آیات مع ترجمہ

- 1.1 تنالوا البر حتی تنفقوا مما تحبون
- 1.2 واعتصموا بحبل اللہ جمیعاً ولا تفرقوا
- 1.3 ولا یجر منکم شنان قوم علی ان لا تعدلوا
- 1.4 ان اللہ یا مریکم ان تودوا الامانات الی اهلها
- 1.5 ان اللہ یا مریکم بالعدل والاحسان
- 1.6 ان الصلوٰۃ تنہی عن الفحشاء وامنکر
- 1.7 لقد کان لکم فی رسول اللہ سۃ حسنۃ
- 1.8 ان اکرمکم عند اللہ اتقاکم
- 1.9 وما آتاکم الرسول فخرزوه وما نہی عنہوا نتهوا
- 1.10 واولفوا بالعہد
- 1.11 وما شروہن بالمعروف
- 1.12 یمحق اللہ الربو ویربى الصمدقات
- 1.13 واصبر علی ما اصابک
- 1.14 وقولوا سدیداً
- 1.15 ان الدین عند اللہ السلام

(ب) سنت

- 1- سنت کی اہمیت
- 2- دس منتخب احادیث مع ترجمہ و تشریح

- 1- انما لا اعمال بالنيات
- 2- اما بنت لا تم مكارم الاخلاق
- 3- لا يومن احدكم حق يحب الاخيه ما يحب النفسه
- 4- المسلم من سلم المسلمون من سلم المسلمون من النسانه ويده
- 5- قل امنن بالله سلم استقم
- 6- خيركم خيركم لا اله
- 7- سباب المسلم فسوق وقتاله كفر
- 8- المومن اخو المومن
- 9- كل المسلم على المسلم حرام بجمعه وماله وفرقه
- 10- ايتن المنافق ثلاث اذا حديث كذب وافا او تمن خان واذا وفدا خلف

دين اسلام

- 2.1 اسلام كے بنيادي مقاصد كي وضاحت اور انسان كي انفرادي و اجتماعي زندگي پر ان كے اثرات

- 1- توحيد
- 2- رسالت
- 3- آخرت
- 4- ملائكه
- 5- آسماني كتب

2.2 عبادات

- 1- نماز 2- روزه 3- حج 4- زكوة
- مندرجہ بالا عبادات كي اہميت و فضيلت، حکمتیں اور انسان كي انفرادي و معاشرتي زندگي پر اس كے اثرات

تدریسی مقاصد

1- قرآن مجید

- عمومی مقصد: طالب علم یہ سمجھنے کے قابل ہو کہ اسلام کی تعلیمات کا اصل سرچشمہ قرآن مجید ہے
خصوصی مقاصد: طالب علم اس قابل ہو جائے گا کہ
- ☆ قرآن مجید کی تعریف کر سکے
 - ☆ قرآن مجید کے نزول کی صورت بیان کر سکے
 - ☆ قرآن مجید کی کمی و مدنی سورتوں کی پہچان کر سکے
 - ☆ منتخب آیات کا ترجمہ و تشریح کر سکے
- عمومی مقصد: یہ سمجھنے کے قابل ہو جائے گا کہ منتخب قرآنی آیات کے ذریعے اسلامی تعلیمات کا مفہوم کیا ہے
- ☆ قرآنی آیات کا ترجمہ تشریح کر سکے
 - ☆ قرآنی تعلیمات کی روشنی میں اپنی اور معاشرتی اصلاح کر سکے

2- سنت

- عمومی مقصد: طالب علم سنت نبوی کی اہمیت اور ضرورت کو اچھی طرح سمجھنے کے قابل ہو جائے گا
خصوصی مقصد:
- ☆ سنت کی تعریف بیان کر سکے
 - ☆ سنت کی اہمیت و ضرورت کی وضاحت کر سکے
 - ☆ سنت کی روشنی میں اسوہ حسنہ پر عمل کر سکے
- 3- منتخب احادیث نبویہ

- عمومی مقصد: احادیث کی روشنی میں اخلاقی اقدار سے آگاہی حاصل کر سکے
خصوصی مقصد: احادیث کا ترجمہ و تشریح کر سکے
- رسول اللہ ﷺ کے اسوہ حسنہ کی پیروی کا جذبہ پیدا ہو سکے

عمومی مقاصد: دین اسلامی کے بنیادی مقاصد اور عبادات کے بارے میں جان سکے اور بیان کر سکے
خصوصی مقاصد

لفظ دین اسلام کے لغوی اور اصطلاحی معنی بیان کر سکے

اسلام کے بنیادی مقاصد کی اہمیت بیان کر سکے

اسلام کے بنیادی مقاصد سے انسان کی انفرادی و اجتماعی زندگی پر پڑنے والے اثرات بیان کر سکے

عبادت کے لفظی و اصطلاحی معنی بیان کر سکے

عقیدے اور عبادت کا فرق بیان کر سکے

عبادات (نماز، روزہ، حج، زکوٰۃ کے فوری احکامات اور انسانی زندگی پر ان کی اثرات بیان کر سکے

اسلامی مقاصد و عبادات کے مطابق اپنی زندگی ڈھال کر ایک اچھا مسلمان بن سکے

(غیر مسلم طلباء کے لئے)

GEN III

نصاب اخلاقیات سال اول
حصہ دوم مطالعہ پاکستان

ٹی بی سی
1 0 1
کل وقت: 20 گھنٹے

موضوعات

اخلاقیات کی تعریف اور اہمیت
اخلاقیات کا معیار (قانون، عقل، الہی کتب)
مندرجہ ذیل اخلاق کی وضاحت

- ☆ دیانت داری
- ☆ وفاداری
- ☆ نظم و ضبط
- ☆ راست گوئی
- ☆ صبر و استقلال
- ☆ حوصلہ مندی
- ☆ وقت کی پابندی
- ☆ صفائی
- ☆ اعتماد
- ☆ باہمی احترام
- ☆ مصلحت

نصاب اخلاقیات (سل اول)

تدریسی مقاصد

عمومی مقاصد: اعلیٰ اخلاق کی وجہ سے ملکی ترقی میں قتل قدر اضافہ کر سکے

خصوصی مقاصد: طالب اس علم سے اس قابل ہو گا کہ

- ☆ موضوعات کا مطلب بیان کر سکے
- ☆ عملی زندگی سے مثالوں کی نشاندہی کر سکے
- ☆ اپنی شخصیت اور معاشرے پر موضوعات کے مثبت اثرات پیدا کرنے کے طریقے بیان کر سکے
- ☆ دیانت داری کی اہمیت بیان کر سکے
- ☆ وفاداری کی اہمیت بیان کر سکے
- ☆ نظم و ضبط کی افادیت بیان کر سکے
- ☆ صدق بیان کی ضرورت بیان کر سکے
- ☆ حوصلہ مندی کے فوائد بیان کر سکے
- ☆ وقت کی پابندی کے فوائد بیان کر سکے
- ☆ صفائی اور باہمی اختیار سے حسن کارکردگی کو بیان کر سکے
- ☆ مصلحت کے فوائد بیان کر سکے

(غیر مسلم طلباء کے لئے)

GEN III

نصاب اخلاقیات سال اول
حصہ دوم مطالعہ پاکستان

ٹی بی سی
1 0 1
کل وقت: 20 گھنٹے

موضوعات

اخلاقیات کی تعریف اور اہمیت
اخلاقیات کا معیار (قانون، عقل، الہی کتب)
مندرجہ ذیل اخلاق کی وضاحت

- ☆ دیانت داری
- ☆ وفاداری
- ☆ نظم و ضبط
- ☆ راست گوئی
- ☆ صبر و استقلال
- ☆ حوصلہ مندی
- ☆ وقت کی پابندی
- ☆ صفائی
- ☆ اعتماد
- ☆ باہمی احترام
- ☆ مصلحت

نصاب (سال اول) Gen III

کل وقت 12 گھنٹے

مطالعہ پاکستان

حصہ دوم

موضوعات

- ☆ حریت فکر: مسلمان قوم میں آزادی فکر کی تاریخ - مسلمانوں میں سیاسی آزادی کی اہمیت اور ضرورت - ذہنی و جسمانی غلامی کے نقصانات
- ☆ نظریہ پاکستان
- ☆ قیام پاکستان کی اساس (دین اسلام) قیام پاکستان کی غرض و غایت نظریہ پاکستان کی وضاحت - نظریہ پاکستان اور علامہ اقبال اور قائد اعظم کے ارشادات کی روشنی میں
- ☆ نظریہ پاکستان کا تاریخی پہلو
- ☆ محمد بن قاسم کی آمد: مجدد الف ثانی اور شاہ ولی اللہ کی تبلیغی خدمات سید احمد شہید کی تحریک مجاہدین
- ☆ تعلیمی تحریکیں
- ☆ علی گڑھ - ندوت العلماء - دیوبند - مدرسۃ الاسلام - (سندھ) اسلامیہ کالج (پشاور) انجمن حمایت اسلام (لاہور)

مطالعہ پاکستان (حصہ دوم)
تدریسی مقاصد
حریت فکر:

- عمومی مقصد
- طالب علم یہ جان لے کہ اسلام میں اور مسلمان قوم میں آزادی فکر کی کیا اہمیت ہے
- خصوصی مقاصد
- ☆ حریت فکر کا معنی و مفہوم بیان کر سکے
 - ☆ آزادی فکر کی اہمیت بیان کر سکے
 - ☆ خصوصاً "اسلام میں آزادی اظہار رائے کی اہمیت بیان کر سکے
 - ☆ ذہنی غلامی کے قومی سطح پر نقصانات کے بیان کر سکے
 - ☆ جسمانی غلامی قومی سطح پر نقصانات بیان کر سکے
- نظریہ پاکستان
- عمومی مقصد:
- نظریہ پاکستان (دین اسلام) سے پوری طرح واقفیت ہو جائے
- خصوصی مقاصد:
- ☆ نظریہ کی تعریف بیان کر سکے اور اس کی وضاحت کر سکے
 - ☆ نظریہ پاکستان کی تعریف کر سکے اور اس کا مفہوم بیان کر سکے
 - ☆ علامہ اقبال اور قائد اعظم کے فرمودات کی روشنی میں نظریہ پاکستان بیان کر سکے
- نظریہ پاکستان کا تاریخی پہلو
- عمومی مقصد
- ☆ نظریہ پاکستان کے تاریخی پس منظر سے واقفیت حاصل کر سکے
- خصوصی مقاصد:
- ☆ محمد بن قاسم کے بارے میں بیان کر سکے

TTQ 111 TARJAMA TUL QURAN / CIVIC-111

Theory	32	T	P	C
Practical	0	1	0	1

As per syllabus of BISE from PCTB Book

Eng-112 ENGLISH

Total Contact Hours

Theory	64	T	P	C
Practical	0	2	0	2

AIMS At the end of the course, the students will be equipped with cognitive skill to enable them to present facts in a systematic and logical manner to meet the language demands of dynamic field of commerce and industry for functional day-to-day use and will inculcate skills of reading, writing and comprehension.

COURSE CONTENTS

ENGLISH PAPER "A"

1. PROSE/TEXT 16 Hours

1.1 First eight essays of Intermediate. English Book-II

2. CLOZE TEST 4 Hours

2.1 A passage comprising 50-100 words will be selected from the text. Every 11th word or any word for that matter will be omitted. The number of missing word will range (5-10). The chosen word may or may not be the one used in the text, but it should be an appropriate word.

ENGLISH PAPER "B"

3. GRAMMAR 26 Hours

- 3.1 Sentence Structure.
- 3.2 Tenses.
- 3.3 Parts of speech.
- 3.4 Punctuation,
- 3.5 Change of Narration.
- 3.6 One word for several
- 3.7 Words often confused

4. COMPOSITION 8 Hours

- 4.1 Letters/Messages
- 4.2 Job application letter
- 4.3 For character certificate/for grant of scholarship
- 4.4 Telegrams, Cablegrams and Radiograms, Telexes, Facsimiles
- 4.5 Essay writing
- 4.6 Technical Education, Science and Our life, Computers, Environmental Pollution, Duties of a Student.

5. TRANSLATION 6 Hours

- 5.1 Translation from Urdu into English.
For Foreign Students: A paragraph or a dialogue.

RECOMMENDED BOOKS

- 1. Technical English developed by Mr. Zia Sarwar, Mr. Habib-ur –Rehman, Evaluated by Mr.Zafar Iqbal Khokhar, Mr. Zahid Zahoor, Vol - I, National Book Foundation

INSTRUCTIONAL OBJECTIVES

PAPER-A

1. DEMONSTRATE BETTER READING, COMPREHENSION AND VOCABULARY

- 1.1 Manipulate, skimming and scanning of the text.
- 1.2 Identify new ideas.
- 1.3 Reproduce facts, characters in own words
- 1.4 Write summary of stories

2. UNDERSTAND FACTS OF THE TEXT

- 2.1 Rewrite words to fill in the blanks recalling the text.
- 2.2 Use own words to fill in the blanks.

PAPER-B

3. APPLY THE RULES OF GRAMMAR IN WRITING AND SPEAKING

- 3.1 Use rules of grammar to construct meaningful sentences containing a subject and a predicate.
- 3.2 State classification of time, i.e. present, past and future and use verb tense correctly in different forms to denote relevant time.
- 3.3 Identify function words and content words.
- 3.4 Use marks of punctuation to make sense clear.
- 3.5 Relate what a person says in direct and indirect forms.
- 3.6 Compose his writings.
- 3.7 Distinguish between confusing words.

4. APPLY THE CONCEPTS OF COMPOSITION WRITING TO PRACTICAL SITUATIONS

- 4.1 Use concept to construct applications for employment, for character certificate, for grant of scholarship.
- 4.2 Define and write telegrams, cablegrams and radiograms, telexes, facsimiles
- 4.3 Describe steps of a good composition writing.
- 4.4 Describe features of a good composition.
- 4.5 Describe methods of composition writing.
- 4.6 Use these concepts to organize facts and describe them systematically in practical situation

5. APPLIES RULES OF TRANSLATION

- 5.1 Describe confusion.
- 5.2 Describe rules of translation.
- 5.3 Use rules of translation from Urdu to English in simple paragraph and sentences.

Math-123 APPLIED MATHEMATICS-I

Theory	96	T	P	C
Practical	0	3	0	3

Pre-requisite: Must have completed a course of Elective Mathematics at Matric level.

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

1. Solve problems of Algebra, Trigonometry, vectors, Mensuration, Matrices and Determinants.
2. Develop skill, mathematical attitudes and logical perception in the use of mathematical instruments as required in the technological fields.
3. Acquire mathematical clarity and insight in the solution of technical problems.

COURSE CONTENTS**1. QUADRATIC EQUATIONS****6 Hours**

- 1.1 Standard Form
- 1.2 Solution
- 1.3 Nature of roots
- 1.4 Sum & Product of roots
- 1.5 Formation
- 1.6 Problems

2. BINOMIAL THEOREM**6 Hours**

- 2.1 Factorials
- 2.2 Binomial Expression
- 2.3 Binomial Co-efficient
- 2.4 Statement
- 2.5 The General Term
- 2.6 The Binomial Series

2.7 Problems.

3. PARTIAL FRACTIONS 6 Hours

- 3.1 Introduction
- 3.2 Linear Distinct Factors Case I
- 3.3 Linear Repeated Factors Case II
- 3.4 Quadratic Distinct Factors Case III
- 3.5 Quadratic Repeated Factors Case IV
- 3.6 Problems

4. FUNDAMENTALS OF TRIGONOMETRY 6 Hours

- 4.1 Angles
- 4.2 Quadrants
- 4.3 Measurements of Angles
- 4.4 Relation between Sexagesimal & circular system
- 4.5 Relation between Length of a Circular Arc & the Radian Measure of its central Angle
- 4.6 Problems

5. TRIGONOMETRIC FUNCTIONS AND RATIOS 6 Hours

- 5.1 Trigonometric functions of any angle
- 5.2 Signs of trigonometric Functions
- 5.3 Trigonometric Ratios of particular Angles
- 5.4 Fundamental Identities
- 5.5 Problems

6. GENERAL IDENTITIES 6 Hours

- 6.1 The Fundamental Law
- 6.2 Deductions
- 6.3 Sum & Difference Formulae
- 6.4 Double Angle Identities
- 6.5 Half Angle Identities
- 6.6 Conversion of sum or difference to products
- 6.7 Problems

7.	SOLUTION OF TRIANGLES	6 Hours
7.1	The law of Sines	
7.2	The law of Cosines	
7.3	Measurement of Heights & Distances	
7.4	Problems	
8.	VECTORS AND PHASORS	12 Hours
8.1	Scalars and Vectors	
8.2	The unit Vectors i, j, k	
8.3	Direction Cosines	
8.4	Dot Product	
8.5	Cross Product	
8.6	Analytic Expressions for dot and cross products	
8.7	Phasors	
8.8	Significance of j Operator	
8.9	Different Forms	
8.10	Algebraic Operations	
8.11	Problems	
9.	COMPLEX NUMBERS	9 Hours
9.1	Introduction and Properties	
9.2	Basic Operations	
9.3	Conjugate	
9.4	Modulus	
9.5	Different Forms	
9.6	Problems	
10.	BOOLEAN ALGEBRA AND GATE NETWORKS	15 Hours
10.1	Concept and basic laws	
10.2	Sums of product and products of sums	
10.3	Binary, decimals and octals, presentation of decimal numbers in BCD	

10.4	Intercorversion of numbers	
10.5	OR Gates and AND Gates	
10.6	Logical Expressions and their simplifications	
10.7	Demorgan's Theorams	
10.8	NAND Gates and NOR Gates	
10.9	Problems	
11.	PLANE ANALYTIC GEOMETRY AND STRAIGHT LINE	6 Hours
11.1	Coordinate system	
11.2	Distance formula	
11.3	Ration Formulas	
11.4	Inclination and slope of line	
11.5	Slope Formula	
11.6	Problems	
12.	EQUATIONS OF THE STRAIGHT LINE	6 Hours
12.1	Some Important Forms	
12.2	General form	
12.3	Angle Formula	
12.4	Parallelism and Perpendicularity	
12.5	Problems	
13.	EQUATIONS OF THE CIRCLE	6 Hr.
13.1	Standard and Central forms of equations	
13.2	General Form of Equation	
13.3	Radius and Coordinates of Center	
13.4	Problems	

RECOMMENDED BOOKS

Applied Mathematics Math-113, by Nasir -ud-Din Mahmood, Sana-ullah Khan, Tahir Hameed, Syed Tanvir Haider, Javed Iqbal, Vol - I, National Book Foundation

INSTRUCTIONAL OBJECTIVES

1. USE DIFFERENT METHODS FOR THE SOLUTION OF QUADRATIC EQUATION

- 1.1 Define a standard quadratic equation.
- 1.2 Use methods of factorization and method of completing the square for solving the equations.
- 1.3 Derive quadratic formula.
- 1.4 Write expression for the discriminant.
- 1.5 Explain nature of the roots of a quadratic equation.
- 1.6 Calculate the sum and product of the roots.
- 1.7 Form a quadratic equation from the given roots.
- 1.8 Solve problems involving quadratic equations.

2. APPLY BINOMIAL THEOREM FOR THE EXPANSION OF BINOMIAL AND EXTRACTION OF ROOTS.

- 2.1 State binomial theorem for positive integral index.
- 2.2 Explain binomial coefficients:
 $(n,0), (n,1), \dots, (n,r), \dots, (n,n)$
- 2.3 Derive expression for the general term.
- 2.4 Calculate the specified terms.
- 2.5 Expand a binomial of a given index.
- 2.6 Extract the specified roots.
- 2.7 Compute the approximate value to a given decimal place.
- 2.8 Solve problems involving binomials.

3. APPLY DIFFERENT METHODS FOR RESOLVING A SINGLE FRACTION INTO PARTIAL FRACTIONS USING DIFFERENT METHODS

- 3.1 Define a partial fraction, a proper and an improper fraction.
- 3.2 Explain all the four types of partial fractions.
- 3.3 Set up equivalent partial fractions for each type.

- 3.4 Explain the methods for finding constants involved.
- 3.5 Resolve a single fraction into partial fractions.
- 3.6 Solve problems involving all the four types.

4. UNDERSTAND THE SYSTEMS OF MEASUREMENT OF ANGLES.

- 4.1 Define angles and the related terms.
- 4.2 Illustrate the generation of an angle.
- 4.3 Explain sexagesimal and circular systems for the measurement of angles.
- 4.4 Derive the relationship between radian and degree.
- 4.5 Convert radians to degrees and vice versa.
- 4.6 Derive a formula for the circular measure of a central angle.
- 4.7 Use this formula for solving problems.

5. UNDERSTAND BASIC CONCEPTS AND PRINCIPLES OF TRIGONOMETRIC FUNCTIONS.

- 5.1 Define the basic trigonometric functions/ratios of an angle as ratios of the sides of a right triangle.
- 5.2 Derive fundamental identities.
- 5.3 Find trigonometric ratios of particular angles.
- 5.4 Draw the graph of trigonometric functions.
- 5.5 Solve problems involving trigonometric functions.

6. USE TRIGONOMETRIC IDENTITIES IN SOLVING TECHNOLOGICAL PROBLEMS.

- 6.1 List fundamental identities.
- 6.2 Prove the fundamental law.
- 6.3 Deduce important results.
- 6.4 Derive sum and difference formulas.
- 6.5 Establish half angle, double and triple angle formulas.
- 6.6 Convert sum or difference into product and vice versa.
- 6.7 Solve problems.

7. USE CONCEPT, PROPERTIES AND LAWS OF TRIGONOMETRIC FUNCTIONS FOR SOLVING TRIANGLES.

- 7.1 Define angle of elevation and angle of depression.

- 7.2 Prove the law of sines and the law of cosines.
- 7.3 Explain elements of a triangle.
- 7.4 Solve triangles and the problems involving heights and distances.

8. UNDERSTAND PRINCIPLES OF VECTORS AND PHASORS

- 8.1 Define unit vectors i, j, k .
- 8.2 Express a vector in the component form.
- 8.3 Explain magnitude, unit vector, direction cosines of a vector.
- 8.4 Explain dot product and cross product of two vector.
- 8.5 Deduce important results from dot and cross product.
- 8.6 Define phasor and operator j .
- 8.7 Explain different forms of phasors.
- 8.8 Perform basic Algebraic operation on phasors.
- 8.9 Solve problems on phasors.

9. USE PRINCIPLES OF COMPLEX NUMBERS IN SOLVING TECHNOLOGICAL PROBLEMS.

- 9.1 Define a complex number and its conjugate.
- 9.2 State properties of complex numbers.
- 9.3 Give different forms of complex numbers.
- 9.4 Perform basic algebraic operations on complex numbers.
- 9.5 Solve problem involving complex numbers.

10. SOLVE TECHNICAL PROBLEMS USING PRINCIPLES OF BOOLEAN ALGEBRA

- 10.1 Explain fundamental concepts of Boolean algebra
- 10.2 Explain binary numbers, octal numbers, decimal numbers and their interconversion.
- 10.3 Explain digital addition and multiplication and its applications to OR gates and AND Gates
- 10.4 Illustrate complimentation and inversion
- 10.5 Evaluate logical expression
- 10.6 List basic Laws of Boolean Algebra
- 10.7 Explain De-Morgan's theorem
- 10.8 Explain basic duality of Boolean algebra
- 10.9 Derive Boolean expression
- 10.10 Explain combination of GATES

- 10.11 Illustrate sum of products and product of sum
- 10.12 Derive product of sum expression
- 10.13 Explain NAND Gates and NOR Gates
- 10.14 Use the map methods for simplifying expressions
- 10.15 Explain sub-cubes and covering

11. UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY

- 11.1 Explain the rectangular coordinate system.
- 11.2 Locate points in different quadrants.
- 11.3 Derive distance formula.
- 11.4 Describe the ratio formula
- 11.5 Derive slope formula
- 11.6 Solve problems using the above formulae.

12. USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

- 12.1 Define equation of a straight line.
- 12.2 Derive slope intercept and intercept forms of equations of a straight line.
- 12.3 Write general form of equations of a straight line.
- 12.4 Derive an expression for angle between two straight lines.
- 12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
- 12.6 Solve problems using these equations/formulae.

13. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE

- 13.1 Define a circle.
- 13.2 Describe standard, central and general forms of the equation of a circle.
- 13.3 Convert general form to the central form of equation of a circle.
- 13.4 Deduce formula for radius and coordinates of the center of a circle.
- 13.5 Derive equation of the circle passing through three points.
- 13.6 Solve problems involving these equations.

Phy-122 Applied Physics

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

AIMS: The students will be able to understand the fundamental principles and concept of physics and apply this to solve technical problems pertaining to real life situations. This shall also inspire them to learn advance physics and other technical courses.

COURSE CONTENTS

1 MEASUREMENTS. 2 Hours

- 1.1 Fundamental units and derived units
- 1.2 Systems of measurement and S.I. units
- 1.3 Concept of dimensions, dimensional formula
- 1.4 Conversion from one system to another
- 1.5 Significant figures

2. SCALARS AND VECTORS. 4 Hours

- 2.1 Revision of head to tail rule
- 2.2 Laws of parallelogram, triangle and polygon of forces
- 2.3 Resolution of a vector
- 2.4 Addition of vectors by rectangular components
- 2.5 Multiplication of two vectors, dot product and cross product

3. MOTION 4 Hours

- 3.1 Review of laws and equations of motion
- 3.2 Law of conservation of momentum
- 3.3 Angular motion
- 3.4 Relation between linear and angular motion
- 3.5 Centripetal acceleration and force
- 3.6 Equations of angular motion

4. TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA 2 Hours

- 4.1 Torque
- 4.2 Center of gravity and center of mass
- 4.3 Equilibrium and its conditions
- 4.4 Torque and angular acceleration
- 4.5 Rotational inertia

5.	WAVE MOTION	5 Hours
5.1	Review Hooke's law of elasticity,	
5.2	Motion under an elastic restoring force.	
5.3	Characteristics of simple harmonic motion	
5.4	S.H.M. and circular motion	
5.5	Simple pendulum	
5.6	Wave form of S.H.M.	
5.7	Resonance	
5.8	Transverse vibration of a stretched string	
6.	SOUND	5 Hours
6.1	Longitudinal waves	
6.2	Intensity, loudness, pitch and quality of sound	
6.3	Units of Intensity of level and frequency response of ear	
6.4	Interference of sound waves silence zones, beats	
6.5	Acoustics	
6.6	Doppler's' effect	
7.	LIGHT	5 Hours
7.1	Review laws of reflection and refraction	
7.2	Image formation by mirrors and lenses	
7.3	Optical instruments	
7.4	Wave theory of light	
7.5	Interference, diffraction, polarization of light waves	
7.6	Applications of polarization in sunglasses, optical activity and stress analysis	
8.	OPTICAL FIBER	2 Hours
8.1	Optical communication and problems	
8.2.	Review total internal reflection and critical angle	
8.3	Structure of optical fiber	
8.4	Fiber material and manufacture	
8.5	Optical fiber - uses.	
9.	LASERS	3 Hours
9.1	Corpuscular theory of light	
9.2	Emission and absorption of light	
9.3	Stimulated absorption and emission of light	
9.4	Laser principle	
9.5	Structure and working of lasers	

- 9.6 Types of lasers with brief description.
- 9.7 Applications (basic concepts)
- 9.8 Material processing
- 9.9 Laser welding
- 9.10 Laser assisted machining
- 9.11 Micro machining
- 9.12 Drilling scribing and marking
- 9.13 Printing
- 9.14 Lasers in medicine

RECOMMENDED BOOKS

1. Applied Physics, Phy-122 by Mr. Khalid Mehmood, Zafar Tarar, Dr. Muhammad Ajmal, Mr. Habib-ullah, Mr. Asif Ali

INSTRUCTIONAL OBJECTIVES

1 USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS

- 1.1 Write dimensional formulae for physical quantities
- 1.2 Derive units using dimensional equations
- 1.3 Convert a measurement from one system to another
- 1.4 Use concepts of measurement and significant figures in problem solving.

2 USE CONCEPTS OF SCALARS AND VECTORS IN SOLVING PROBLEMS INVOLVING THESE CONCEPTS

- 2.1 Explain laws of parallelogram, triangle and polygon of forces
- 2.2 Describe method of resolution of a vector into components
- 2.3 Describe method of addition of vectors by rectangular components
- 2.4 Differentiate between dot product and cross product of vectors
- 2.5 Use the concepts in solving problems involving addition, resolution and multiplication of vectors

3 USE THE LAW OF CONSERVATION OF MOMENTUM AND CONCEPTS OF ANGULAR MOTION TO PRACTICAL SITUATIONS

- 3.1 Use law of conservation of momentum to practical/technological problems
- 3.2 Explain relation between linear and angular motion
- 3.3 Use concepts and equations of angular motion to solve relevant technological problems

4 USE CONCEPTS OF TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA TO PRACTICAL SITUATION/PROBLEMS

- 4.1 Explain Torque
- 4.2 Distinguish between Centre of gravity and centre of mass
- 4.3 Explain rotational Equilibrium, and its conditions
- 4.4 Explain Rotational Inertia giving examples
- 4.5 Use the above concepts in solving technological problems.

5 USE CONCEPTS OF WAVE MOTION IN SOLVING RELEVANT PROBLEMS

- 5.1 Explain Hooke's Law of Elasticity
- 5.2 Derive formula for Motion under an elastic restoring force
- 5.3 Derive formulae for simple harmonic motion and simple pendulum
- 5.4 Explain wave form with reference to S.H.M. and circular motion
- 5.5 Explain Resonance

- 5.6 Explain Transverse vibration of a stretched 'string
- 5.7 Use the above concepts and formulae of S.H.M. to solve relevant problems.

6 UNDERSTAND CONCEPTS OF SOUND

- 6.1 Describe longitudinal wave and its propagation
- 6.2 Explain the concepts: Intensity, loudness, pitch and quality of sound
- 6.3 Explain units of Intensity of level and frequency response of ear
- 6.4 Explain phenomena of silence zones, beats
- 6.5 Explain Acoustics of buildings.
- 6.6 Explain Doppler Effect giving mathematical expressions.

7 USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS AND LENSES

- 7.1 Explain laws of reflection and refraction
- 7.2 Use mirror formula to solve problems
- 7.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscopes, telescopes, camera and sextant.

8 UNDERSTAND WAVE THEORY OF LIGHT

- 8.1 Explain wave theory of light
- 8.2 Explain phenomena of interference, diffraction, polarization of light waves
- 8.3 Describe uses of polarization given in the course contents.

9 UNDERSTAND THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER

- 9.1 Explain the structure of the Optical Fiber
- 9.2 Explain its principle of working
- 9.3 Describe use of optical fiber in industry and medicine.

LIST OF PRACTICALS

1. Draw graphs representing the functions:
 - a) $y=mx$ for $m=0, 0.5, 1, 2$
 - b) $y=x^2$
 - c) $y = 1/x$
2. Find the volume of a given solid cylinder using Verniercalipers.
3. Find the area of cross-section of the given wire using micrometer screw gauge.
4. Prove that force is directly proportional to (a) mass, (b) acceleration, using fletchers trolley
5. Verify law of parallelogram of forces using Grave-sands apparatus.
6. Verify law of triangle of forces and Lami's theorem
7. Determine the weight of a given body using
 - a) Law of parallelogram of forces
 - b) Law of triangle of forces
 - c) Lami's theorem
8. Verify law of polygon of forces using Grave-sands apparatus.
9. Locate the position and magnitude of resultant of like parallel forces.
10. Determine the resultant of two unlike parallel forces.
- II. Find the weight of a given body using principle of moments.
12. Locate the centre of gravity of regular and irregular shaped bodies.
13. Find Young's Modules of Elasticity of a metallic wire.
14. Verify Hooke's Law using helical spring.
15. Study of frequency of stretched string with length.
16. Study of variation of frequency of stretched string with tension.
17. Study resonance of air column in resonance tube and find velocity of sound.
18. Find the frequency of the given tuning fork using resonance tube.
19. Find velocity of sound in rod by Kundt's tube
20. Verify rectilinear propagation of light and study shadow formation.
21. Study effect of rotation of plane mirror on reflection.
22. Compare the refractive indices of given glass slabs.
23. Find focal length of concave mirror by locating centre of curvature.
24. Find focal length of concave mirror by object and image method
25. Find focal length of concave mirror with converging lens.
26. Find refractive index of glass by apparent depth.
27. Find refractive index of glass by spectrometer.
28. Find focal length of converging lens by plane mirror.
29. Find focal length of converging lens by displacement method.
30. Find focal length of diverging lens using converging lens.
31. Find focal length of diverging lens using concave mirror.
32. Find angular magnification of an astronomical telescope.
33. Find angular magnification of a simple microscope (Magnifying Glass)
34. Find angular magnification of a compound microscope.
35. Study working and structure of camera.

36. Study working and structure of sextant.
37. Compare the different scales of temperature and verify the conversion formula.
38. Determine the specific heat of lead shots.
39. Find the coefficient of linear expansion of a metallic rod.
40. Find the heat of fusion of ice.
41. Find the heat of vaporization.
42. Determine relative humidity using hygrometer

Total Contact HoursTheory **32**Practical **96**

Pre-requisite: The student must have studied the subject of elective chemistry at Secondary, school level.

AIMS After studying this course a student will be able to;

1. Understand the significance and role of chemistry in the development of modern technology.
2. Become acquainted with the basic principles of chemistry as applied in the study of relevant Technology.
3. Know the scientific methods for production, properties and use of materials of industrial & .technological significance.
4. Gains skill for the efficient conduct of practical's in a Chemistry lab.

COURSE CONTENTS

1	INTRODUCTION AND FUNDAMENTAL CONCEPTS	2 Hrs
1.1	Orientation with reference to this technology	
1.2	Terms used & units of measurements in the study of chemistry	
1.3	Chemical Reactions & their types	
2	ATOMIC STRUCTURE	2 Hrs
2.1	Sub-atomic particles	
2.2	Architecture of atoms of elements, Atomic No. & Atomic Weight	
2.3	The periodic classification of elements periodic law	
2.4	General characteristics of a period and group	
3	CHEMICAL BOND	2 Hrs
3.1	Nature of chemical Bond	
3.2	Electrovalent bond with examples	
3.3	Covalent Bond (Polar and Non-polar, sigma & Pi Bonds with examples	
3.4	Co-ordinate Bond with examples	
4	WATER	2 Hrs
4.1	Chemical nature and properties.	
4.2	Impurities	
4.3	Hardness of water (types, causes & removal)	
4.4	Scales of measuring hardness (Degrees Clark	
4.5	Boiler feed water, scales & treatment	
4.6	Sea-water desalination, sewage treatment	
5	ACIDS, BASES AND SALTS	2 Hrs

5.1	Definitions with examples	
5.2	Properties, their strength, basicity & Acidity	
5.3	Salts and their classification with examples	
5.4	pH-value and scale	
6	OXIDATION & REDUCTION	2 Hrs
6.1	The process, definition& examples	
6.2	Oxidizing and reducing agents	
6.3	Oxides and their classifications	
7	NUCLEAR CHEMISTRY	2 Hrs
7.1	Introduction	
7.2	Radioactivity (alpha, beta and gamma rays)	
7.3	Half life process	
7.4	Nuclear reaction & transformation of elements	
8	CEMENT	2 Hrs
8.1	Introduction	
8.2	Composition and manufacture	
8.3	Chemistry of setting and hardening	
8.4	Special purpose cements	
9	GLASS	2 Hrs
9.1	Composition and raw material	
9.2	Manufacture	
9.3	Varieties and uses	
10	PLASTICS AND POLYMERS	2 Hrs
10.1	Introduction and importance	
10.2	Classification	
10.3	Manufacture	
10.4	Properties and uses	
11	PAINTS, VARNISHES AND DISTEMPER	2 Hrs
11.1	Introduction	
11.2	Constituents	
11.3	Preparation and uses	
12	CORROSION	2 Hrs
12.1	Introduction with causes	
12.2	Types of corrosion	
12.3	Rusting of iron	
12.4	Protective measures against-corrosion	
13	REFRACTORY MATERIALS AND ABRASIVE	2 Hrs

13.1	Introduction to Refractories	
13.2	Classification of Refractories	
13.3	Properties and Uses	
13.4	Introduction to Abrasives	
13.5	Artificial and Natural Abrasives and their uses	
14	ALLOYS	2 Hrs
14.1	Introduction with need	
14.2	Preparation and Properties	
14.3	Some Important alloys and their composition	
14.4	Uses	
15	FUELS AND COMBUSTION	2 Hrs
15.1	Introduction of fuels	
15.2	Classification of fuels	
15.3	Combustion	
15.4	Numerical Problems of Combustion	
16	LUBRICANTS	1 Hr
16.1	Introduction.	
16.2	Classification.	
16.3	Properties of lubricants.	
16.4	Selection of lubricants:	
17	POLLUTION	1 Hr
17.1	The problem and its dangers.	
17.2	Causes of pollution.	
17.3	Remedies to combat the hazards of pollution.	

BOOKS RECOMMENDED

1. Applied Chemistry-112, developed by Mr. Muhammad Ayub, Mr. Qasim Shamim, Mr. Yousuf Qamar, Shaukat Ali Awan and Muhammad Naushad

INSTRUCTIONAL OBJECTIVES**1 UNDERSTAND THE SCOPE, SIGNIFICANCE AND FUNDAMENTAL ROLE OF THE SUBJECT**

- 1.1 Define chemistry and its important terms
- 1.2 State the units of measurements in the study of chemistry
- 1.3 Write chemical formula of common compounds
- 1.4 Describe types of chemical reactions with examples

2 UNDERSTAND THE STRUCTURE OF ATOMS AND ARRANGEMENT OF SUB ATOMIC PARTICLES IN THE ARCHITECTURE OF ATOMS

- 2.1 Define atom.
- 2.2 State the periodic law of elements.
- 2.3 Describe the fundamental sub atomic particles
- 2.4 Distinguish between atomic no. and mass no.; isotopes and isobars
- 2.5 Explain the arrangements of electrons in different shells and sub energy levels
- 2.6 Explain the grouping and placing of 'elements' in the periodic table

3 UNDERSTAND THE NATURE OF CHEMICAL BOND

- 3.1 Define chemical bond
- 3.2 Describe the nature of chemical bond
- 3.3 Differentiate between electrovalent and covalent bonding
- 3.4 Explain the formation of polar and non polar, sigma and pi-bond with examples
- 3.5 Describe the nature of coordinate bond with examples

4 UNDERSTAND THE CHEMICAL NATURE OF WATER

- 4.1 Describe the chemical nature of water with its formula
- 4.2 Describe the general impurities present in water
- 4.3 Explain the causes and methods to removing hardness of water
- 4.4 Express hardness in different units like mg/liter, p.p.m, degrees Clark and degrees French
- 4.5 Describe the formation and nature of scales in boiler feed water
- 4.6 Explain the method for the treatment of scales
- 4.7 Explain the sewage treatment and desalination of sea water

5 UNDERSTAND THE NATURE OF ACIDS, BASES AND SALTS

- 5.1 Define acids, bases and salts with examples
- 5.2 State general properties of acids and bases
- 5.3 Differentiate between acidity and basicity and use the related terms
- 5.4 Define salts, state their classification with examples
- 5.5 Explain p-H value of solution and pH scale

6 UNDERSTAND THE PROCESS OF OXIDATION AND REDUCTION

- 6.1 Define oxidation
- 6.2 Explain the oxidation process with examples

- 6.3 Define reduction
- 6.4 Explain reduction process with examples
- 6.5 Define oxidizing and reducing-agents and give it least six examples of each
- 6.6 Define oxides
- 6.7 Classify the oxides and give example

7 UNDERSTAND THE FUNDAMENTALS OF NUCLEAR CHEMISTRY

- 7.1 Define nuclear chemistry and radio activity
- 7.2 Differentiate between alphas, Beta and Gamma particles
- 7.3 Explain half-life process
- 7.4 Explain at least six nuclei reactions resulting in the transformation of some elements
- 7.5 State important uses of isotopes

8 UNDERSTAND THE MANUFACTURE, SETTING AND HARDENING CEMENT

- 8.1 Define port land cement and give its composition
- 8.2 Describe the method of manufacture
- 8.3 Describe the chemistry of setting and hardening of cement
- 8.4 Distinguish between ordinary and special purpose cement

9 UNDERSTAND THE PROCESS OF MANUFACTURE OF GLASS.

- 9.1 Define glass
- 9.2 Describe its composition and raw materials
- 9.3 Describe the manufacture of glass
- 9.4 explain its varieties and uses

10 UNDERSTAND THE NATURE AND IMPORTANCE OF PLASTICS POLYMERS

- 10.1. Define plastics and polymers
- 10.2 Explain the mechanism of polymerization
- 10.3 Describe the preparation and uses of some plastics/polymers

11 KNOW THE CHEMISTRY OF PAINTS, VARNISHES AND DISTEMPERS

- 11.1 Define paints, varnishes and distemper
- 11.2 State composition of each
- 11.3 State methods of preparation of each and their uses

12 UNDERSTAND THE PROCESS OF CORROSION WITH ITS CAUSES AND TYPES

- 12.1 Define corrosion
- 12.2 Describe different types of corrosion
- 12.3 State the causes of corrosion
- 12.4 Explain the process of rusting of iron
- 12.5 Describe methods to prevent/control corrosion

13 UNDERSTAND THE NATURE OF REFRACTORY MATERIALS AND ABRASIVE

- 13.1 Define refractory materials
- 13.2 Classify refractory materials

- 13.3 Describe properties and uses of refractories
- 13.4 Define abrasive.
- 13.5 Classify natural and artificial abrasives
- 13.6 Describe uses of abrasives

14 UNDERSTAND THE NATURE AND IMPORTANCE OF ALLOYS

- 14.1 Define alloy
- 14.2 Describe different methods for the preparation of alloys
- 14.3 Describe important properties of alloys
- 14.4 Enlist some important alloys with their composition, properties and uses

15 UNDERSTAND THE NATURE OF FUELS AND THEIR COMBUSTION

- 15.1 Define fuels
- 15.2 Classify fuels and make distinction of solid, liquid & gaseous fuels
- 15.3 Describe important Fuels
- 15.4 Explain combustion
- 15.5 Calculate air quantities in combustion, gases

16 UNDERSTAND THE NATURE OF LUBRICANTS.

- 16.1 Define a lubricant
- 16.2 Explain the uses of lubricants
- 16.3 Classify lubricants and cite examples
- 16.4 State important properties of oils, greases and solid lubricants
- 16.5 State the criteria for the selection of lubricant for, particular purpose/job

17 UNDERSTAND THE NATURE OF POLLUTION

- 17.1 Define Pollution (air, water, food)
- 17.2 Describe the causes of environmental pollution.
- 17.3 Enlist some common pollutants.
- 17.4 Explain methods to prevent pollution

CH-112 APPLIED CHEMISTRY

LIST OF PRACTICALS

1. To introduce the common apparatus, glassware and chemical reagents used in the lab.
2. To purify a chemical substance by crystallization.
3. To separate a mixture of sand and salt.
4. To find the melting point of substance.
5. To find the pH of a solution with pH paper.
6. To separate a mixture of inks by chromatography.
7. To determine the co-efficient of viscosity of benzene with the help of Ostwald viscometer.
8. To find the surface tension of a liquid with a stalagmometer.
9. To perform electrolysis of water to produce Hydrogen and Oxygen.
10. To determine the chemical equivalent of copper by electrolysis of Cu SO.
11. To get introduction with the scheme of analysis of salts for basic radicals.
12. To analyse 1st group radicals (Ag^+ - Pb^{++} - Hg^+).
13. To make practice for detection 1st group radicals.
14. To get introduction with the scheme of II group radicals.
15. To detect and confirm II-A radicals (Hg^{++} , Pb^{++++} , Cu^+ , Cd^{++} , Bi^{+++}).
16. To detect and confirm II-B radicals Sn^{+++} , Sb^{+++} , As^{+++}).
17. To get introduction with the scheme of III group radicals (Fe^{+++} - Al^{+++} , Cr^{+++})
18. To detect and confirm Fe^{+++} , Al^{+++} and Cr^{+++} .
19. To get introduction with the scheme of IV group radicals.
20. To detect and confirm An^{++} and Mn^{++} radicals of IV group.
21. To detect and confirm Co^{++} and Ni^{++} radicals of IV group.
22. To get introduction with the Acid Radical Scheme.
23. To detect dilute acid group.
24. To detect and confirm CO_3^{--} and HCO_3^- radicals.
25. To get introduction with the methods/apparatus of conducting volumetric estimations.
26. To prepare standard solution of a substance.
27. To find the strength of a given alkali solution.
28. To estimate HCO_3^- contents in water.
29. To find out the %age composition of a mixture solution of KNO_3 and KOH volumetrically.
30. To find the amount of chloride ions in water volumetrically.

MECH-132 BASIC ENGINEERING DRAWING AND CAD

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

Students will be able to understand the fundamentals of engineering drawing with specific reference to mechatronics technology. The students shall become familiar with the use of conventional drawing equipment as well as the modern CAD tools (i.e., AutoCAD) to develop & understand technical drawings that impart the competency to draw simple geometrical figures and two/three-dimensional drawing of objects, efficiently and more precisely. The manual drawing part of the course constitutes around 40% of the course whereas the remaining 60% will be reserved for CAD.

Pre-requisites:

None

Course Contents:

- 1. Introduction of Technical Drawing** **2 Hours**
 - 1.1. Need and significance of Technical Drawings
 - 1.2. Bill of material and Bill of Quantity
 - 1.3. Types of Drawings
 - 1.4. Symbol of devices and components
- 2. Drafting Equipment, Types of Lines and Lettering** **3 Hours**
 - 2.1. List of drawing equipment
 - 2.2. Basic lines and Types of line
 - 2.3. Lettering
- 3. Basic Dimensioning** **2 Hours**
 - 3.1. Elements of dimensioning
 - 3.2. System of measurements
 - 3.3. Tolerance
 - 3.4. Note & specification.
- 4. Drafting Geometry, Sketching, And Engineering Curves** **3 Hours**
 - 4.1. Introduction to geometry, plane, and solid type
 - 4.2. Different conventional shapes, surfaces, and objects
 - 4.3. Introduction to sketching techniques.
 - 4.4. Introduction to the curve
 - 4.5. Cone and conic section
 - 4.6. Spiral and Involute
 - 4.7. Cycloid, Epicycloids, Hypocycloid
- 5. Introduction to Multi-View Drawings** **3 Hours**
 - 5.1. Introduction to the plane and its types
 - 5.2. Projection of point, lines, plane, and solids
 - 5.3. Definition and concept of multi-view drawings
 - 5.4. Perceptual views of plan of projections
 - 5.5. Orthographic projections
 - 5.6. 1st angle and 3rd angle projection

5.7. Isometric sketching	
5.8. Principal views and its arrangements	
5.9. multi-view drawings and missing line	
6. Introduction to AutoCAD (Recent available version)	2 Hours
6.1. Introduction to Auto CAD	
6.2. User Interface	
6.3. Templates	
6.4. Layers and Objects	
7. Drawing Aids and Coordinate System	2 Hours
7.1. Object snap and ortho	
7.2. Dynamic input setting	
7.3. Units and user Coordinate system	
7.4. Methods of drawing lines	
7.5. Introduction, Creation and working in layers.	
8. Dimensions, Symbols and Drawing Layout	2 Hours
8.1. create Dimension	
8.2. Create Symbols and annotations.	
8.3. creation of Layout	
8.4. creation of Drawing Frame	
8.5. creation of Contents and Template	
9. Sketching of different objects in 2D	2 Hours
9.1. Creating 2D sketch.	
9.2. Modify 2D Sketch.	
10. 3D Design and Solid Modeling	5 Hours
10.1. Conversion of 2D into 3D	
10.2. Extrude command.	
10.3. Revolve command.	
10.4. Sweep command.	
10.5. Loft command.	
10.6. Conversion of 3D into 2D	
11. 3D Surface Modeling	4 Hours
11.1. Plane surface, ruled surface	
11.2. Extrude surface, revolved surface	
11.3. Sweep surface, Loft surface	
11.4. Surface trim and extend	
11.5. Part surface	
11.6. Ballooning surface	
12. Bills of material, Parts List, Final checks	2 Hours
12.1. Bill of materials	
12.2. Bill of quantities	
12.3. Review and final checks of drawings	

INSTRUCTIONAL OBJECTIVES:

1. Introduction to Technical Drawing

- 1.1 Explain the need and significance of technical drawing in various industries.
- 1.2 Describe how accurate technical drawings contribute to efficient communication and problem-solving.
- 1.3 Describe the need of defining Bill of Materials and Bill of Quantity
- 1.4 Differentiate between BOM and BOQ.
- 1.5 Differentiate between different types of technical drawings, such as orthographic, isometric, and perspective drawings.
- 1.6 Recognize real-world applications of technical drawing in fields like engineering, architecture, manufacturing, and more.
- 1.7 Explain how different technical drawings are used to communicate design intent, manufacturing and assembly instructions, and specifications.
- 1.8 Recognize and explain common symbols used to represent devices and components in technical drawings.
- 1.9 Interpret technical drawings with various symbols and annotations.
- 1.10 Create a reference sheet that lists and explains commonly used symbols in technical drawings.

2. Drafting Equipment, Types of Lines, and Lettering

- 2.1. Explain the purpose of each drafting tool and its contribution to creating accurate drawings.
- 2.2. Define the concept of basic lines in technical drawings.
- 2.3. Differentiate between various types of basic lines, such as straight, curved, and freehand lines.
- 2.4. Demonstrate the ability to draw neat and precise basic lines.
- 2.5. Classify different types of lines used in technical drawings, including object lines, hidden lines, centerlines, and more.
- 2.6. Apply appropriate pencil techniques to create consistent and accurate lines, such as light lines, dark lines, and hatching.
- 2.7. Apply the knowledge of different types of lines to create accurate technical drawings.
- 2.8. Use appropriate line types to represent different features of objects, such as visible, hidden, and dimension lines.
- 2.9. Demonstrate the ability to create consistent and legible lettering using appropriate techniques.
- 2.10. Create and use guidelines effectively to maintain proper alignment, spacing, and proportions in drawings.

3. Basic Dimensioning

- 3.1. Define dimensioning and its importance in technical drawings.
- 3.2. Differentiate between linear, angular, and radial dimensions.
- 3.3. Explain the purpose of dimension lines, extension lines, and arrowheads in dimensioning.
- 3.4. Identify and describe the elements of dimensioning, including dimension lines, extension lines, arrowheads, and leaders.
- 3.5. Apply proper placement and alignment of dimensions on technical drawings.
- 3.6. Define tolerance and its significance in engineering design.
- 3.7. Explain the concepts of upper and lower limits, and nominal dimensions.
- 3.8. Interpret tolerance notations on technical drawings.
- 3.9. Write and interpret notes related to material, finish, and other special instructions.

4. Drafting Geometry, Sketching, and Engineering Curves

- 4.1. Differentiate between plane and solid geometry.
- 4.2. Identify different conventional shapes and objects used in technical drawings.
- 4.3. Understand the basics of sketching techniques used in technical drawings.
- 4.4. Create accurate and neat sketches of simple geometric shapes.
- 4.5. Define engineering curves and their applications in technical drawings.

4.6. Identify different types of curves, including conic sections, spirals, involutes, and more.

5. Introduction to Multi-View Drawings

- 5.1. Understand the concept of planes and their significance in projection.
- 5.2. Differentiate between different types of planes, such as principal planes and auxiliary planes.
- 5.3. Understand the concept of multi-view drawings and their purpose in communicating object details.
- 5.4. Identify and create principal views, including front, top, and side views.
- 5.5. Differentiate between 1st angle and 3rd angle projection methods.
- 5.6. Create isometric sketches to represent objects in three dimensions.
- 5.7. Identify and arrange principal views to communicate object features effectively.
- 5.8. Understand the concept of missing lines in multi-view drawings.

6. Introduction to AutoCAD

- 6.1. Navigate and understand the key components of the AutoCAD Mechanical user interface.
- 6.2. Identify various tools, panels, and menus in the software interface.
- 6.3. Describe the concept of templates in AutoCAD and their role in consistent drawing creation.
- 6.4. Create, modify, and utilize templates for efficient workflow.
- 6.5. Define layers and their importance in organizing drawing elements.
- 6.6. Explain object properties and their control through layers.
- 6.7. Identify and explain the benefits of using AutoCAD Mechanical in mechanical engineering tasks.

7. Drawing Aids and Coordinate System

- 7.1. Define object snap and ortho functions and their role in accurate drawing creation.
- 7.2. Apply object snap and ortho settings effectively for precise alignment and drawing.
- 7.3. Explain dynamic input and its benefits in enhancing drafting efficiency.
- 7.4. Utilize dynamic input settings for real-time input and feedback during drawing.
- 7.5. Define units and their importance in maintaining consistency and scale in drawings.
- 7.6. Set up and manipulate the user coordinate system (UCS) for convenient drawing alignment.
- 7.7. Demonstrate various methods of drawing lines, including specifying endpoints, angles, and lengths.
- 7.8. Apply different line-drawing techniques to create accurate and complex shapes.
- 7.9. Understand the concept of layers and their organization within a drawing.
- 7.10. Create, manage, and manipulate layers effectively for clear and organized drawings.

8. Dimensions, Symbols, and Drawing Layout

- 8.1. Explain the role of dimensions in communicating object size and relationships.
- 8.2. Create different types of dimensions, including linear, angular, and radial dimensions.
- 8.3. Define symbols and annotations and their significance in conveying additional information.
- 8.4. Create symbols and annotations using appropriate tools and techniques.
- 8.5. Understand the concept of layouts in AutoCAD and their role in presenting drawings.
- 8.6. Create and manage layouts for various views and presentations.
- 8.7. Understand the importance of creating content blocks and templates for efficient drawing creation.
- 8.8. Develop content blocks and templates for reuse in different drawings.

9. Sketching of Different Objects in 2D

- 9.1. Define the process of creating 2D sketches in AutoCAD.
- 9.2. Create accurate and detailed 2D sketches of various objects using appropriate tools.
- 9.3. Demonstrate the ability to modify and edit 2D sketches to refine shapes and dimensions.
- 9.4. Utilize various editing tools for manipulation and adjustments.

10. 3D Design and Solid Modeling

- 10.1. Explain the concept of converting 2D sketches into 3D models.
- 10.2. Utilize appropriate tools to extrude and generate 3D solids from 2D sketches.
- 10.3. Define the extrude command and its role in creating 3D objects.
- 10.4. Apply the extrude command to generate simple 3D forms.
- 10.5. Explain the revolve command and its use in generating 3D shapes through rotation.
- 10.6. Create 3D objects using the revolve command with various profiles.

- 10.7. Define the sweep command and its purpose in creating complex 3D shapes.
- 10.8. Apply the sweep command to generate objects along specified paths.
- 10.9. Understand the loft command and its role in creating smooth transitions between 3D profiles.
- 10.10. Create 3D objects using the loft command with multiple profiles.
- 10.11. Explain the process of converting 3D models back into 2D drawings.
- 10.12. Generate 2D orthographic projections and sections from 3D models.

11. 3D Surface Modeling

- 11.1. Explain the concept of Plane surface,
- 11.2. Explain the concept of ruled surface
- 11.3. Explain the concept of extrude surface
- 11.4. Explain the concept of revolved surface
- 11.5. Explain the concept of Sweep surface
- 11.6. Explain the concept of Loft surface
- 11.7. Explain the concept of Surface trim
- 11.8. Explain the concept of extend
- 11.9. Explain the concept of Ballooning surface

12. Bills of material, Parts List, Final checks

- 12.1. Explain the concept of Bill of material
- 12.2. Explain the concept of Part surface
- 12.3. Perform review and final checks of drawings

List of Recommended Books:

- 1. First year Engineering Drawing, by A. C. Parkinson, Latest Edition.
- 2. Engineering Drawing and Graphic Technology, by T. E. French, C. J. Vierck, R. J. Foster, McGraw Hill.
- 3. CAD Packages by T.F. French.

LIST OF PRACTICAL:

96 Hrs.

(Note: Tentatively, for 3-Month its Lab./ practical may be conducted in Drawing Hall, while remaining session may be used for AutoCAD Lab.)

1. Read out of technical drawing
2. Taking of quantity from drawing
3. Read out of assembly drawings
4. Read out of flow drawings
5. Identification of basic drawing tools and their application
6. Practice of single stroke capital vertical & inclined lettering
7. Construction of angles and triangles, quadrilaterals and circles elements
8. Construction of inscribe and circumscribe figures (square, triangle and hexagon)
9. Construction of pentagon, Hexagon, Octagon by general and different methods
10. Construction of Tangents of circles (Inside & Outside)
11. Construction of Ellipse and parabola curve by four different methods
12. Construction of hyperbola
13. Construction of involutes curve of square rectangle hexagon and circle
14. Construction of cycloid, epicycloids, and hypocycloid
15. Orthographic projection 1 and 3rd angle
16. Orthographic projection and Isometric Drawing
17. Development of prism, cylinder, cone, pyramid
18. Installation and activation of Auto-CAD (Latest available Version)
19. Title Bar, Tool Bar, Menu Bar, Browser, Status Bar, Command Line
20. Zoom, Pan, Orbit, Object Snap, Grid, Orthogonal
21. Layer and Object Property
22. Construction Line and Center Line
23. Exercise of Save, Units, and Coordinate System commands
24. Line and Poly line, Circle, Arc and Ellipse Command
25. Rectangular and Polygon Command
26. Dimension and Hatching
27. Text Command, Copy, Mirror, Offset, Move, Rotate and Scale Command
28. Trim and Extend, Join and Break Command
29. Fillet, Chamfer, Explode Command
30. Exercise of Basic 2D Drawings
31. Exercise of Mechanical Drawings.
32. Extrude, Revolve, Sweep, Loft command
33. Plane Surface command, Ruled surface.
34. Extrude surface, Revolve surface, Sweep surface, loft surface, Surface trim and extend.
35. Practice of basic 3D drawing

COMP-172 COMPUTER APPLICATIONS

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

This subject will enable the student to be familiar with the basic daily life applications of computer. Trainee will also learn computer applications and other information according to profession at elementary level. Trainee will learn the knowledge and skills regarding EDP, Windows OS, MS-Word, Spread Sheets (Excel), Power Point & Internet.

Pre-requisites:

None

Course Contents:

1. INTRODUCTION TO COMPUTER

2 Hours

- 1.1. Introduction to computer system
- 1.2. BIT, Byte, RAM & ROM
- 1.3. Input & Output devices
- 1.4. Secondary storage devices
- 1.5. Types of Software
- 1.6. Applications in Engineering, Education & Business

2. MS-WINDOWS (latest version)

5 Hours

- 2.1 Introduction to Windows
- 2.2 How to install Drivers & Windows
- 2.3 Loading & Shut down process
- 2.4 Introduction to Desktop items (Creation of Icons, Shortcut, Folder & modify Taskbar)
- 2.5 Desktop properties
- 2.6 Use of Control Panel
- 2.7 Searching a document

3. MS-OFFICE (MS-WORD latest Version)

5 Hours

- 3.1 Introduction to MS-Office
- 3.2 Introduction to MS-Word & its Screen
- 3.3 Create a new document
- 3.4 Editing & formatting the text
- 3.5 Saving & Opening a document
- 3.6 Page setup (Set the Margins & Paper)
- 3.7 Spell Check & Grammar
- 3.8 Paragraph Alignment
- 3.9 Inserting Page numbers, Symbols, Text box & Picture in the document
- 3.10 Use the different Format menu drop down commands (Drop Cap, Change Case, Bullet & Numbering and Shading & Border)
- 3.11 Insert the Table and its Editing
- 3.12 Printing the document
- 3.13 Saving a document file as PDF format

4. MS-OFFICE (MS-EXCEL latest Version)

5 Hours

- 4.1 Introduction to MS-Excel & its Screen
- 4.2 Entering data & apply formulas in worksheet
- 4.3 Editing & Formatting the Cells, Row & Column
- 4.4 Insert Graphs in sheet
- 4.5 Page setup, Print Preview & Printing
- 4.6 Types & Categories of Charts

- 5. MS-OFFICE (MS-POWER POINT latest Version) 5 Hours**
 - 5.1 Introduction to MS-Power point
 - 5.2 Creating a presentation
 - 5.3 Editing & formatting a text box
 - 5.4 Adding pictures & colors to a slide
 - 5.5 Making slide shows
 - 5.6 Slide Transition

- 6. INTERNET & E-MAIL 6 Hours**
 - 6.1 Introduction to Internet & browser window
 - 6.2 Searching, Saving and Print a page from internet
 - 6.3 Creating, Reading & Sending E-Mail
 - 6.4 File Attachment
 - 6.5 Uploading and downloading file(s) and software(s)
 - 6.6 Explain some advance features over the internet and search engines
 - 6.7 Difference between Internet, Intranet and Extranet

- 7. INTRODUCTION TO ONLINE TOOLS 4 Hours**
 - 7.1 Google Workspace
 - 7.2 ZOOM/Voov/Lark
 - 7.3 MS Team

INSTRUCTIONAL OBJECTIVES:

1. Introduction to Computer

- 1.1. Introduction to computer system
- 1.2. Explain BIT, Byte, RAM & ROM
- 1.3. Explain Input & Output devices
- 1.4. Explain Secondary storage devices
- 1.5. Explain Types of Software
- 1.6. Explain Applications in Engineering, Education & Business

2. UNDERSTAND MS-WINDOWS (Latest Version)

- 2.1 Explain Introduction to Windows
- 2.2 How to install Drivers & Windows
- 2.3 Describe Loading & Shut down process
- 2.4 Explain Introduction to Desktop items(Creation of Icons, Shortcut, Folder & modify Taskbar)
- 2.5 Explain Desktop properties
- 2.6 Describe Use' of Control Panel (add/remove program, time & date, mouse and create user account)
- 2.7 Explain the method of searching a document

3. UNDERSTAND MS-OFFICE (MS-WORD Latest Version)

- 3.1 Explain Introduction to MS-Office
- 3.2 Describe -Introduction to MS-Word & its Screen
- 3.3 Describe create a new document
- 3.4 Explain Editing & formatting the text
- 3.5 Describe saving & Opening a document
- 3.6 Explain Page setup, (Set the Margins & Paper)
- 3.7 Describe Spell Check & Grammar
- 3.8 Explain Paragraph Alignment
- 3.9 Explain Inserting Page numbers, Symbols, Text box & Picture in the document
- 3.10 Describe Use the different Format menu drop down commands(Drop Cap, Change Case, Bullet & Numbering and Border & Shading)
- 3.11 Explain Insert the Table and its Editing and modifying
- 3.12 Describe printing the document
- 3.13 Describe the method of file saving as a PDF Format

4. UNDERSTAND MS-OFFICE (MS-EXCEL Latest Version)

- 4.1 Explain Introduction to MS-Excel & its Screen
- 4.2 Describe Entering data & apply formulas in worksheet
- 4.3 Describe Editing & Formatting the, Cells, Row & Column
- 4.4 Explain Insert Graphs in sheet
- 4.5 Describe Page setup, Print preview & Printing
- 4.6 Explain in details the types of charts e.g pie chart, bar chart

5. UNDERSTAND MS-OFFICE (MS-POWER POINT Latest Version)

- 5.1 Describe Introduction to MS-Power point
- 5.2 Explain creating a presentation
- 5.3 Describe Editing & formatting a text box
- 5.4 Explain Adding pictures & colors to a slide

5.5 Describe Making slide shows

5.6 Explain Slide Transitions

6. UNDERSTAND INTERNET & E-MAIL

6.1 Explain Introduction to Internet and browser window

6.2 Explain Searching, Saving and Print a page from internet

6.3 Describe Creating, Reading & Sending E-Mail

6.4 File attachment.

6.5 Uploading and downloading file(s) and software(s)

6.6 Explain some advance features over the internet and how to search topics on different search engines

6.7 Difference between Internet, Intranet and Extranet

7. INTRODUCTION TO ONLINE TOOLS

7.1. Explain Google Workspace

7.2. Explain use of ZOOM/voov/Lark

7.3. Explain MS Team

List of Recommended Books:

1. Bible Microsoft Office 2016 by John Walkenbach
2. Bible Microsoft Excel 2016 by John Walkenbach
3. Bible Microsoft PowerPoint 2016 by John Walkenbach
4. User Guides for Windows 2010 and MS Office 2016 by Microsoft Corporation

LIST OF PRACTICAL:

96 Hrs.

1. Identify key board, mouse, CPU, disk drives, disks, monitor, and printer,
Speakers, microphone, scanner, digital camera, card reader, DSL
Modem and other magnetic elements.
2. **MS WINDOWS Latest Version**
 - 2.1 Practice of loading and shutdown of operating system
 - 2.2 How to install Drivers & Windows
 - 2.3 Creating items (icons, shortcut, folders etc) and modifying taskbar
 - 2.4 Changing of wallpaper, screensaver, and resolution
 - 2.5 Practice of control panel items (add/remove, time and date, mouse, and create user account)
3. **MS OFFICE (MS-WORD Latest Version)**
 - 3.1 Identifying the MS Word Screen and its menu
 - 3.2 Practice of create a new document, saving and re-opening it from the location and spell check & grammar
 - 3.3 Practice of Page Formatting (Borders, Character Spacing, Paragraph, Bullets & Numberings and Fonts)
 - 3.4 Practice of different tool bars like standard, format& drawing tool bars
 - 3.5 Practice of Insert pictures, clipart, and shapes
 - 3.6 Practice of header and footer
 - 3.7 Practice of insert table and also format of table
 - 3.8 Practice of page setup, set the page margins, and printing documents
4. **MS OFFICE (MS-EXCEL Latest Version)**
 - 4.1 Identifying the MS EXCEL Screen and its menu
 - 4.2 Practice of create a new sheet, saving and re-opening it from the location and spell check
 - 4.3 Practice of insert and delete of row and columns (format of cell)
 - 4.4 Practice of entering data and formulas in worksheet(Add, Subtract, Multiplying, and Divide & Average)
 - 4.5 Practice of insert chart and its types
 - 4.6 Practice of page setup, set the page margins, and printing
5. **MS OFFICE (MS-POWER POINT Latest Version)**
 - 5.1 Identifying the MS POWER POINT Screen and its menu
 - 5.2 Practice of create a new presentation and save
 - 5.3 Practice of open saves presentations
 - 5.4 Practice of inset picture and videos
6. **INTERNET & E-MAIL**
 - 6.1 Identifying internet explorer
 - 6.2 Practice of searching data from any search engine
 - 6.3 Practice of create an E-Mail account and how to send and receive mails, download attachments
 - 6.4 File attachment.
 - 6.5 Uploading and downloading file(s) and software(s)
7. **INTRODUCTION TO ONLINE TOOLS**
 - 7.1 How to use Google Workspace
 - 7.2 How to install and use ZOOM/VooV/Lark
 - 7.3 How to install and use MS Team

MTR-142 INTRODUCTION TO MECHATRONICS

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

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

1. To introduce the basic concept of Mechatronics and Industrial Automation.
2. To understand the applications of Mechatronics in industries.

Pre-requisites:

None

Course Contents:

- 1. Introduction** **3 Hours**
 - 1.1. Definition of Mechatronics
 - 1.2. What are the five basic components in Mechatronics system?
 - 1.3. Definition of Automation and Instrumentation
 - 1.4. Significance of Mechatronics and Automation in modern industries
 - 1.5. Applications of Mechatronics & Automation
 - 1.6. Relationship between Mechatronics, Automation and Instrumentation
- 2. Introduction to CNC Machines** **4 Hours**
 - 2.1. Overview of CNC technology and its applications
 - 2.2. Benefits and limitations of CNC machining
 - 2.3. Types of CNC machines (milling, turning, etc.)
 - 2.4. Components of a CNC machine (control unit, axes, drives, tools)
 - 2.5. CNC coordinate systems (Cartesian and polar) Introduction to CNC machine safety procedures
 - 2.6. Setting up the machine (work holding, tools, offsets)
 - 2.7. Loading and unloading parts
 - 2.8. Introduction to CNC simulation and verification software
- 3. Introduction to Sensor and Transducers** **5 Hours**
 - 3.1. Definition and classification of sensors and transducers.
 - 3.2. Differences between sensors and transducers.
 - 3.3. Applications of sensors and transducers in various fields (e.g., robotics, automation, medical, environmental monitoring).
 - 3.4. Measurement principles: physical, chemical, electrical, etc.
 - 3.5. Static and dynamic characteristics of sensors and transducers.
 - 3.6. Performance parameters: sensitivity, accuracy, resolution, linearity, etc.
 - 3.7. Resistive sensors: potentiometers, strain gauges, thermistors, RTDs (Resistance Temperature Detectors).
 - 3.8. Inductive sensors: LVDT (Linear Variable Differential Transformer), resolvers, proximity sensors.
 - 3.9. Capacitive sensors: pressure sensors, humidity sensors, level sensors.
 - 3.10. Piezoelectric sensors: vibration sensors, pressure sensors, accelerometers.
- 4. Introduction to Actuators** **4 Hours**
 - 4.1. Definition and classification of actuators (electrical, pneumatic, hydraulic, mechanical)
 - 4.2. Working principles of different types of actuators
 - 4.3. Comparison of different actuator types (advantages, disadvantages, and applications)
 - 4.4. DC motors (brushed, brushless) - principles, characteristics, control methods
 - 4.5. Stepper motors - principles, characteristics, control methods
 - 4.6. Servo motors - principles, characteristics, control methods
 - 4.7. Solenoids - principles, characteristics, applications
 - 4.8. Fundamentals of pneumatics (pressure, flow, components)
 - 4.9. Single-acting and double-acting cylinders
 - 4.10. Hydraulic motors - types (gear, vane, piston), characteristics, applications

- 4.11. Gearmotor and gearboxes - principles, types, applications
- 4.12. Linear actuators (ball screw, rack and pinion, lead screw) - principles, applications
- 4.13. Cams and followers - principles, types, applications
- 5. Applications of Mechatronics 5 Hours**
 - 5.1 Mechatronics Design of Automatic Washing Machine
 - 5.2 Inverter type Air Conditioning System
 - 5.3 Robotic manipulator
- 6. Automatic Production Line 6 Hours**
 - 6.1. Definition of simulation and its role in manufacturing
 - 6.2. Importance of production line simulation in optimizing processes
 - 6.3. Introduction to Industrial Digital Twin Technology
 - 6.4. What is simulation in production management?
 - 6.5. What is factory flow simulation?
 - 6.6. Components of Automatic production line (SCADA, PLC, etc.)
- 7. Brief introduction to Data Acquisition 5 Hours**
 - 7.1 Analog-to-digital converters (ADCs), digital-to-analog converters (DACs).
 - 7.2 Signal conditioning (amplification, filtering, noise reduction) techniques.
 - 7.3 Sampling theory and sampling rate selection.
 - 7.4 Data quantization: resolution, quantization error.
 - 7.5 Time domain analysis: signal characteristics, amplitude, period, frequency, phase, power, energy.
 - 7.6 Understanding signals in the frequency domain.
 - 7.7 Analog filters: passive and active filters, filter types (low-pass, high-pass, band-pass, band-stop).
 - 7.8 Audio signal processing: filtering, noise reduction, audio compression.
 - 7.9 Communication signal processing: modulation, demodulation techniques.

INSTRUCTIONAL OBJECTIVES:

1. Introduction

- 1.1. Define the terms: Automation, Mechatronics and Instrumentation
- 1.2. Draw the block diagram of a Mechatronics system.
- 1.3. Write names of major components of a Mechatronics system.
- 1.4. Describe the need for a Mechatronics system.
- 1.5. Describe the Applications of Mechatronics system in modern industry.
- 1.6. Describe the major advantages of Mechatronics system.

2. Introduction to CNC Machines

- 2.1. Define Computerized Numerical Control (CNC) technology.
- 2.2. Explain the basic principles of CNC machining.
- 2.3. Identify common applications of CNC technology in various industries.
- 2.4. List the key benefits of using CNC machines compared to traditional machining methods.
- 2.5. Classify different types of CNC machines based on their function (milling, turning, etc.).
- 2.6. Label and explain the major components of a CNC machine (control unit, axes, drives, tools).
- 2.7. Define and differentiate between Cartesian and polar coordinate systems used in CNC programming.
- 2.8. Describe various work holding methods used to secure work pieces in a CNC machine.
- 2.9. Explain the process of selecting and installing appropriate cutting tools for a CNC machining job.
- 2.10. Demonstrate safe and proper procedures for loading and unloading parts on a CNC machine.
- 2.11. Explain the purpose of CNC simulation and verification software.

3. Introduction to Sensor and Transducers

- 3.1. Explain the basic concept of sensors and transducers.
- 3.2. Identify the key differences between sensors and transducers based on their output.
- 3.3. Explain the role of transducers in converting signals between different energy domains.
- 3.4. Describe how sensors and transducers are used in diverse fields like robotics, automation, medicine, and environmental monitoring.
- 3.5. Explain the fundamental principles of physical, chemical, and electrical measurements used in sensors and transducers.
- 3.6. Define and distinguish between static and dynamic characteristics of sensors.
- 3.7. Explain the importance of common sensor performance parameters like sensitivity, accuracy, resolution, and linearity.
- 3.8. Describe the working principles of common resistive sensors like potentiometers, strain gauges, thermistors, and RTDs.
- 3.9. Introduce Inductive sensors: LVDT, resolvers, proximity sensors.
- 3.10. Describe Capacitive sensors: pressure sensors, humidity sensors, level sensors.
- 3.11. Interpret Piezoelectric sensors: vibration sensors, pressure sensors, accelerometers.
- 3.12. Describe the working of any five sensors used in a modern car.

4. Introduction to Actuators

- 4.1. Define and classify the actuators (electrical, pneumatic, hydraulic, mechanical)
- 4.2. Explain the basic working principles of different types of actuators
- 4.3. Compare and contrast different actuator types
- 4.4. Explain the operating principles of stepper motors.
- 4.5. Describe the key characteristics of stepper motors (e.g., step size, holding torque, accuracy).
- 4.6. Explain the operating principles of servo motors.
- 4.7. Describe the key characteristics of servo motors (e.g., speed, torque, precision).
- 4.8. Explain the operating principles of solenoids.
- 4.9. Describe the key characteristics of solenoids (e.g., force, stroke, response time).
- 4.10. Explain the key concepts of pneumatics, including pressure, flow.
- 4.11. Identify the essential components used in pneumatic systems.
- 4.12. Differentiate between single-acting and double-acting cylinders.
- 4.13. Classify hydraulic motors based on their design (gear, vane, and piston).
- 4.14. Discuss the applications of gear motors and gearboxes in various machines and devices.

- 4.15. Explain the applications of various linear actuators (ball screw, rack and pinion, lead screw).
- 5. Applications of Mechatronics**
- 5.1 Explain the fundamental principles of mechatronics and their application in automatic washing machines.
- 5.2 Explain the working principle of inverter-type air conditioning systems compared to traditional systems.
- 5.3 Explain different types of robotic manipulators and their applications
- 6. Automatic Production Line**
- 6.1 Define simulation.
- 6.2 Describe optimization.
- 6.3 Describe the importance of simulation and optimization in the manufacturing process.
- 6.4 Describe digital twin technology.
- 6.5 Describe the importance of simulation in production management.
- 6.6 Describe factory flow simulation.
- 6.7 Explain following components of Automatic production line: SCADA, PLC
- 7. Brief introduction to Data Acquisition**
- 7.1 Explain the purpose and function of ADCs and DACs.
- 7.2 Describe the different types of signal conditioning techniques (amplification, filtering, and noise reduction).
- 7.3 Explain, what are the effects of different sampling rates on signal quality?
- 7.4 Explain the concept of data quantization and its impact on signal fidelity.
- 7.5 Describe the fundamental characteristics of signals in the time domain (amplitude, period, frequency, and phase).
- 7.6 Explain the concept of Frequency analysis and its importance in signal processing.
- 7.7 Explain the purpose and different types of analog filters (low-pass, high-pass, band-pass, and band-stop).
- 7.8 Describe different methods for audio compression and their applications.
- 7.9 Describe different modulation techniques (e.g., amplitude modulation, frequency modulation) used to transmit information.

List of Recommended Books:

Mechatronics by W Bolton latest version

A Text Book of Mechatronics RK Rajput 2007

LIST OF PRACTICAL:

1. Practice various machining operations on CNC Simulator like facing, turning etc.
2. Create a simple PCB circuit with an LED and resistor that switch the LED on and off.
3. Use PCB Design technique create a circuit that can control the speed and direction of a small DC motor.
4. Familiarize with different types of sensors temperature sensors, light sensors, pressure sensors, proximity sensors, etc.
5. Interface sensors with displaying the sensor readings on an LCD screen or controlling LEDs based on sensor values.
6. Explore different types of actuators like DC motors, stepper motors, servos, pneumatic actuators, hydraulic actuators, etc.
7. Build simple robots using LEGO Mind storms or other robotics kits by involving in assembling the robot, programming its behavior.
8. Learn basic CAD software and to introduce to 2D and 3D CAD software to design mechanical components and robotic parts.
9. Use 3D printer to fabricate parts designed in CAD software as assigned by the instructor.
10. Analyze the different components of an automatic washing machine (motor, control system, sensors, etc.) and their interactions.
11. Analyze the components of an inverter-type air conditioning system and their functionalities.
12. Familiarize with popular data acquisition and signal processing software tools

MTRC-133- Electrical Essentials

Total Contact Hours

Theory	64	T	P	C
Practical	96	2	3	3

Aims

1. Understanding electricity involves the sound familiarity with the established laws and concepts and their application in different situations and solving these problems also forms part of cognition of these concepts.
2. This course is aims at providing a strong foundation in the basic concepts and laws of electricity, alongwith an appreciation of the magnitude of these quantities involved or to be solved through numerical problems.
3. In the light of above mentioned aims these concepts are to be further strengthened through extensivelythrough laboratory work.

Pre-requisites:

None

Course Contents

1. Basic Concepts of Electricity

8 Hours

- 1.1 Charge
- 1.2 Electric Current
- 1.3 Voltage/Potential Difference
- 1.4 Work/Energy
 - 1.4.1. KWH
- 1.5 Power
- 1.6 Difference between AC & DC Power
 - 1.6.1. KVA
 - 1.6.2. KW
- 1.7 Conversion of electrical energy to mechanical energy
- 1.8 Calculation of energy billing of an installation

2. DC Fundamentals

9 Hours

- 2.1 Ohm's Law
 - 2.1.1. State ohm's law
 - 2.1.2. Solve problems on ohm's law
- 2.2 Laws of Resistance
 - 2.2.1. Specific resistance, conductance and conductivity
 - 2.2.2. Resistance in series, parallel and series-parallel
- 2.3 Resistors
 - 2.3.1. Application of resistors
 - 2.3.2. Color coding
- 2.4 DC sources
- 2.5 Solar panels

2.5.1. Types of solar panels

2.6 Batteries

- 2.6.1. Types of cells, primary and secondary cells (Mercury, silver oxide, nickel-cadmium, etc.)
- 2.6.2. Lead acid batteries
- 2.6.3. Solar cell
- 2.6.4. Lithium ion batteries
- 2.6.5. Super capacitor
- 2.6.6. Gel batteries
- 2.6.7. Internal resistance of a cell

3. Transformers

7 Hours

- 3.1 Principle of transformer, mutual inductance, coefficient of mutual inductance.
- 3.2 Turn ratio and e.m.f. equation
- 3.3 Construction, types of transformers, core materials.
- 3.4 Application of transformers in electronics.
- 3.5 Auto-transformers, principle, advantages, disadvantages and applications.
- 3.6 Star/delta transformation
- 3.7 Delta/star transformation
- 3.8 Problems
- 3.9 Poly phase transformers, star and delta connection.
- 3.10 Phase voltage and current, line voltage and current, and their inter-relation.
- 3.11 Transformer losses.
 - 3.11.1. Core loss.
 - 3.11.2. Hysteresis loss.

4. Magnetism And Electromagnetism

6 Hours

- 4.1 Magnetism
 - 4.1.1. Introduction to magnetism, magnetic line of force, flux, flux density, permeability, reluctance and their units
 - 4.1.2. Properties of magnetic lines of force
 - 4.1.3. Magnetic induction
- 4.2 Electromagnetism
 - 4.2.1. Electromagnetism, field intensity, and ampere turns/meter
 - 4.2.2. Electromagnetic induction
 - 4.2.3. Magnetic field around a current carrying conductor and solenoids Cork screw and left hand rules
 - 4.2.4. Faraday's law of Electromagnetic induction ($\mathcal{E} = -N \frac{d\phi}{dt}$)
 - 4.2.5. Lenz's law

5. Electrostatics

8 Hours

- 5.1 Principle of electrostatic, positive and negative charges.
- 5.2 Laws of electrostatics
- 5.3 Capacitance and capacitors. Capacitance of parallel plate capacitor
- 5.4 Equivalent capacitance for series, parallel and series parallel combination of capacitors
- 5.5 Energy stored in capacitors
- 5.6 Color code, tolerance and rating of capacitors

6. AC Fundamentals	8 Hours
6.1 The simple AC generator	
6.2 Sin wave, square wave, modified sin wave.	
6.3 Sin wave, cycle, wavelength, period, frequency and units	
6.4 AC sine wave form and its characteristics. (Instantaneous, peak, average, rms or effective values and their inter relation)	
6.5 Types of alternating wave forms (sinusoidal and non-sinusoidal waves)	
6.6 AC circuits	
6.7 AC through pure resistor, phasor quantities	
6.8 AC through pure inductor, phasor quantities	
6.9 AC through pure capacitor, phasor quantities	
7. Electrical Devices	7 Hours
7.1 Common Electrical Components	
7.1.1. AC and DC breakers	
7.1.2. MCB & MCCB breakers	
7.1.3. Relays	
7.1.4. ATS (Auto Transfer Switches)	
7.1.5. Timers Relays	
7.1.6. Changeovers	
7.1.7. Types of change over	
(a) Electrical	
(b) Mechanical	
(c) 3-phase change over	
7.1.8. Magnetic contactors	
7.1.9. Control Panels	
(a) Types of Control Panels	
(b) Types of DB Box	
7.1.10. Connection strips	
7.1.11. Bus Bars	
7.2 Protective Devices	
7.2.1. Voltage Protector	
7.2.2. SPD (Surge Protection Devices)	
8. Electric Wiring	6 Hours
8.1 Symbols/Schematics	
8.2 Electrical Tools	
8.3 Types of Cables/Wires	
8.3.1. AC cables (Standard)	

8.3.2. DC cables (Flexible)

- 8.4 Wire Gauge
- 8.5 Wiring Regulations
- 8.6 Earthing & Electrical Safety
- 8.7 Measurement and Testing Methods
- 8.8 Common Circuits (Single Way, Two Way, Ringed, Etc.,)
- 8.9 Electrical Wiring Quality Standards

9. Soldering

5 Hours

- 9.1 Define Soldering and Different Types of Solders
- 9.2 Common Soldering Tools and Equipment
- 9.3 Method-and Techniques for Soldering
- 9.4 De-Soldering Techniques
- 9.5 Inspection of Soldered Joints
- 9.6 Rectification of Soldered Joints
- 9.7 PCB Soldering: How to Translate a Circuit On to a PCB?
- 9.8 Etching, Drilling and Soldering Component on PCB
- 9.9 Introduction to software e.g. Proteus, Altium.

RECOMMENDED BOOKS

1. Richard C. Dorf and James A. Svoboda, *Introduction to Electric Circuits*
2. Stan Gibilisco, *Teach Yourself Electricity and Electronics*, 5th Edition (2011)

INSTRUCTIONAL OBJECTIVES

1. BASIC CONCEPTS OF ELECTRICITY

- 1.1. Definition and unit of Charge
- 1.2. Definition and unit of Electric Current
- 1.3. Definition and unit of Voltage/Potential Difference
- 1.4. Definition and unit of Work/Energy
 - 1.4.1. Definition and use of KWh
- 1.5. Definition and Unit of Power
- 1.6. Definition and difference between AC/DC power
 - 1.6.1. Use of KVA
 - 1.6.2. Use of KW

2. DC FUNDAMENTALS

- 2.1. Ohm's Law
 - 2.1.1. State ohm's law
 - 2.1.2. Solve problems on ohm's law
- 2.2. Laws of Resistance
 - 2.2.1. Definition and unit of Specific resistance
 - 2.2.2. Definition and unit of conductance
 - 2.2.3. Definition and unit of conductivity
 - 2.2.4. Effect of temperature on resistance and temp. coefficient of resistance
 - 2.2.5. Problems on $R =$ and $R_t = R_o (1 + \alpha t)$
 - 2.2.6. Resistance in series, parallel and series-parallel
 - 2.2.7. Power and Energy their units and calculations
- 2.3. Resistors
 - 2.3.1. Application of resistors
 - 2.3.2. Resistors, color coding
- 2.4. Types of DC sources
- 2.5. Definition of Solar Panels and its uses
 - 2.5.1. Different types of solar panels
- 2.6. Batteries and their types
 - 2.6.1. Different types of cells, Primary and Secondary
 - 2.6.2. Lead acid Batteries
 - 2.6.3. Solar cell
 - 2.6.4. Lithium Ion Batteries
 - 2.6.5. Super Capacitor
 - 2.6.6. Gel Batteries
- 2.6.7. Internal resistance of a cell

3. TRANSFORMERS

- 3.1. Explain principle of transformer and understand the concept of mutual inductance, coefficient of mutual inductance.
- 3.2. Define Turn Ratio and drive EMF equation of transformer.
- 3.3. Explain construction of transformer
 - 3.3.1. Types of transformer
 - 3.3.2. Core materials
- 3.4. Understands the application of transformers in electronics
- 3.5. Explain Auto-transformers, its principle and also explain its advantages, disadvantages and

applications.

- 3.6. Explain the concept of star/delta transformation in three phase transformer
- 3.7. Explain the concept of delta/ star transformation in three phase transformer
- 3.8. Enlist Different types of problems with the working of transformers.
- 3.9. Describe poly phase transformers, star and delta connections
- 3.10. Explain phase and line voltage and their inter-relation
- 3.11. Explain different types of transformer losses
 - 3.11.1. Core loss
 - 3.11.2. Hysteresis loss
 - 3.11.3. Copper Losses

4. MAGNETISM AND ELECTROMAGNETISM

- 4.1. Understand magnetism
 - 4.1.1. Define magnetic lines of force, flux, flux density, permeability, & reluctance and their units.
 - 4.1.2. Explain the properties of magnetic lines of force
 - 4.1.3. Describe magnetic induction.
- 4.2. To understand electromagnetism
 - 4.2.1. Describe electromagnetism field intensity and ampere turns/meter
 - 4.2.2. Explain electromagnetic induction
 - 4.2.3. Explain magnetic field around a current carrying conductor and solenoids cork screw rule and left hand rule
 - 4.2.4. Explain faraday's law of electromagnetism induction $\{e=N(d/dt)\}$
 - 4.2.5. State Lenz's law

5. ELECTROSTATICS

- 5.1. Explain the Principal of electrostatic charges and state the effect of negative & positive charges.
- 5.2. Describe the laws of electrostatics.
- 5.3. Describe capacitor and capacitance. Also capacitance of parallel plate capacitors
- 5.4. Calculate the equivalent capacitance in a series, parallel combination
- 5.5. Explain energy stored in a capacitor
- 5.6. Color code, tolerance and rating of capacitors

6. AC FUNDAMENTALS

- 6.1. Understand the concept of AC generator
- 6.2. Describe sine wave, Square wave and modified sine wave
- 6.3. Explain cycle, wave length, period, frequency and their units w.r.t Sine wave
- 6.4. Draw AC sine waveform (sinusoidal, square, saw-tooth) and describe instantaneous value, peak value, average value, r.m.s value, effective value and their inter-relation
- 6.5. Explain types of alternating waveforms (Sinusoidal and non-sinusoidal waves)
- 6.6. Understand AC circuits
- 6.7. Describe AC through resistors and phasor quantities
- 6.8. Describe AC through inductors and phasor quantities
- 6.9. Describe AC through capacitors and phasor quantities

7. ELECTRICAL DEVICES

- 7.1. Explain electrical components
 - 7.1.1. AC and DC Breakers
 - 7.1.2. MCB and MCCB Breakers
 - 7.1.3. Relays and their types (Solid-state, Mechanical)
 - 7.1.4. Auto-Transfer Switches

- 7.1.5. Timers Relays
- 7.1.6. Changeovers
- 7.1.7. Understand different types of Changeovers
 - 7.1.7.1. Electrical
 - 7.1.7.2. Mechanical
 - 7.1.7.3. 3-phase Change over
- 7.1.8. Understand Magnetic Contactors
- 7.1.9. Control Panels
 - 7.1.9.1. Types of Control Panels
 - 7.1.9.2. Types of DB Box
- 7.1.10. Explain Connection Strips
- 7.1.11. Understand Bus Bars
- 7.1.12. Explain Different types of protective devices
 - 7.1.12.1. Voltage protector
 - 7.1.12.2. Surge protection devices
- 8. ELECTRIC WIRING**
 - 8.1. Understand the various electrical symbols/schematics
 - 8.2. Identify various electrical tools for electrical wiring
 - 8.3. Identify the various types of cables/wires for electrical wiring
 - 8.3.1. AC Cables
 - 8.3.2. DC Cables
 - 8.4. Explain Wire Gauges
 - 8.5. Understand the various wiring regulations
 - 8.6. Understand the concept of Earthing with reference to electrical safety
 - 8.7. Identify the various measurement and testing methods for electrical wiring
 - 8.8. Describe the common electrical circuitry (Single way, two way, ringed, etc.)
 - 8.9. Identify and describe Electrical Wiring Quality standards
- 9. SOLDERING**
 - 9.1. Define soldering and identify different types of solders
 - 9.2. Identify and describe the common soldering tools and equipment
 - 9.3. Understand the methods and techniques for soldering
 - 9.4. Understand various De-soldering techniques
 - 9.5. Understand the different Inspection techniques of soldered joints
 - 9.6. Understand how to rectification of a soldered joint
 - 9.7. Understand PCB soldering and describe how to translate a circuit onto a PCB
 - 9.8. Understand etching, drilling and soldering component on PCB
 - 9.9. Introduce yourself to different softwares for PCB Designing, e.g. Proteus, Altium

List of Recommended Books:

Introduction to Electric Circuits by Ray Powell.

Basic Electrical Engineering by V N Mittle Arvind Mittal.

LIST OF PRACTICALS

1. Electrical Essentials (Basics)

- 1) Identify and observe rating of different capacitors, inductors and resistors.
- 2) Construct a simple circuit to operate a load e.g. a bulb
- 3) Demonstrate Ohms Law
- 4) Measuring voltage and current by using voltmeter and ammeter in a series and parallel circuit
- 5) Demonstrate the use of a Variable resistor
- 6) Demonstrate using a relay as switch in a circuit
- 7) Demonstrating the use of a transformer
- 8) Learn how to use an oscilloscope and its various features & study DC/AC output waves on an oscilloscope and the rectified wave
- 9) Demonstrate the working of an oscilloscope by generating a AC/DC signal on it. Vary the amplitude and wavelength and note the effects

2. Electrical Wiring

- 1) Identify various types of electrical wires provided and develop a table noting their current, resistance & voltage rating and comparing these with the actual measurements.
- 2) Using electrician' tools, demonstrate how to cut wires and make proper mechanical joints. Practice how to do proper covering with insulation tapes to ensure safety against electric shock.
- 3) Make a basic electrical circuit for lighting a bulb on the demonstration boards and demonstrate the working of your circuit by changing various variables. (to control one lamp with a single switch, to control 2 lamps individually by 1 way and 2-Way switches, to control one lamp from 3 different places, to control two lamps in a series, both in parallel and individual control.
- 4) To construct fuse indication circuit
- 5) To install single-phase Energy meter, Main switch and Distribution fuse board.
- 6) To install voltage-ampere protector in AC circuit and observe its function as safety device.
- 7) To design a DB box using different breakers, changeover & Relays.
- 8) To install magnetic contactor & timer relays in a control circuit.
- 9) To install a solar system of 300 watt using solar panels, charge controller (30 A) and battery (12 volts).

3. Soldering

- 1) Identify the common solders, soldering tools and equipment and practice soldering techniques by soldering various electrical components on board.
- 2) Practice of Soldering and de-Soldering on PCB
- 3) Familiarization and practice on Hot air Soldering & de-soldering station.
- 4) Perform various operations such as etching, drilling and soldering on a PCB
- 5) Using a PCB, demonstrate working of series and parallel circuits. This is done also to show how neat soldering and de-soldering is done.
- 6) Make a buzzer circuit incorporating safety devices and test the circuit for any faults.

MTR-153 Workshop Practice

Total Contact Hours

Theory	32	T	P	C
Practical	192	1	6	3

Aims

1. Familiarize students with the layout, sections, tools, equipment, and safety protocols of the workshop.
2. Comprehend the commonly utilized workshop processes and techniques involved in repairing and producing parts and components.
3. Foster an environment that encourages students to gain practical experience in machining, metalworking, wiring, soldering, and other related skills

Pre-requisites:

None

Course Contents:

1. INTRODUCTION TO WORKSHOP

4 Hours

- 1.1 Workshop and its Layout
- 1.2 Major Sections and Their Importance
- 1.3 Types of Jobs Performed
- 1.4 Overview of General Measurement Terms and Units
- 1.5 General Tools Used in Workshop
- 1.6 Safety Procedures

2. METAL WORKING

6 Hours

- 2.1 Define Metal Working
- 2.2 Concept of Material Deformation
 - 2.2.1. Metal Cutting
 - 2.2.2. Forging
 - 2.2.3. Rolling
 - 2.2.4. Extrusion and Drawing
 - 2.2.5. Indenting
 - 2.2.6. Shrinking and Stretching
 - 2.2.7. Recessing
 - 2.2.8. Spinning
 - 2.2.9. Shearing and Bending
 - 2.2.10. Pipe bending
- 2.3 Introduction to Metal Forming Machines
- 2.4 Metal Working Quality Standards

3. MACHINING

8 Hours

- 3.1 Define Machining
- 3.2 Introduction to Machining Processes & Their Techniques
 - 3.2.1. Turning (Rough Turning, Finish Turning)
 - 3.2.2. Facing, Parting, Boring
 - 3.2.3. Drilling, Cutting, threading
 - 3.2.4. Tapping & Making Tapers
- 3.3 Introduction to Machining Equipment, Their Working/ Functions
 - 3.3.1. Lathe Machine and its Types
 - 3.3.2. Milling Machine and its Types
 - 3.3.3. Shaping Machine
 - 3.3.4. Drilling Machine
- 3.4 Machining Quality Standards

4. METAL FABRICATION

6 Hours

- 4.1 Introduction and applications
- 4.2 Metal Cutting Processes

	4.2.1 Sawing	
	4.2.2 Shaping	
	4.2.3 Broaching	
	4.2.4 Turning and Facing	
	4.2.5 Drilling, Reaming, Boring and Tapping	
4.3	Manufacturing Processes	
	4.3.1 Casting	
	4.3.2 Shearing and Forming	
4.4	Metal Joining	
	4.4.1 Arc welding	
	4.4.2 Gas Welding	
	4.4.3 Fusion Welding	
	4.4.4 TIG and MIG welding	
5.	ELECTRICAL WIRING & PCB	8 Hours
5.1	Introduction to electrical hand tools	
	5.1.1 Combination pliers	
	5.1.2 Screw driver and its types	
	5.1.3 Phase and earth tester	
	5.1.4 Cable cutter and its types	
	5.1.5 Wire stripper	
5.2	Electrical Measurements	
	5.2.1 Voltmeter	
	5.2.2 Ammeter	
	5.2.3 Wattmeter	
5.3	Electrical wiring components	
	5.3.1 Switches (one way and two way), Holders, ceiling rose, socket, main switch, PVC casing, conduit pipes	
	5.3.2 Electrical safety components (Fuse, Circuit breakers, Earth breakers)	
5.4	Types of Voltage Sources	
5.5	Benefits of Electrical wiring	
5.6	Electrical symbols of wiring components	
5.7	Wiring diagram and its importance	
5.8	Examples of wiring diagram	
	5.8.1 Two way switch circuit	
	5.8.2 Wiring diagram for light	
5.9	Process of PCB Making.	

INSTRUCTIONAL OBJECTIVES:

1. INTRODUCTION TO WORKSHOP

- 1.1 Identify the purpose of a workshop and its layout
- 1.2 Describe the major sections of a workshop and the tasks performed there in.
- 1.3 Explain different types of jobs performed in workshop
- 1.4 Understand the commonly used measurement in industry along with their unit
- 1.5 Identify and describe general tools used in workshop
- 1.6 Understand safety procedures for working in a workshop

2. METAL WORKING

- 2.1 Define metal working
- 2.2 Understand the concept of material deformation
 - 2.2.1 Describe the metal cutting process
 - 2.2.2 Describe the forging process
 - 2.2.3 Describe the rolling process
 - 2.2.4 Describe the extrusion and drawing processes
 - 2.2.5 Describe the indenting process
 - 2.2.6 Describe the shrinking and stretching process
 - 2.2.7 Describe the recessing process
 - 2.2.8 Describe the spinning process
 - 2.2.9 Describe the shearing and bending process
 - 2.2.10 Describe the pipe Bending
- 2.3 Understand the working of various metal forming machines
- 2.4 Understand the working of various Metal Working Quality Standards

3. MACHINING

- 3.1 Define Machining
- 3.2 Understand Various Machining Processes and describe:
 - 3.2.1 Turning Process (Rough Turning, Finish Turning)
 - 3.2.2 Facing Process
 - 3.2.3 Parting Process
 - 3.2.4 Boring Process
 - 3.2.5 Drilling Process
 - 3.2.6 Cutting Process
 - 3.2.7 Tapping Process
 - 3.2.8 Tapers (Tapering)
 - 3.2.9 Threading Process
- 3.3 Understand and describe the working of important Machines and their functions, such as:
 - 3.3.1 Lathe Machine & Its Types
 - 3.3.2 Milling Machine & Its Types
 - 3.3.3 Shaping Machine
 - 3.3.4 Drilling Machine
- 3.4 Identify and describe the Machining Quality Standards

4. METAL FABRICATION

- 4.1 What is metal fabrication and write its applications
- 4.2 Briefly describe the following Metal Cutting Processes
 - 4.2.1 Sawing
 - 4.2.2 Shaping
 - 4.2.3 Broaching
 - 4.2.4 Turning and Facing
 - 4.2.5 Drilling, Reaming, Boring and Tapping
- 4.3 Briefly describe the following Manufacturing Processes
 - 4.3.1 Casting
 - 4.3.2 Shearing and Forming

4.4 Briefly describe the following Metal Joining

- 4.4.1 Arc welding
- 4.4.2 Gas Welding
- 4.4.3 Fusion Welding
- 4.4.4 TIG and MIG welding

5. ELECTRICAL WIRING AND PCB MAKING

5.1 Describe the use of following electrical hand tools

- 5.1.1 Combination pliers
- 5.1.2 Screw driver and its types
- 5.1.3 Phase and earth tester
- 5.1.4 Cable cutter and its types
- 5.1.5 Wire stripper

5.2 Describe the use of following Electrical Measurements devices

- 5.2.1 Voltmeter
- 5.2.2 Ammeter
- 5.2.3 Wattmeter

5.3 Describe the use of following Electrical wiring components

- 5.3.1 Switches (one way and two way), Holders, ceiling rose, socket, main switch, PVC casing, conduit pipes
- 5.3.2 Electrical safety components (Fuse, Circuit breakers, Earth breakers)

5.4 Explain the Types of Voltage Sources

5.5 Write the Benefits of Electrical wiring

5.6 Draw Electrical symbols of wiring components

5.7 What is wiring diagram and write its importance

5.8 Draw the following wiring diagrams.

- 5.8.1 Two way switch circuit
- 5.8.2 Wiring diagram for light

5.9 Explain the complete Process of PCB Making.

List of Recommended Books:

1. Machine Tools and Workshop Practice for Engineering Students and Apprentices by Alfred Parr
2. Mechanical Workshop Practice by K.C John

LIST OF PRACTICAL:**Hrs.****Machining:****96**

1. Preparation of name plate.
2. Preparation of Bottle opener.
3. Turning and Facing exercise on Lathe machine.
4. Manual and machine tapping exercise.
5. Threading Exercise on lathe machine.
6. Exercise Face milling using milling machine.
7. Slotting exercise using shaper machine.

Metal Fabrication**32**

8. Practice Butt and Lap joint using Arc welding equipment.
9. Sheet cutting and bending exercise.

Electrical Wiring & PCB**64**

10. Connect three lamps in parallel and control them with single switch.
11. Practice two way switch wiring to control the light.
12. Practice to install switch and socket board.
13. Practice to install circuit breaker and perform testing.
14. Real time wiring activity and replacement of components of a room as assigned by instructor.
15. Develop a PCB to connect a Micro push button, resistor and to control an LED.
16. Develop a PCB for Bridge Rectifier circuit.

MTRC-151 Occupational Health Safety & Environment

Total contact hours:		T	P	C
Theory:	32 Hours	1	0	1
Practical:	0 Hours			

AIM. At the end of this course, the students will be able to:-

1. Adopt safety standards, codes, rules, etc., to be desired in Mechanical Workshop / Labs of Industries.
2. Understand methods of prevention of accident.
3. Provide first aid and rescue in case of any accident.

Course Contents

- 1. Introduction and Importance of Safety** **3 Hours**
 - 1.1. Introduction to safety and House keeping
 - 1.2. Importance of safety in Institute workshops /labs
 - 1.3. Importance of safety in industry
 - 1.4. Implementation of 3S and 5S in Workplace
 - 1.5. Accident prevention fundamentals
 - 1.6. Introduction to IOSH & NEBOSH
- 2. Accidents in Chemical Industry** **3 Hours**
 - 2.1. Accidents in petroleum, paint and fertilizer industry
 - 2.2. Explosive vapors and gases
 - 2.3. Preventions in chemical Industry accidents
- 3. Accidents in Mechanical Industry** **4 Hours**
 - 3.1. Due to material handling and transportation
 - 3.2. Accidents due to hand tools
 - 3.3. Accidents in Workshops
 - 3.4. Accidents in confined spaces
 - 3.5. Accidents in hot work
 - 3.6. Safety procedures while operating machinery/automated machines
 - 3.7. Heat & ventilation
 - 3.8. Prevention in mechanical industry accidents
- 4. Electric Hazards** **3 Hours**
 - 4.1. Hazards related to electric shock phenomena
 - 4.2. Reasons of electric shock
 - 4.3. Prevention of electric shock

5. Fire accidents and their prevention	3 Hours
5.1. Fire accidents and their prevention	
5.2. Fire hazard and their types	
5.3. Firefighting equipment, and fire extinguishers	
5.4. How to store flammable & hazardous materials	
5.5. Disposal of flammable & hazardous materials	
6. Safety in plant Lay-out	2 Hours
6.1. Safety in Plant lay out	
6.2. Housekeeping for safety	
6.3. Safety instruction during maintenance	
6.4. Safety instruction in use of electricity	
6.5. Implementation of 3S and 5S in Workplace	
7. Personal Protective Equipment (PPE)	2 Hours
7.1. Personal Protective Equipment and its importance	
7.2. First Aid Procedure and training	
7.3. Extended medical services	
8. Risk Management	6 Hours
8.1. What is Risk management for OHSE?	
8.2. Identification of health, safety and environmental hazard	
8.3. Risk Assessment and Risk Control Processes	
8.4. How to Plan Risk management?	
9. Monitoring Ohse Programs	6 Hours
9.1. Statistical Review	
9.2. Management/Staff meetings	
9.3. Stakeholders surveys	
9.4. Internal & External Reviews & Audits	
9.5. Suppliers'/Manufacturers products inspection	
9.6. Industrial procedures & operations review	

RECOMMENDED BOOKS

1. Occupational Health and Safety Management-A Practical Approach:
Charles D. Reese Second Edition (2008)
2. Practical Guide to Occupational Health and Safety: Paul A. Erickson (1996)
3. Health & Safety, Environment and Quality Audits: Stephen Asbury (2007)

INSTRUCTIONAL OBJECTIVES:

1. KNOW IMPORTANCE OF SAFETY PRACTICES AND ITS NECESSITY IN THE INDUSTRY

- 1.1 Describe importance of housekeeping, Safety and accidents
- 1.2 Describe the importance of safety practices in Institute shops/labs
- 1.3 Describe the hazards for not observing safety
- 1.4 Implementation of 3S and 5S in Workplace
- 1.5 Accident prevention fundamentals
- 1.6 Introduction to IOSH & NEBOSH

2. KNOW CAUSES AND PREVENTIONS OF ACCIDENT IN CHEMICAL BASED INDUSTRY

- 2.1 State the type and causes of accidents in petroleum, fertilizer, paint and chemical based industry
 - 2.1.1 Enlist causes and preventions of chemical based industrial accidents
- 2.2 Describe accidental causes and effects of explosive gases and vapors
 - 2.2.1 Describe toxic chemicals and their effects on human
 - 2.2.2 List of preventions for accidental causes due to explosive gases and vapors

3. KNOW CAUSES AND PREVENTION OF ACCIDENTS IN MECHANICAL INDUSTRY

- 3.1 List of accidents in material handling and transportation in industry
 - 3.1.1 Describe the methods of prevention of accident due to material and machine handling in manufacturing Industry
- 3.2 Explain proper use of hand tools to prevent accident
- 3.3 Describe accidents in machines shop
- 3.4 Describe accidents in confined spaces
- 3.5 Describe accidents in hot work
- 3.6 Describe safety procedures while operating machinery/automated machines
- 3.7 Role of Heat & ventilation
- 3.8 Prevention in mechanical industry accidents

4. ELECTRIC SHOCKS & EARTHING (PREVENTION AND ITS REMEDY)

- 4.1 Describe Electric shock phenomena

- 4.2 Describe Reasons of electric shock
- 4.3 Describe Prevention of electric shock

5. FIRE ACCIDENTS AND THEIR PREVENTION

- 5.1 Describe prevention of fire accidents on plant
- 5.2 Know the causes of fire hazard
 - 5.2.1 Identify fire hazard and their types
 - 5.2.2 List the causes of accidents due to fire
- 5.3 Know Steps to control fire/fire fighting
 - 5.3.1 Training of fire fighting with the help of Rescue 1122
 - 5.3.2 Know the types of fire extinguishers and their use
- 5.4 Describe how to store flammable & hazardous materials
- 5.5 Understand disposal of flammable & hazardous materials

6. KNOW THE BASIC CONCEPT OF SAFETY IN PLANT LAYOUT

- 6.1 Identify the safety aspect in plant layout
- 6.2 Describe the house keeping procedure for safety
- 6.3 Identify the procedure to lay out machines and equipment by considering safety aspect
- 6.4 Explain the instructions use of electricity
- 6.5 Interpret Implementation of 3S and 5S in Workplace

7. KNOW PRINCIPLE METHOD AND IMPORTANCE OF PERSONAL PROTECTIVE DEVICE

- 7.1 State useful protective devices
- 7.2 List personal protective devices and describe their importance
 - 7.2.1 Describe protection devices protecting Hand, faces, Ear, Leg, Foot and Eyes
 - 7.2.2 Describe protection
 - 7.2.3 Describe personal safety equipment
 - 7.2.4 Describe lather safety belt, fire ropes, chain, slings and other supports forprecautions
- 7.3 Describe use of protection devices for protecting from chemicals and gases

8. UNDERSTAND WHY RISK MANAGEMENT IS IMPORTANT

- 8.1 Understand the concept of risk management for OHSE
- 8.2 Identify health, safety and environmental hazards
- 8.3 Understand the risk assessment process and risk control methods
- 8.4 Understand the planning techniques for risk management

9. UNDERSTAND HOW TO MONITOR AN OHSE PROGRAMS

- 9.1 Describe the process of statistical review of the industry for OHSE
- 9.2 Understand the importance of management/staff meetings for implementation of OHSE
- 9.3 Identify the stakeholders and understand the process of conducting surveys for the stakeholders
- 9.4 Understand the importance of internal & external reviews & audits
- 9.5 Outline the method of suppliers'/manufacturers products inspection
- 9.6 Outline the methods of industrial procedures & operations review

اسلامیات / مطالعہ پاکستان

نصاب سال دوم

حصہ اول اسلامیات

حصہ دوم مطالعہ پاکستان

موضوعات:

GEN201

ٹی پی سی

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کل وقت 20 گھنٹے:

1- سورة المومنون ایک تا گیارہ آیات کا ترجمہ مع تشریح

2- دس منتخب احادیث مع ترجمہ و تشریح

() خیر کم من تعلم القرآن و علمہ

() لا ایمان لمن لا امانته له ولا دین لا من لا اعهد له

() و یا کم و الظن ان الظن اکرب الحدیث

() من احدث فی امرنا هذا ما لیس منه فہورد

() من حمل علینا السلاح فلیس منا

() انا و کافل الیتیم فی الجنہ

() لا ضرور ولا ضرار فی السلام

() کلکم راع و کلکم راع و کلکم مسول عن رعیتہ

3- سیرۃ طیبہ

() مکی زندگی - ولادت - بعثت - ہجرت

() مدنی زندگی - مواخات - میثاق مدینہ - فتح مکہ (سبب و نتائج)

4- حضور ﷺ بحیثیت

() خطبہ حجۃ الوداع - انسانی حقوق کا اعلامیہ / حقوق انسانی پالیسی 2018

() معلم کامل - سربراہ خاندان

5- اسلامی معاشرہ

نظام تعلیم اور اس کے مقاصد - عدل و انصاف - امر با المعروف - نہی عن المنکر - انسانی حقوق کا معاشرتی اور معاشی ترقی میں کردار

جہاد - کسب حلال - مسجد (اہمیت و فضیلت)

6- اسلامی ریاست کی تعریف - اسلامی ریاست کی خصوصیات - اسلامی حکومت کے فرائض - اسلامی طرز حکومت -

() حضور ﷺ کی بطور سربراہ بیان کر سکے

حضور ﷺ بحیثیت

() خطبہ حجۃ الوداع۔ انسانی حقوق کا اعلامیہ / حقوق انسانی پالیسی 2018 کے بارے جان سکے

اسلامی معاشرہ:

عمومی مقاصد: اسلامی معاشرہ کی خصوصیات سے آگاہی حاصل کر سکے

خصوصی مقاصد:

() اسلامی معاشرہ کا معنی و مفہوم کر سکے

() اسلامی معاشرہ کی امتیازی خصوصیات بیان کر سکے

() اسلامی معاشرہ میں عدل و احسان کی اہمیت بیان کر سکے

() تبلیغ کے لغوی معنی بیان کر سکے

() تبلیغ کی اہمیت اور ضرورت بیان کر سکے

() جہاد کے لفظی و اصطلاحی معنی بیان کر سکے

() جہاد کی اہمیت بیان کر سکے

() جہاد اور قتل میں فرق بیان کر سکے

() جہاد کی مختلف اقسام بیان کر سکے

() لفظ مسجد کی تعریف بیان کر سکے

() مسجد کی سابقہ حیثیت کو بحال کرنے کے بارے میں اقدامات کو مان سکے

() انسانی حقوق کی معاشی اور معاشرتی ترقی میں اہمیت اور کردار بیان کر سکے

اسلامی ریاست:

عمومی مقاصد:

() اسلامی ریاست کی خصوصیات بیان کر سکے

خصوصی مقاصد:

() ریاست کی تعریف بیان کر سکے

() اسلامی ریاست میں طرز حکومت سے آگاہی حاصل کر سکے

() اسلامی ریاست کی خصوصیات بیان کر سکے

حصہ دوم
مطالعہ پاکستان

تدریس مقاصد:

تحریک پاکستان:

عمومی مقاصد:

() قیام پاکستان کے اسباب و تحریک کو بیان کر سکے

خصوصی مقاصد:

() قومیت کے مفہوم کو بیان کر سکے

() دو قومی نظریہ کی تعریف و توضیح کر سکے

() دو قومی نظریہ کی اہمیت بیان کر سکے

() ہندوستانی مسلمانوں کی محرومیوں کو بیان کر سکے

() قومی تشخص کو بحال رکھنے کے لیے مسلمانان ہند کی مساعی بیان کر سکے

() آزادی ہند اور قیام پاکستان علامہ اقبال اور قائد اعظم کی مسایام کریں

() قیام پاکستان سے مستقبل اسلامی مملکت کے قیام کے لیے مسلم عوام کی کوششوں کو بیان کر سکے

() مسلم لیگ کے قیام پاکستان کے لیے جدوجہد بیان کر سکے

(غیر مسلم طلباء کے لیے)

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کل وقت 20 گھنٹے

نصاب اخلاقیات

سال دوم

موضوعات:

معاشرتی اقدار بلحاظ ہمسایہ۔ قوم۔ قومی سطح۔ شہری سطح۔ صنعتی اداروں کی سطح۔ ضروریات۔ ورثہ

() حقوق و فرائض

() قوت برداشت

() قوت ارادی

() لگن و جذبہ

() وسیع النظری

() بے غرضی

() انسانی دوستی

() حفاظتی شعور

() پاس آزادی

() کامل آگاہی

() تغیرات کو قبول کرنا

() خود شناسی

() انسانی حقوق کا اعلامیہ / حقوق انسانی پالیسی 2018

() انسانی حقوق کا معاشرتی اور معاشی ترقی میں کردار

() حقوق آگاہی / معلومات تک رسائی۔ ملازم پیشہ خواتین کا تحفظ

نصاب اخلاقیات سال دوم

تدریس مقاصد:

طالب علم اخلاقیات کی اہمیت و ضرورت سے آگاہ ہو سکے اور بیان کر سکے
خصوصی مقاصد: طالب علم اس قابل ہو کہ

- () موضوعات کا مطلب بیان کر سکے
- () عملی زندگی سے مثالوں کی نشاندہی کر سکے
- () اپنی شخصیت اور معاشرے پر موضوعات کے مطابق اثرات پیدا کرنے کے طریقے بیان کر سکے
- () اعلیٰ اخلاقی اقدار میں سے قوت برداشت - قوت ارادی - لگن و جذبہ - وسیع النظری - بے غرض - انسانی دوستی شعور - پاس آزادی - کامل آگاہی اور خود شناسی کی اہمیت
- () اخلاقیات سے متصف ہو کر قومی خدمت بہتر طور پر انجام دے سکے
- () انسانی حقوق کا اعلامیہ / حقوق انسانی کی پالیسی 2018 کے بارے میں جان سکے
- () انسانی حقوق کا معاشرتی اور معاشی ترقی میں اہمیت اور کردار بیان کر سکے
- () حقوق آگاہی / معلومات تک رسائی کے قانون کو جان سکے
- () ملازم پیشہ خواتین کا تحفظ کو اخلاقیات کا حصہ تصور کرے

TTQ 211/ Civic-211 TARJAMA TUL QURAN / CIVICS

Theory	32	T	P	C
Practical	0	1	0	1

As per syllabus of BISE from PCTB Book

MATH-212 APPLIED MATHEMATICS-II

Theory	64	T	P	C
Practical	0	2	0	2

Aims & Objectives:

The course mainly covers the topics related to Calculus and Analytical Geometry to further enhance the students' capabilities to solve technical problems.

COURSE CONTENTS: FURTHER

- 1. FUNCTIONS & LIMITS. 4 Hours**
 - 1.1 Constants and variables
 - 1.2 Functions & their types
 - 1.3 The concept of limit
 - 1.4 Limit of a function
 - 1.5 Fundamental theorems on limit
 - 1.6 Some important limits
 - 1.7 Problems
- 2. DIFFERENTIATION. 4 Hours**
 - 2.1 Increments
 - 2.2 Different Coefficient or Derivative
 - 2.3 Differentiation ab-initio or by first principle
 - 2.4 Geometrical Interpretation of Differential Coefficient
 - 2.5 Differential Coefficient of Xa , $(ax + b)a$
 - 2.6 Three important rules
 - 2.7 Problems.
- 3. DIFFERENTIATION OF ALGEBRIC FUNCTION. 4 Hours**
 - 3.1 Explicit function
 - 3.2 Implicit function
 - 3.3 Parametric forms
 - 3.4 Problems
- 4. DIFFERENTIATION OF TRIGNOMETRIC FUNCTION. 4 Hours**
 - 4.1 Differential coefficient of $\sin x$, $\cos x$, $\tan x$ from first principle.
 - 4.2 Differential coefficient of $\operatorname{Cosec} x$, $\sec x$, $\cot x$.
 - 4.3 Differentiation of inverse trigonometric function.
 - 4.4 Problems.

5. DIFFERENTIATION OF LOGARITHMIC & EXPONENTIAL FUNCTION. 4 Hours

- 5.1 Differentiation of $\ln x$
- 5.2 Differentiation of $\log ax$
- 5.3 Differentiation of a^x
- 5.4 Differentiation of e^x
- 5.5 Problems.

6. RATE OF CHANGE OF VARIABLE. 4 Hours

- 6.1 Increasing and decreasing function
- 6.2 Maxima and Minima values
- 6.3 Criteria for maximum and minimum values.
- 6.4 Method of finding maxima and minima.
- 6.5 Problems.

7. INTEGRATION. 8 Hours

- 7.1 Concept
- 7.2 Fundamental Formulas
- 7.3 Important Rules
- 7.4 Problems.

8. METHOD FOR INTEGRATION. 6 Hours

- 8.1 Integration by substitution
- 8.2 Integration by parts
- 8.3 Problems.

9. DEFINITE INTEGRALS. 6 Hours

- 9.1 Properties
- 9.2 Application to Area
- 9.3 Problems

10. PLANE ANALYTIC GEOMETRY & STRAIGHT LINE. 6 Hours

- 10.1 Coordinate System
- 10.2 Distance Formula
- 10.3 The Ratio Formulas
- 10.4 Inclination and slope of a line
- 10.5 The Slope Formula
- 10.6 Problems.

11. EQUATION OF STRAIGHT LINE. 6 Hours

- 11.1 Some Important Forms
- 11.2 General form
- 11.3 Angle formula
- 11.4 Parallelism and perpendicularity
- 11.5 Problems

12. THE EQUATION OF THE CIRCLE. 8 Hours

- 12.1 Standard form of equation
- 12.2 Central form of equation
- 12.3 General form of equation
- 12.4 Radius & coordinate of the Centre
- 12.5 Problems

RECOMMENDED BOOKS

- 1 Thomas Finny –Calculus and Analytic Geometry
- 2 GhulamYasinMinhas –Technical mathematics Vol II, IlmiKitabKhana ,Lahore.
- 3 Prof .Riaz Ali Khan –Poly Technique Mathematics Series, Volume I & II, MajeedSons, Faisalabad.
- 4 Prof. SanaullahBhatti –Calculus and Analytic Geometry , Punjab Text Book Board, Lahore.

INSTRUCTIONAL OBJECTIVES**1. USE THE CONCEPT OF FUNCTION AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS**

- 1.1 Define a function
- 1.2 List all types of function
- 1.3 Explain the concept of limit and limit of a function
- 1.4 Explain fundamental theorem on limits
- 1.5 Derive some important limits
- 1.6 Solve simple problems on limits

2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT

- 2.1 Derive mathematics expression for a differential coefficient.
- 2.2 Explain geometrical interpretation of differential coefficient.
- 2.3 Differentiate a content, constant associated with a variable and the Sum of finite number of function.
- 2.4 Solved related problems.

3. USE RULES OF DIFFERENTIAL TO SOLVE PROBLEMS OF ALGEBRIC FUNCTIONS.

- 3.1 Differentiate ab-initio X^n and $(aX+b)^n$
- 3.2 Derive product, quotient and chain rules.
- 3.3 Find derivative of implicit function & explicit function.
- 3.4 Differentiate parametric forms; function w.r.t another function and byrationalization.
- 3.5 Solve problems using these formulas.

4. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS OF ALGEBRIC FUNCTIONS.

- 4.1 Differentiate from first principle $\sin x, \cos x, \tan x$.
- 4.2 Derive formula for derivation of $\sec x, \operatorname{cosec} x, \cot x$.
- 4.3 Find differential coefficient of inverse trigonometric functions.

5. USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.

- 5.1 Derive formulas for differential coefficient of logarithmic and exponential functions.
- 5.2 Solve problems using these formulas.

6. UNDERSTAND RATE OF CHANGE OF ONE VARRIABLE WITH RESPECT TO ANOTHER.

- 6.1 Write expression for velocity, acceleration, and slope of a line.
- 6.2 Define an increasing and decreasing function, maxima and minima values, of inflection.
- 6.3 Explain criteria for maxima and minima values of a function.
- 6.4 Solve problems involving rate of change of variables.

7. APPLY CONCEPT OF INTEGRATION IN SOLVING TECHNOLOGICAL PROBLEMS

- 7.1 Explain the concept of integration
- 7.2 Write basic theorem of integration
- 7.3 List some important rules of integration
- 7.4 Derive fundamental formulas of integration
- 7.5 Solve problems based on these formulas /rules.

8. UNDERSTAND DIFFERENT METHODS OF INTEGRATION.

- 8.1 List standard formulas
- 8.2 Integrate a function by substitution method
- 8.3 Find integrals by the method of integration by parts
- 8.4 Solve problems using these methods.

9. UNDERSTAND THE METHOD OF SOLVING DEFINITE INTEGRALS.

- 9.1 Define definite integral
- 9.2 List properties of definite integrals using definite integrals.
- 9.3 Find areas under curves
- 9.4 Solve problems of definite integrals.

10. UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.

- 10.1 Explain the rectangular coordinate system
- 10.2 Locate points in different quadrants
- 10.3 Derive distance formula
- 10.4 Prove section formula
- 10.5 Derive slope formula
- 10.6 Solve problems using the above formulas.

11. USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

- 11.1 Define a straight line
- 11.2 State general form of equation of a straight line
- 11.3 Derive slope intercept and intercept forms of equations.
- 11.4 Derive expression for angle between two straight lines
- 11.5 Derives conditions of perpendicularity and parallelism lines
- 11.6 Solve problems involving these equations/formulas.

12. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATION OF CIRCLE.

- 12.1 Define a circle
- 12.2 Describe standards, central and general forms of the equation of a circle.
- 12.3 Convert general forms to the central forms of equation of a circle.
- 12.4 Deduce formulas for the radius and the coordinates of the center of a circle from the general form.
- 12.5 Derive equation of the circle passing through three given points.
- 12.6 Solve problems involving these equations

MGM-252 PROFESSIONAL ETHICS, COMMUNICATION & REPORT WRITING

Total Contact Hours:	128	T	P	C
Theory (Hours):	32	1	3	2
Practical (Hours):	96			

Aims

- To inculcate professional ethics as required in the Mechatronics discipline
- To develop an understanding of business communication process and mediums
- To learn about basic communication practices
- To develop effective writing and speaking techniques for communication
- To introduce students to effective employment related communication

COURSE CONTENTS

- | | |
|---|---------|
| 1. INTRODUCTION TO PROFESSIONAL ETHICS | 5 Hours |
| 1.1 Introduction: Definition and importance of professional ethics,
1.2 Ethical theories (brief overview), virtue ethics, importance of character in professional careers, Professional responsibility
1.3 Codes of Ethics: Introduction to professional engineering codes (e.g., IEEE, ASME), Core principles and values, Importance of adhering to codes
1.4 Confidentiality and Intellectual Property
1.5 Conflict of Interest and ways to resolve these conflicts
1.6 Safety, Risk, and Environment
1.7 Environmental impact and sustainable design and development
1.8 Product Liability, legal and ethical responsibilities
1.9 Privacy and data security | |
| 2. TECHNIQUES FOR EFFECTIVE COMMUNICATION | 2 Hours |
| 2.1 Identifying audience
2.2 Establishing purpose
2.3 Formulating message
2.4 Selecting style and tone
2.5 Writing process
2.6 Communicating in the electronic office | |
| 3. BASIC WRITING PRACTICES | 3 Hours |
| 3.1 Types and functions of paragraphs
3.2 Topic sentence
3.3 Appearance and patterns
3.4 How to make Sentences: construction and punctuation
3.5 Active and passive voice
3.6 Parallelism
3.7 Context; modifiers; pronoun reference | |

3.8	How to Use Proper Words: Spelling, Right meaning	
3.9	Eliminating unnecessary words: Jargon and slang	
4.	TYPES OF BUSINESS CORRESPONDENCE	6 Hours
3.1	Memorandums	
3.2	Agendas and Minutes of Meeting	
3.3	Emails	
3.4	Business Letters: General Correspondence	
	○ Letters of Inquiry ○ Customer relations letters ○ Letters of instruction	
5.	PRESENTATIONS TECHNIQUES	4 Hours
5.1	Effective speaking and listening	
5.2	Briefings	
5.3	Formal Presentations	
6.	REPORT WRITING	5 Hours
6.1	Report Process and Research Methods	
6.2	Planning	
6.3	Pre-writing	
	• Collecting Information & Documenting Sources • Preparing Structure • Conducting Interviews • Summarizing Materials	
6.4	Report Structure	
6.5	Table of Contents	
6.6	Front Matter	
	▪ Objectives ▪ Scope of Work ▪ Statement of Problem ▪ Abbreviations	
6.7	Executive Summary	
6.8	Introduction	
6.9	Report Body	
6.10	Conclusion & Recommendations	
6.11	Back Matter	
	▪ Annexes, Appendixes, Glossary of Terms	
6.12	Drafting	
6.13	Revising	
6.14	Managing data and using graphics	
7.	GOOD REPORT WRITING TECHNIQUES	2 Hours
7.1	Organization of facts/data	
7.2	Accuracy of information	
7.3	Style of writing	
7.4	Vocabulary & grammar	
7.5	Presentation	
8.	FORMAL COMMUNICATIONS RELATED TO EMPLOYMENT	5 Hours
8.1	Cover Letters	
8.2	Resume Writing	
8.3	How to make a Curriculum Vitae (CV)	
8.4	Methods Job Search	
8.5	Interviewing techniques	

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO PROFESSIONAL ETHICS

- 1.1. Understand professional ethics and its importance
- 1.2. Introduce ethical theories, virtue ethics, importance of character in professional careers, and professional responsibility
- 1.3. Introduce codes of ethics (focusing professional engineering codes e.g., IEEE, ASME), core principles and values, and importance of adhering to codes
- 1.4. Describe confidentiality and intellectual property
- 1.5. Understand the idea of conflicts of interest and ways to resolve these conflicts
- 1.6. Introduce Safety, Risk, and Environment
- 1.7. Understand environmental impact and sustainable design and development
- 1.8. Understand product liability, legal and ethical responsibilities
- 1.9. Describe privacy and data security

2. UNDERSTAND AND ACQUIRE THE TECHNIQUES FOR EFFECTIVE COMMUNICATION

- 2.1. Understand the relevance of Identifying audience for effective communication
- 2.2. Understand the relevance of establishing purpose for effective communication
- 2.3. Understand the method to formulate the message
- 2.4. Identify how to select the style and tone
- 2.5. Describe effective writing process
- 2.6. Describe the communication through electronic media

3. UNDERSTAND THE BASIC WRITING PRACTICES

- 3.1. Understand the types and purpose of writing paragraphs (topic sentence, appearance and patterns,
- 3.2. Understand the construction of a sentence (punctuation, active and passive voice, parallelism, Context; modifiers; pronoun reference)
- 3.3. Understand the importance of using proper words (spelling, words with appropriate meaning, eliminating unnecessary words, avoiding use of jargon and slangs)

4. KNOW ABOUT THE VARIOUS TYPES OF BUSINESS CORRESPONDENCE

- 4.1. Learn writing memorandums (Parts & composition of a memorandum and text)
- 4.2. Learn writing an agenda (Parts & composition and text)
- 4.3. Learn arranging a meeting and writing minutes of meeting (requirements of a meeting, parts & composition and text of minutes)
- 4.4. Learn writing emails
- 4.5. Learn composing different types of business letters (general correspondence, letters of inquiry, customer relations letters, and letters of instruction)

5. UNDERSTAND AND ACQUIRE THE BASIC PRESENTATIONS TECHNIQUES

- 5.1. Learn effective speaking and listening techniques
- 5.2. Understand how to give briefings (in a meeting)
- 5.3. Learn techniques of giving formal presentations

6. KNOW ABOUT EFFECTIVE REPORT WRITING SKILLS

- 6.1. Understand the reporting process and methods
- 6.2. Understand how to plan a report

- 6.3. Understand the procedure before beginning actual writing (Collecting information & documenting sources, preparing structure, conducting interviews and summarizing materials)
- 6.4. Describing the report structure (table of contents, front matter- objective, scope of work, statement of problem, abbreviations, executive summary, introduction, report body and conclusion & recommendations, back matter- annexes, appendices and glossary)
- 6.5. Learn how to draft a report
- 6.6. Understand the revision process
- 6.7. Understand the representation of data and using graphics

7. UNDERSTAND GOOD REPORT WRITING TECHNIQUES

- 7.1.1. Describe the organization of facts/data
- 7.1.2. Understand the importance of accuracy of information
- 7.1.3. Understand the importance style of writing
- 7.1.4. Understand the proper use of vocabulary & grammar
- 7.1.5. Understand good report presentation

8. KNOW ABOUT THE FORMAL COMMUNICATIONS RELATED TO EMPLOYMENT

- 8.1.1. Learn writing cover letters
- 8.1.2. Learn making resume
- 8.1.3. Learn making a Curriculum Vitae (CV)
- 8.1.4. Understand different mediums of job search
- 8.1.5. Acquire important interviewing skills

RECOMMENDED BOOKS

- 1. Essentials of Business Communication: Mary Ellen Guffey & Dana Loewy (2012)
- 2. Business Communication, Amy Newman and Scot Ober (2012)
- 3. Report writing skills training course. How to write a report and executive summary, And plan, design and present. Margaret Greenhall (2010)

LIST OF PRACTICAL

1. Introduction of each of the class participants. Written & Oral
2. Case study and role-playing where students grapple with ethical dilemmas in a simulated real-world mechatronics scenario.
3. Ethical audit of a mechatronic product where students identify and assess ethical implications of a mechatronic product.
4. Demonstrate basic language skills (i.e., Grammar, Spellings, capitalization, sentence structure, etc.)
5. Practice exercises for “Writing Business Letters”
6. Practice Exercise: Standard Business Communication/Letters
7. Practice Exercise: Email & Business Letters
8. Practice Exercise: Writing a Memorandum
9. Practice Exercise: Arranging a meeting, writing Agenda /Minutes
10. Select Interesting Topics: For individual presentations
11. Select interesting topics: For group presentation
12. Assign topic to individual students for writing short report
13. Assign topics to groups of students for submitting a technical report
14. Writing CVs along with a cover letter
15. Class Group Project: Practice interviewing skills

MTR-232 ENGINEERING MATERIALS

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

After studying this course, the student will be able to Learn about the properties and applications of engineering materials, to understand & perform testing& evaluation of engineering materials and to know about the method of selection of different engineering materials.

Course Contents:

1. Introduction

4 Hours

- 1.1. Definition and function of engineering materials
- 1.2. Classification of engineering material
- 1.3. Properties of engineering materials
- 1.4. Mechanical properties
- 1.5. Electrical properties
- 1.6. Chemical properties
- 1.7. Applications of materials in Mechatronics
- 1.8. Selection criteria based on desired properties

2. Heat Treatment

6 Hours

- 2.1. Definitions
- 2.2. Iron carbon equilibrium diagram
- 2.3. Theory of heat treatment of steel
- 2.4. Heat treatment processes
 - 2.4.1. Annealing
 - 2.4.2. Normalizing
 - 2.4.3. Quenching
 - 2.4.4. Tempering
- 2.5. Surface hardening

3. Ferrous and Non-Ferrous Materials

8

Hours

- 3.1. Cast iron.
- 3.2. Classification, composition, properties, and uses of cast iron
- 3.3. Wrought iron.
- 3.4. Aston process
- 3.5. Classification, composition, properties, and uses of carbon steel
- 3.6. Comparison of cast iron, wrought iron, mild steel, and hard steel.
- 3.7. Alloy of steel, Aluminum, Copper, Lead and Tin

4. Non-Ferrous Alloys

4

Hours

- 4.1. Copper alloys
 - 4.1.1. Brasses
 - 4.1.2. Bronzes
- 4.2. Aluminum alloys
 - 4.2.1. Duralumin

4.2.2.	Y-alloy	
4.3.	Nickel alloys	
5.	Testing of Material	6
	Hours	
5.1.	Introduction	
5.2.	Classification of test	
5.3.	Test Specimen Preparation	
5.4.	Nondestructive test	
5.4.1.	Dye Penetrating test (DPT)	
5.4.2.	Acoustic Emission Testing	
5.4.3.	Electromagnetic Testing	
5.4.4.	Ground Penetrating Radar	
5.4.5.	Laser Testing Methods	
5.4.6.	Magnetic Flux Leakage	
5.4.7.	Ultrasonic Testing	
5.5.	Destructive test	
5.5.1.	Mechanical test	
5.5.2.	Tensile test	
5.5.3.	Impact test	
5.5.4.	Hardness test	
5.5.5.	Fatigue test	
5.5.6.	Creep test	
6.	Composites Materials and Plastics	4 Hours
6.1.	Importance of composite materials	
6.2.	Sandwich Structures	
6.3.	Laminated materials	
6.4.	Different types of plastic materials	
6.5.	Types and uses of thermostatic materials	
6.6.	Application of different thermosetting	
6.7.	Fibre reinforced composite materials	
6.8.	Carbon Fibre materials	
6.9.	Elastomers	

INSTRUCTIONAL OBJECTIVES:

1. Introduction

- 1.1. Define engineering materials and their function.
- 1.2. Explain the following materials:
 - 1.2.1. Metals
 - 1.2.2. Polymers
 - 1.2.3. Ceramics
 - 1.2.4. Composites
- 1.3. Explain Mechanical properties of materials.
- 1.4. Explain Electrical properties of materials.
- 1.5. Explain Chemical properties of materials.
- 1.6. Explain applications of materials in Mechatronics
- 1.7. Describe selection criteria based on desired properties (strength, weight, electrical conductivity)

2. Heat Treatment

- 2.1. Define heat treatment process.
- 2.2. What are Objectives of heat treatment process?
- 2.3. Explain Iron carbon equilibrium diagram.
- 2.4. Explain Theory of heat treatment of steel
- 2.5. Explain the following heat treatment processes.
 - 2.5.1. Annealing
 - 2.5.2. Normalizing
 - 2.5.3. Quenching
 - 2.5.4. Tempering
 - 2.5.5. Surface hardening

3. Ferrous and Non-Ferrous Materials

- 3.1. Define Cast iron.
- 3.2. Describe Classification, composition, properties, and uses of cast iron.
- 3.3. Define Wrought iron.
- 3.4. Explain Aston process.
- 3.5. Describe Classification, composition, properties, and uses of carbon steel.
- 3.6. Comparison of cast iron, wrought iron, mild steel, and hard steel.
- 3.7. Explain Alloy Alloys of steel, Aluminum, Copper, Lead and Tin

4. Non-Ferrous Alloys

- 4.1. Describe Copper alloys
- 4.2. Define Brasses and Bronzes
- 4.3. Explain Aluminum alloys with detail description of Duralumin and Y - alloy
- 4.4. Explain Nickel alloys

5. Testing of Materials

- 5.1. Explain Classification of test
- 5.2. Describe Test Specimen Preparation
- 5.3. Explain Nondestructive test
- 5.4. Explain Dye Penetrating test (DPT)
- 5.5. Explain Acoustic Emission Testing
- 5.6. Explain Electromagnetic Testing
- 5.7. Explain Ground Penetrating Radar
- 5.8. Explain Laser Testing Methods
- 5.9. Explain Magnetic Flux Leakage
- 5.10. Explain Ultrasonic Testing

5.11. Explain following Destructive test

5.11.1. Mechanical test

5.11.2. Tensile test

5.11.3. Impact test

5.11.4. Hardness test

5.11.5. Fatigue test

5.11.6. Creep test

6. Composites Materials and Plastics

6.1. What is the Importance of composite material?

6.2. Explain Sandwich Structures

6.3. Explain laminated materials.

6.4. Explain Different types of plastic materials.

6.5. Explain Types and uses of thermosetting materials.

6.6. Write the application of different thermosetting.

6.7. Explain Fibre reinforced composite materials

6.8. Describe carbon Fibre materials

6.9. Introduce Elastomers

List of Recommended Books:

- Mechanical Testing of Material by Emmanuel Gdoutos & Maria Konsta- Gdoutos.
- Engineering Materials 1 BY Michael F Ashby & David RH Jones.
- Fundamentals of engineering materials by Peter A Thornton.

LIST OF PRACTICAL:

96 Hrs.

1. From given samples of engineering materials, identify the materials. State the major characteristics for each category (e.g., metals, ceramic, plastic & composite etc.)
2. Make any model using composite material.
3. Utilize some hydraulic/pneumatic software like SOLIDWORKS Simulation to evaluate your designs for nonlinear and dynamic response, dynamic loading, and composite materials.
4. To study the structural characteristics or constitution of a metal or an alloy in relation to its physical and mechanical properties.
5. To conduct Rockwell or Vicker Hardness tests on samples made from metallic & plastic materials
6. Study the properties of heat-treated samples of steel. Differentiate the effects of Annealing, Normalizing and Quenching on the properties of different grades of steels.
7. To study the decomposition of Austenite as a function of cooling rates .
8. To conduct Charpy V-notch impact test and determine the ductile-brittle transition temperature of steels.
9. To determine the Young's Modulus, %age Elongation, Yield Stress and UTS of given samples of Steels, Aluminum and brass using Tensile testing machine.
10. To examine the nature of inhomogeneity's and flow lines in a metal by unaided eye or with the aid of a low-powered microscope or magnifying glass.
11. To examine the internal flaws in given samples of materials using various NDT methods.
12. To determine the glass transition temperature of polymers on Differential Scanning Calorimeter.
13. To determine the rate of corrosion for mild steel sample by exposing it to ambient Environment.
14. To study the fracture modes and features for given samples of cast iron, steel, plastics, and composites
15. For construction of typical mechanized system, make appropriate selection of engineering materials for the following components:
 - a) Linkage
 - b) Drive
 - c) Cam
 - d) (Brake) Shuttle valve Give your reasons for the selection.

MTR-242 Engineering Mechanisms

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

- ❖ To understand the basic components of a mechanism/ machine
- ❖ To learn about different types of mechanisms and their applications
- ❖ To understand the phenomenon of vibrations control during operation of machines

Pre-requisites:

None

Course Contents:

- | | |
|---|---------------------|
| 1. Kinematics Fundamentals & Mechanism | 08 Hours |
| 1.1 Degree of Freedom | |
| 1.2 links, joints and kinematics chain | |
| 1.3 Types of joints | |
| 1.3.1. Lower Pairs/Full Joint | |
| 1.3.2. Higher Pair/Half Joint | |
| 1.4 Differentiate between mechanism and machine | |
| 1.5 Differentiate between mechanism and structure | |
| 1.6 Linkage Transformation & Inversion | |
| 1.7 Four Bar Chain and The GRASHOF Condition | |
| 1.8 Mechanism | |
| 1.8.1. Geneva mechanism | |
| 1.8.2. Ratchet and Pawl mechanism | |
| 1.8.3. Slider crank mechanism | |
| 1.8.4. Double crank mechanism | |
| 1.8.5. Cam and Follower mechanism | |
|
2. Belts And Chain Drives |
08 Hours |
| 2.1 Significance of Belt Drives | |
| 2.2 Types of Belts | |
| 2.2.1. Flat | |
| 2.2.2. V-Belt | |
| 2.2.3. Circular or Ropes | |
| 2.3 Flat Belt Drive | |
| 2.3.1. Types/Configurations of Flat Belt Drive | |
| 2.3.2. Velocity Ratio of a Flat Belt | |
| 2.3.3. Power Transmitted by a Flat belt | |
| 2.4 V-Belt Drives | |
| 2.4.1. Types of V-Belts | |
| 2.4.2. Advantages and Disadvantages of V-belt Drive | |
| 2.5 Rope Drives | |
| 2.5.1. Types of Rope Drives | |
| 2.6 Chain Drives | |

- 2.6.1. Advantages and Disadvantages of Chain Drive
- 2.6.2. Velocity Ratio of Chain Drives
- 2.6.3. Classification of Chains
 - a) Hoisting and Hauling Chains
 - b) Conveyor Chains
 - c) Power Transmitting Chains
- 2.6.4. Power Transmitted by Chains

3. Clutches & Brakes

06 Hours

- 3.1 Definition
- 3.2 Types of Clutches
 - 3.2.1. Positive Clutches
 - 3.2.2. Friction Clutches
- 3.3 Types of Brakes
 - 3.3.1. Hydraulic brakes
 - 3.3.2. Electric brakes
 - 3.3.3. Mechanical brakes

4. Gears

06 Hours

- 4.1 Definition
- 4.2 Advantages and Disadvantages of Gear Drives
- 4.3 Terms used in Gears
- 4.4 Law of Gearing for constant velocity
- 4.5 Spur Gears
 - 4.5.1. Definition
 - 4.5.2. Applications
- 4.6 Bevel Gears
 - 4.6.1. Definition
 - 4.6.2. Applications
- 4.7 Worm Gear
 - 4.7.1. Definition
 - 4.7.2. Applications
- 4.8 Gear train
 - 4.8.1. Simple Gear train
 - 4.8.2. Compound Gear train
 - 4.8.3. Reverted Gear train
 - 4.8.4. Velocity ratio of Simple Gear train, Compound Gear train & Reverted Gear train.

5. Cam Follower Mechanism

04 Hours

- 5.1 Cam Terminologies
- 5.2 Types of Follower Motion
- 5.3 Types of Cam
 - 5.3.1. Radial/Plate Cam
 - 5.3.2. Axial/Cylindrical Cam
- 5.4 Types of Follower
 - 5.4.1. Flat-faced
 - 5.4.2. Mushroom (Curved)
 - 5.4.3. Roller

INSTRUCTIONAL OBJECTIVES:

1. Kinematics Fundamentals & Mechanism

- 1.1 Describe Degree of Freedom
- 1.2 Explain links, joints and kinematics chain
- 1.3 Describe following Types of joints
 - 1.3.1. Lower Pairs/Full Joint
 - 1.3.2. Higher Pair/Half Joint
- 1.4 Differentiate between mechanism and machine
- 1.5 Differentiate between mechanism and structure
- 1.6 Explain Linkage Transformation & Inversion
- 1.7 Describe Four Bar Chain and The GRASHOF Condition
- 1.8 Briefly describe the following Mechanism
 - 1.8.1. Geneva mechanism
 - 1.8.2. Ratchet and Pawl mechanism
 - 1.8.3. Slider crank mechanism
 - 1.8.4. Double crank mechanism
 - 1.8.5. Cam and Follower mechanism

2. Belts and Chain Drives

- 2.1 Describe Significance of Belt Drives
- 2.2 Explain the following Types of Belts
 - 2.2.1. Flat
 - 2.2.2. V-Belt
 - 2.2.3. Circular or Ropes
- 2.3 Explain following Flat Belt Drive
 - 2.3.1. Types/Configurations of Flat Belt Drive
 - 2.3.2. Velocity Ratio of a Flat Belt
 - 2.3.3. Power Transmitted by a Flat belt
- 2.4 Explain following V-Belt Drives
 - 2.4.1. Types of V-Belts
 - 2.4.2. Advantages and Disadvantages of V-belt Drive
- 2.5 Explain following Rope Drives
 - 2.5.1. Types of Rope Drives
- 2.6 Explain following Chain Drives
 - 2.6.1. Advantages and Disadvantages of Chain Drive
 - 2.6.2. Velocity Ratio of Chain Drives
 - 2.6.3. Classification of Chains
 - a) Hoisting and Hauling Chains
 - b) Conveyor Chains
 - c) Power Transmitting Chains
 - 2.6.4. Power Transmitted by Chains

3. Clutches & Brakes

- 3.1 Define clutch and Brake
- 3.2 Explain Types of Clutches
 - 3.2.1. Positive Clutches
 - 3.2.2. Friction Clutches
- 3.3 Briefly describe Types of Brakes
 - 3.3.1. Hydraulic brakes
 - 3.3.2. Electric brakes
 - 3.3.3. Mechanical brakes

4. Gears

- 4.1 Define Gears
- 4.2 Explain the Advantages and Disadvantages of Gear Drives
- 4.3 Describe different Terms used in Gears
- 4.4 Explain Law of Gearing for constant velocity
- 4.5 Describe Spur Gears
 - 4.5.1. Definition
 - 4.5.2. Applications
- 4.6 Describe Bevel Gears
 - 4.6.1. Definition
 - 4.6.2. Applications
- 4.7 Describe Worm Gear
 - 4.7.1. Definition
 - 4.7.2. Applications
- 4.8 Describe Gear train
 - 4.8.1. Simple Gear train
 - 4.9.2. Compound Gear train
 - 4.9.3. Reverted Gear train
 - 4.9.4. Velocity ratio of Simple Gear train, Compound Gear train & Reverted Gear train.

5. Cam Follower Mechanism

- 5.1 Describe Cam Terminologies
- 5.2 Explain Types of Follower Motion
- 5.3 Explain Types of Cam
 - 5.3.1. Radial/Plate Cam
 - 5.3.2. Axial/Cylindrical Cam
- 5.4 Explain Types of Follower
 - 5.4.1. Flat-faced
 - 5.4.2. Mushroom (Curved)
 - 5.4.3. Roller

List of Recommended Books:

- Mechanics of Machines by William L cleghorn.
- Theory of Machines by J.K Gupta.

List of Practical:

1. Study the effect of friction in different types of belts, such as flat, vee and round belts.
2. Evaluate the coefficient of friction between the belt and the pulley.
3. To study the characteristics of four bar mechanism by applying Gruebler and Grashof conditions.
4. To plot slider displacement, velocity and acceleration against crank rotation for single slider Crank mechanism.
5. Study the transmission calculation of Worm Drive.
6. Study and compare the velocity ratios and direction of rotation of Simple, Compound and Reverted Gear Train.
7. Determine the follower displacement against angular rotation of a cam.
8. Draw the velocity and acceleration diagrams of cam follower mechanism.
9. Study of uniform motion cam with a roller follower.
10. Study the comparison of SHM and constant acceleration cams with a roller follower.
11. Verify the application of the expression for maximum torque in Clutch Plate.
12. Measure the slip & creep on measurement apparatus in belt drive.
13. Create the various types of linkage mechanism in CAD and simulate for the motion output.

MTR-243 INSTRUMENTATION AND MEASUREMENTS

Total Contact Hours

Theory	64	T	P	C
Practical	96	2	3	3

Aims

- ❖ To understand the working Principle of different instruments used in industry.
- ❖ To understand the calibration of instruments.

Pre-requisites:

None

Course Contents:

1.Fundamentals of Measurement Systems 04 Hours

- 1.1 Introduction
- 1.2 Measurement Unit
- 1.3 Measurement System Design
- 1.4 Elements of a Measurement System
- 1.5 Choosing Appropriate Measuring Instruments
- 1.6 Measurement System Applications

2. Instrument Types and Performance Characteristics 08 Hours

- 2.1 Introduction
- 2.2 Review of Instrument Types
 - 2.2.1 Active and Passive Instruments
 - 2.2.2 Null-Type and Deflection-Type Instruments
 - 2.2.3 Analogue and Digital Instruments
 - 2.2.4 Indicating Instruments and Instruments with a Signal Output
 - 2.2.5 Smart and Non-smart Instruments
- 2.3 Static Characteristics of Instruments
 - 2.3.1 Accuracy and Inaccuracy (Measurement Uncertainty)
 - 2.3.2 Precision/Repeatability/Reproducibility
 - 2.3.3 Tolerance
 - 2.3.4 Range or Span
 - 2.3.5 Linearity
 - 2.3.6 Sensitivity of Measurement
 - 2.3.7 Threshold
 - 2.3.8 Resolution
 - 2.3.9 Sensitivity to Disturbance
 - 2.3.10 Hysteresis Effects
 - 2.3.11 Dead Space
- 2.4 Dynamic Characteristics of Instruments
 - 2.4.1 Zero-Order Instrument
 - 2.4.2 First-Order Instrument
 - 2.4.3 Second-Order Instrument
- 2.5 Necessity for Calibration

3. Measurement Uncertainty 08 Hours

- 3.1 Introduction
- 3.2 Sources of Systematic Error
 - 3.2.1 System Disturbance due to Measurement
 - 3.2.2 Errors due to Environmental Inputs
 - 3.2.3 Wear in Instrument Components

- 3.2.4 Connecting Leads
- 3.3 Reduction of Systematic Errors
 - 3.3.1 Careful Instrument Design
 - 3.3.2 Calibration
 - 3.3.3 Method of Opposing Inputs
 - 3.3.4 High-Gain Feedback
 - 3.3.5 Signal Filtering
 - 3.3.6 Manual Correction of Output Reading
 - 3.3.7 Intelligent Instruments
- 3.4 Sources and Treatment of Random Errors

4. Electrical Indicating and Test Instruments

08 Hours

- 4.1 Introduction
- 4.2 Digital Meters
 - 4.2.1 Voltage-to-Time Conversion Digital Voltmeter
 - 4.2.2 Potentiometric Digital Voltmeter
 - 4.2.3 Dual-Slope Integration Digital Voltmeter
 - 4.2.4 Voltage-to-Frequency Conversion Digital Voltmeter
 - 4.2.5 Digital Multi-meter
- 4.3 Analogue Meters
 - 4.3.1 Moving Coil Meter
 - 4.3.2 Moving Iron Meter
 - 4.3.3 Clamp-on Meters
 - 4.3.4 Analogue Multi-meter
 - 4.3.5 Measuring High-Frequency Signals with Analogue Meters
 - 4.3.6 Calculation of Meter Outputs for Nonstandard Waveforms
- 4.4 Oscilloscopes
 - 4.4.1 Analogue Oscilloscope (Cathode Ray Oscilloscope)
 - 4.4.2 Digital Storage Oscilloscopes
 - 4.4.3 Digital Phosphor Oscilloscope
 - 4.4.4 Digital Sampling Oscilloscope
 - 4.4.5 Personal Computer-Based Oscilloscope

5. Sensor Technologies

08 Hours

- 5.1 Introduction
- 5.2 Capacitive Sensors
- 5.3 Resistive Sensors
- 5.4 Magnetic Sensors
- 5.5 Hall-Effect Sensors
- 5.6 Piezoelectric Transducers
- 5.7 Strain Gauges
- 5.8 Piezo-resistive Sensors
- 5.9 Optical Sensors
 - 5.9.1 Optical Sensors (Air Path)
 - 5.9.2 Optical Sensors (Fiber Optic)
- 5.10 Ultrasonic Transducers
 - 5.10.1 Transmission Speed
 - 5.10.2 Directionality of Ultrasound Waves
 - 5.10.3 Relationship between Wavelength, Frequency, and Directionality of Ultrasound Waves
- 5.11 Nuclear Sensors
- 5.12 Micro-sensors

6. Temperature Measurement

08 Hours

- 6.1 Thermoelectric Effect Sensors (Thermocouples)
 - 6.1.1 Thermocouple Types
 - 6.1.2 Thermocouple Protection
 - 6.1.3 Thermopile

- 6.1.4 Digital Thermometer
- 6.2 Thermistors
- 6.3 Semiconductor Devices
- 6.4 Intelligent Temperature-Measuring Instruments
- 6.5 Calibration of Temperature Transducers
 - 6.5.1 Reference Instruments and Special Calibration Equipment
 - 6.5.2 Calculating Frequency of Calibration Checks
 - 6.5.3 Procedures for Calibration

7. Pressure Measurement

07 Hours

- 7.1 Diaphragms
- 7.2 Capacitive Pressure Sensor
- 7.3 Fiber-Optic Pressure Sensors
- 7.4 Bellows
- 7.5 Bourdon Tube
- 7.6 Manometers
- 7.7 Electronic Pressure Gauges
- 7.8 Calibration of Pressure Sensors
 - 7.8.1 Reference Calibration Instruments
 - 7.8.2 Calculating Frequency of Calibration Checks
 - 7.8.3 Procedures for Calibration

8. Flow and Level Measurement

07 Hours

- 8.1 Mass Flow Rate
 - 8.1.1 Conveyor-Based Methods
 - 8.1.2 Coriolis Flowmeter
- 8.2 Volume Flow Rate
 - 8.2.1 Differential Pressure (Obstruction-Type) Meters
 - 8.2.2 Variable Area Flowmeters (Rotameters)
 - 8.2.3 Turbine Meters
 - 8.2.4 Ultrasonic Flowmeters
- 8.3 Level Measurement
 - 8.3.1 Dipsticks
 - 8.3.2 Float Systems
 - 8.3.2 Pressure-Measuring Devices (Hydrostatic Systems)
 - 8.3.3 Capacitive Devices
 - 8.3.4 Ultrasonic Level Gauge
 - 8.3.5 Radar (Microwave) Sensors

9. Mass, Force, Torque and Displacement Measurement

07 Hours

- 9.1 Mass (Weight) Measurement
 - 9.1.1 Electronic Load Cell (Electronic Balance)
 - 9.1.2 Pneumatic and Hydraulic Load Cells
 - 9.1.3 Spring Balance
- 9.2 Force Measurement
 - 9.2.1 Use of Accelerometers
 - 9.2.2 Vibrating Wire Sensor
 - 9.2.3 Use of Load Cells
- 9.3 Torque Measurement
 - 9.3.1 Measurement of Induced Strain
 - 9.3.2 Optical Torque Measurement
 - 9.3.3 Reaction Forces in Shaft Bearings
 - 9.3.4 Prony Brake
- 9.4 Displacement Measurement
 - 9.4.1 Resistive Potentiometer
 - 9.4.2 Linear Variable Differential Transformer (LVDT)
 - 9.4.3 Strain Gauges

INSTRUCTIONAL OBJECTIVES

1. Fundamentals of Measurement Systems

- 1.1 Introduce Measurement system
- 1.2 Introduce Measurement Units
- 1.3 Describe the design of Measurement System
 - 1.3.1 Elements of a Measurement System
 - 1.3.2 Choosing Appropriate Measuring Instruments
- 1.4 Write the applications of Measurement System

2. Instrument Types and Performance Characteristics

- 2.1 Introduction
- 2.2 Explain the types of Instruments
 - 2.2.1 Active and Passive Instruments
 - 2.2.2 Null-Type and Deflection-Type Instruments
 - 2.2.3 Analogue and Digital Instruments
 - 2.2.4 Indicating Instruments and Instruments with a Signal Output
 - 2.2.5 Smart and Non-smart Instruments
- 2.3 Explain Static Characteristics of Instruments
 - 2.3.1 Accuracy and Inaccuracy (Measurement Uncertainty)
 - 2.3.2 Precision/Repeatability/Reproducibility
 - 2.3.3 Tolerance
 - 2.3.4 Range or Span
 - 2.3.5 Linearity
 - 2.3.6 Sensitivity of Measurement
 - 2.3.7 Threshold
 - 2.3.8 Resolution
 - 2.3.9 Sensitivity to Disturbance
 - 2.3.10 Hysteresis Effects
 - 2.3.11 Dead Space
- 2.4 Explain Dynamic Characteristics of Instruments
 - 2.4.1 Zero-Order Instrument
 - 2.4.2 First-Order Instrument
 - 2.4.3 Second-Order Instrument
- 2.5 Describe Necessity for Calibration

3. Measurement Uncertainty

- 3.1 Introduction
- 3.2 Briefly describe the Sources of Systematic Error
 - 3.2.1 System Disturbance due to Measurement
 - 3.2.2 Errors due to Environmental Inputs
 - 3.2.3 Wear in Instrument Components
 - 3.2.4 Connecting Leads
- 3.3 How to Reduce Systematic Errors
 - 3.3.1 Careful Instrument Design
 - 3.3.2 Calibration
 - 3.3.3 Method of Opposing Inputs
 - 3.3.4 High-Gain Feedback
 - 3.3.5 Signal Filtering
 - 3.3.6 Manual Correction of Output Reading
 - 3.3.7 Intelligent Instruments
- 3.4 Describe the Sources and Treatment of Random Errors

4. Electrical Indicating and Test Instruments

- 4.1 Introduction
- 4.2 Explain different types of Digital Meters

- 4.2.1 Voltage-to-Time Conversion Digital Voltmeter
- 4.2.2 Potentiometric Digital Voltmeter
- 4.2.3 Dual-Slope Integration Digital Voltmeter
- 4.2.4 Voltage-to-Frequency Conversion Digital Voltmeter
- 4.2.5 Digital Multi-meter
- 4.3 Explain different types Analogue Meters
 - 4.3.1 Moving Coil Meter
 - 4.3.2 Moving Iron Meter
 - 4.3.3 Clamp-on Meters
 - 4.3.4 Analogue Multi-meter
 - 4.3.5 Measuring High-Frequency Signals with Analogue Meters
 - 4.3.6 Calculation of Meter Outputs for Nonstandard Waveforms
- 4.4 Explain different types Oscilloscopes
 - 4.4.1 Analogue Oscilloscope (Cathode Ray Oscilloscope)
 - 4.4.2 Digital Storage Oscilloscopes
 - 4.4.3 Digital Phosphor Oscilloscope
 - 4.4.4 Digital Sampling Oscilloscope
 - 4.4.5 Personal Computer-Based Oscilloscope

5. Sensor Technologies

- 5.1 Introduction
- 5.2 Describe the operation of Capacitive Sensors
- 5.3 Describe the operation of Resistive Sensors
- 5.4 Describe the operation of Magnetic Sensors
- 5.5 Describe the operation of Hall-Effect Sensors
- 5.6 Describe the operation of Piezoelectric Transducers
- 5.7 Describe the operation of Strain Gauges
- 5.8 Describe the operation of Piezo-resistive Sensors
- 5.9 Describe the operation of Optical Sensors
 - 5.9.1 Optical Sensors (Air Path)
 - 5.9.2 Optical Sensors (Fiber Optic)
- 5.10 Describe the operation and characteristics of Ultrasonic Transducers
 - 5.10.1 Transmission Speed
 - 5.10.2 Directionality of Ultrasound Waves
 - 5.10.3 Relationship between Wavelength, Frequency, and Directionality of Ultrasound Waves
- 5.11 Describe the operation of Nuclear Sensors
- 5.12 Describe the operation of Micro-sensors

6. Temperature Measurement

- 6.1 Describe the operation of following Thermoelectric Effect Sensors (Thermocouples)
 - 6.1.1 Thermocouple Types
 - 6.1.2 Thermocouple Protection
 - 6.1.3 Thermopile
 - 6.1.4 Digital Thermometer
- 6.2 Describe the operation of Thermistors
- 6.3 Explain Semiconductor Devices
- 6.4 Describe the operation of Intelligent Temperature-Measuring Instruments
- 6.5 How to Calibrate Temperature Transducers
 - 6.5.1 Reference Instruments and Special Calibration Equipment
 - 6.5.2 Procedures for Calibration

7. Pressure Measurement

- 7.1 Describe the operation of Diaphragms
- 7.2 Describe the operation of Capacitive Pressure Sensor
- 7.3 Describe the operation of Fiber-Optic Pressure Sensors
- 7.4 Describe the operation of Bellows
- 7.5 Describe the operation of Bourdon Tube

- 7.6 Describe the operation of Manometers
- 7.7 Describe the operation of Electronic Pressure Gauges
- 7.8 How to Calibrate Pressure Sensors
 - 7.8.1 Reference Calibration Instruments
 - 7.8.2 Procedures for Calibration

8. Flow and Level Measurement

- 8.1 Define Mass Flow Rate
 - 8.1.1 Conveyor-Based Methods
 - 8.1.2 Coriolis Flowmeter
- 8.2 Define Volume Flow Rate
 - 8.2.1 Differential Pressure (Obstruction-Type) Meters
 - 8.2.2 Variable Area Flowmeters (Rotameters)
 - 8.2.3 Turbine Meters
 - 8.2.4 Ultrasonic Flowmeters
- 8.3 Explain Level Measurement methods
 - 8.3.1 Dipsticks
 - 8.3.2 Float Systems
 - 8.3.2 Pressure-Measuring Devices (Hydrostatic Systems)
 - 8.3.3 Capacitive Devices
 - 8.3.4 Ultrasonic Level Gauge
 - 8.3.5 Radar (Microwave) Sensors

9. Mass, Force, Torque and Displacement Measurement

- 9.1 Explain Mass (Weight) Measurement methods
 - 9.1.1 Electronic Load Cell (Electronic Balance)
 - 9.1.2 Pneumatic and Hydraulic Load Cells
 - 9.1.3 Spring Balance
- 9.2 Explain Force Measurement methods
 - 9.2.1 Use of Accelerometers
 - 9.2.2 Vibrating Wire Sensor
 - 9.2.3 Use of Load Cells
- 9.3 Explain Torque Measurement methods
 - 9.3.1 Measurement of Induced Strain
 - 9.3.2 Optical Torque Measurement
 - 9.3.3 Reaction Forces in Shaft Bearings
 - 9.3.4 Prony Brake
- 9.4 Explain Displacement Measurement methods
 - 9.4.1 Resistive Potentiometer
 - 9.4.2 Linear Variable Differential Transformer (LVDT)

List of Recommended Books:

Measurement and Instrumentation Theory and application by Allan S. Morris and Reza Lengari.

LIST OF PRACTICAL:

96 Hrs.

1. Study and calibration of LVDT transducer for displacement measurement.
2. Study of resistance temperature detector for temperature measurement.
3. Calibration of thermocouple for temperature measurement.
4. Study and calibration of a rotameter for flow measurement.
5. Measurement of displacement using strain gauge.
6. Measurement of load using load cell.
7. Measurement and calibration of a bourdon pressure gauge.
8. Level measurement

COMP-212 FUNDAMENTALS OF COMPUTER PROGRAMMING

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

A general introduction to computing and first programming language course. It aims to introduce the students to computers and IT in general and provide the knowledge and skills to use high level programming language to solve problems. It covers general introduction to computers and IT and study of the celebrated C programming language. This has laboratory component to complement classroom discussion. Specifically, students will learn:

- To draw flowcharts in a language independent manner
- To learn how to write modular, efficient and readable C programs
- To create and use Arrays of the C data types.
- To describe the techniques for creating program modules in C using functions and recursive functions.
- To demonstrate creation of derived data types and perform operations on files.
- To familiarize pointers and dynamic memory allocation functions to efficiently solve problems

Pre-requisites:

None

Course Contents:

- 1. Introduction to Computers and Programming Languages** **2 Hours**
 - 1.1. Programming Languages
 - 1.2. Categories of Programming Languages
 - 1.3. Machine Languages
 - 1.4. Symbolic or Assembly Language
 - 1.5. High-Level Languages
 - 1.6. Features of Programming Languages
- 2. The Programming Cycle** **2 Hours**
 - 2.1. Defining the Problem
 - 2.2. Planning and Coding Solution
 - 2.3. Checking and Debugging
 - 2.4. Importance of Readability and Documentation
 - 2.5. Flowcharting
 - 2.6. Flowchart Symbols
 - 2.7. Advantages and Disadvantages of Flowcharts
- 3. The C Integrated Development Environment (IDE)** **2 Hours**
 - 3.1. IDE Setup and Use of IDE
 - 3.2. Files used in C Program Developer
 - 3.3. The Structure of C Programs
- 4. C Building Blocks** **2 Hours**
 - 4.1. Constants and Variables
 - 4.2. Input/Output
 - 4.3. Operators
 - 4.4. Expressions
- 5. Conditional Control Construct: Decisions** **3 Hours**
 - 5.1. The if Statement
 - 5.2. The if-else Statement
 - 5.3. The else-if Statement
 - 5.4. The switch Statement

5.5.	The Conditional Operator	
6.	Iterative Control Construct: Loops	3 Hours
6.1.	The for Loop	
6.2.	The while Loop	
6.3.	The do while Loop	
7.	Functions	3 Hours
7.1.	Introduction	
7.2.	Simple Functions and Value-Returning Functions	
7.3.	Parameter Passing	
7.4.	Using Multiple Functions and External Variable	
7.5.	Preprocessor Directives	
7.6.	Recursion & Recursive Functions	
8.	Arrays and Strings	3 Hours
8.1.	Introduction	
8.2.	Single and Two-dimensional Arrays	
8.3.	Strings	
9.	Pointers	3 Hours
9.1.	Introduction to Pointer	
9.2.	Returning Data from Functions	
9.3.	Pointers and Arrays	
9.4.	Pointers and Strings	
9.5.	Double Indirection: Pointers to Pointers	
10.	Structures and Unions	3 Hours
10.1.	Structures	
10.2.	Unions	
10.3.	Unions of Structures	
11.	Files	3 Hours
11.1.	Types of Disk I/O and Standard Input/Output	
11.2.	Binary and Text Mode	
11.3.	Record Input/Output and Random Access	
11.4.	Error conditions and Redirection	
12.	Larger Programs	3 Hours
12.1.	Making Stand-alone Executable	
12.2.	Separate Compilation and Conditional Compilations	
12.3.	Memory Models	

INSTRUCTIONAL OBJECTIVES:

1. Introduction with the Computers and Programming Languages

- 1.1. Discuss programming languages
- 1.2. Explain categories of programming languages
- 1.3. Describe machine language
- 1.4. Describe symbolic or assembly language
- 1.5. Describe high-level languages
- 1.6. Explain features of programming languages

2. Programming Cycle

- 2.1. Describe the programming cycle
- 2.2. Explain importance of readability and documentation
- 2.3. Describe Flowcharts
- 2.4. Cite advantages and disadvantages of flowcharting
- 2.5. Draw flowchart of procedures

3. The C Integrated Development Environment (IDE)

- 3.1. Demonstrate setting up the IDE
- 3.2. Explain files used in c program developer
- 3.3. Explain the use of IDE
- 3.4. Explain the structure of c programs

4. C Building Blocks

- 4.1. Define constants and variables
- 4.2. Explain Input/Output
- 4.3. Enumerate operator symbols in C
- 4.4. Explain the use these operators
- 4.5. Use basic expressions

5. Conditional Control Construct: Decisions

- 5.1. Demonstrate use of the if Statement
- 5.2. Demonstrate use of the if-else Statement
- 5.3. Demonstrate use of the else-if Statement
- 5.4. Demonstrate use of the switch Statement
- 5.5. Write C functions using conditional statements

6. Iterative Control Construct: Loops

- 6.1. Demonstrate use of the for Loop
- 6.2. Demonstrate use of the while Loop
- 6.3. Demonstrate use of the do while Loop
- 6.4. Write C functions using iterations

7. Functions

- 7.1. Explain Functions
- 7.2. Explain Simple Functions
- 7.3. Explain Value-Returning Functions
- 7.4. Perform Parameter Passing
- 7.5. Demonstrate use of Multiple Functions
- 7.6. Describe External Variable
- 7.7. Explain Preprocessor Directives
- 7.8. Explain Recursive Functions

8. Arrays and Strings

- 8.1. Describe Array Data Types
- 8.2. Demonstrate use of Single and Two-dimensional Arrays
- 8.3. Explain Strings

- 9. Pointers**
 - 9.1. Explain Pointers
 - 9.2. Describe how to Return Data from Functions
 - 9.3. Explain Pointers and Arrays
 - 9.4. Explain Pointers and Strings
 - 9.5. Demonstrate use of Double Indirection: Pointers to Pointers

- 10. Structures and Unions**
 - 10.1. Demonstrate use of Structures
 - 10.2. Demonstrate use of Unions
 - 10.3. Demonstrate use of Unions of Structures

- 11. Files**
 - 11.1. Explain Types of Disk I/O
 - 11.2. Explain Standard Input/Output
 - 11.3. Explain Binary and Text Mode Files
 - 11.4. Program Record Input/Output
 - 11.5. Explain Random Access Files
 - 11.6. Explain Error Handling in File I/O
 - 11.7. Explain Redirection

- 12. Larger Programs**
 - 12.1. Make Stand-alone Executables
 - 12.2. Perform Separate Compilation
 - 12.3. Perform Conditional Compilations
 - 12.4. Explain Memory Models

List of Recommended Books:

- 1. Turbo C Programming for the PC and Turbo C++, Latest Ed., Robert Lafore, The Waite's Group, Inc.
- 2. C++ How to Program, Latest Ed., Deitel and Deitel, Prentice-Hall.
- 3. Guide to C Programming, Jack Purdum, Latest Ed., Ziff-Davis Press.
- 4. Mastering Turbo C, Stan Kelly-Bootle, Latest Ed., Sybex Computer Books Inc.
- 5. Jim Hubbard and Maureen Sprankle, Problem Solving and Programming Concepts, Latest Ed.

LIST OF PRACTICAL:**96 Hrs.**

1. Installation and Setup of C- Compiler
2. Navigation of Integrated Development Environment
3. Use of Program Editor
4. Cycle of Writing C Program
5. Program: Input/Output
6. Program: Mathematical Operations
7. Program: Mathematical Operations with Conditional Statements
8. Program: Mathematical Operations with Iterations
9. Program: Functions
10. Program: Passing Parameters to Functions
11. Program: Recursion
12. Program: Emulation of String Functions
13. Program: One Dimensional Array
14. Program: Two Dimensional Array
15. Program: Structure and Records
16. Program: Pointers and Link List
17. Program: File Handling
18. Programming Project

MTR-273 ELECTRONIC DEVICES AND CIRCUITS

Total Contact Hours

Theory	64	T	P	C
Practical	96	2	3	3

Aims

Apply the principles of operation and function of various electronic components and devices to practical circuits.

1. Identify various electronics components/devices used in the field of electronics.
2. Explain the principle of operation of various type of electronic Components/ devices.
3. Identify the function of each electronic components/devices.
4. Identify the pin configurations of various electronics components/devices.
5. Identify specification of electronic components/devices.
6. Identify the use of electronic components.

Pre-requisites:

None

Course Contents:

- | | |
|---|-----------------|
| 1. Semiconductor Diodes and Applications | 16 Hours |
| 1.1 Vacuum Tubes (Diode, Triode, Tetrode, Pentode, CRT) | |
| 1.2 Electron Emission | |
| 1.3 Biasing the PN junction. | |
| 1.3.1. Depletion region, Junction barrier potential | |
| 1.3.2. Forward and reverse bias. | |
| 1.4 Rectifier Diode. | |
| 1.4.1. Half wave and full wave (Bridge) rectifier. | |
| 1.4.2. Ripple factor, surge current. | |
| 1.4.3. Rectifier filter: L, PI and T filters. | |
| 1.5 Diode limiting, clamping and Multipliers circuits. | |
| 1.5.1. Single end and double end limiter. | |
| 1.5.2. Positive and Negative clamper | |
| 1.5.3. Voltage multiplier circuit. (Doubler, Tripler, Quadrupler) | |
| 1.6 Diode Data Sheet | |
| 1.7 Common faults in rectifier. | |
| 1.8 Diode as a switch. | |
| 2. Special Diodes | 12 Hours |
| 2.1 Zener Diodes. | |
| 2.2 Zener Diode as voltage Regulator. | |
| 2.2.1. Zener limiting. | |
| 2.3 Varactor Diodes. | |
| 2.3.1. Varactor in Tuning Circuits. | |

- 2.4 Optical Diodes
 - 2.4.1. Light Emitting Diode (LED)
 - 2.4.2. Liquid Crystal Diode (LCD)
 - 2.4.3. Photo Diode.
- 2.5 Other Diodes.
 - 2.5.1. Schottky diode, construction, Characteristics, uses.
 - 2.5.2. Tunnel Diode, Negative resistance region.
 - 2.5.3. Tunnel Diode Oscillator.
 - 2.5.4. PIN Diode
 - 2.5.5. Step Recovery Diode
 - 2.5.6. LASER Diode
 - 2.5.7. IMPATT Diode.
 - 2.5.8. Gunn Diode.

3. Bipolar Junction Transistors

10 Hours

- 3.1 Transistor types and BJT construction.
- 3.2 Basic Transistor operation, Forward, Reverse Bias. Transistor current.
- 3.3 Transistor Parameters and Ratings
- 3.4 Transistor as a voltage amplifier.
- 3.5 Transistor, modes of operation.
- 3.6 Transistor as a switch.
- 3.7 Transistor and IC packages and terminal Identification.
 - 3.7.1. General purpose transistors
 - 3.7.2. Power Transistor
 - 3.7.3. RF Transistor.

4. Field Effect Transistors

10 Hours

- 4.1 Field Effect Transistor and Its Biasing.
- 4.2 Junction Field Effect Transistor (JFET).
- 4.3 JFET Characteristics and parameter.
- 4.4 JFET Biasing.
- 4.5 Metal oxide Semiconductor FET (MOSFET) types.
- 4.6 MOSFET Biasing.

5. Thyristor & Special Devices

08 Hours

- 5.1 The shockley diode,
- 5.2 Silicon Controlled Rectifier (SCR)
- 5.3 SCR Applications.
- 5.4 Silicon Controlled Switch (SCS)

- 5.5 Diac and Triac
- 5.6 Unijunction Transistor (UJT)
- 5.7 Photo diode & Phototransistor
- 5.8 Light Activated SCR (LASCR)
- 5.9 Opto-coupler.

6. Integrated Circuits and Operational Amplifier

8 Hours

- 6.1 Introduction to ICs
- 6.2 Types of ICs
- 6.3 Types of Integration
- 6.4 Advantages and Disadvantages of ICs.
- 6.5 Introduction to operational Amplifier.
- 6.6 The differential Amplifier.
- 6.7 OP-AMP Data Sheet Parameters.
- 6.8 OP-AMP with negative Feedback.
- 6.9 Inverting and non-inverting amplifiers.
- 6.10 Voltage follower.
- 6.11 Summing and difference amplifiers.

List of Recommended Books: -

Electronic Devices by Thomas L. Floyd

INSTRUCTIONAL OBJECTIVES:

1. Semiconductor Diodes and Applications

- 1.1 Describe Vacuum Tubes (Diode, Triode, Tetrode, Pentode, CRT)
- 1.2 Explain Electron Emission.
- 1.3 Define the following terms regarding Biasing of PN junction.
 - 1.3.1. Depletion region, Junction barrier potential
 - 1.3.2. Forward and reverse bias.
- 1.4 Explain the following circuits and terms:
 - 1.4.1. Half wave and full wave (Bridge) rectifier.
 - 1.4.2. Ripple factor, surge current.
 - 1.4.3. Rectifier filter: L, PI and T filters.
- 1.5 Explain the following Diode limiting, clamping and Multipliers circuits:
 - 1.5.1. Single end and double end limiter.
 - 1.5.2. Positive and Negative clamper
 - 1.5.3. Voltage multiplier circuit. (Doubler, Tripler, Quadrupler)
- 1.6 Study the data sheet of a Diode.
- 1.7 Write the Common faults in rectifier.
- 1.8 Describe the working of Diode as a switch.

2. Special Diodes

- 2.1 Define Zener Diode.
- 2.2 Describe the working of Zener Diode as voltage Regulator.
 - 2.2.1. Describe Zener limiting circuit.
- 2.3 Define Varactor Diode and its application in following circuit.
 - 2.3.1. Varactor in Tuning Circuits.
- 2.4 Explain the following types of Optical Diodes:
 - 2.4.1. Light Emitting Diode (LED)
Liquid Crystal Diode (LCD)
 - 2.4.2. Photo Diode.
- 2.5 Explain the following Diode types:
 - 2.5.1. Schottky diode, construction, Characteristics, uses.
 - 2.5.2. Tunnel Diode, Negative resistance region.
 - 2.5.3. Tunnel Diode Oscillator.
 - 2.5.4. PIN Diode
 - 2.5.5. Step Recovery Diode
 - 2.5.6. LASER Diode
 - 2.5.7. IMPATT Diode.
 - 2.5.8. Gunn Diode.

3. Bipolar Junction Transistors

- 3.1 Enlist Transistor types and describe their construction.
- 3.2 Describe Basic Transistor operation, Forward, Reverse Bias and Transistor currents.
- 3.3 Describe Transistor Parameters and Ratings.
- 3.4 Transistor as a voltage amplifier.
- 3.5 Explain the modes of operation of BJT.
- 3.6 Describe the working of Transistor as a switch.
- 3.7 Describe the following IC packages and terminal Identification of BJTs.
 - 3.7.1. General purpose transistors
 - 3.7.2. Power Transistor
 - 3.7.3. RF Transistor.

4. Field Effect Transistors

- 4.1 Describe Field Effect Transistor and Its Biasing.
- 4.2 Define Junction Field Effect Transistor (JFET).
- 4.3 Explain different JFET Characteristics and parameter.
- 4.4 Describe the biasing of JFET.
- 4.5 Explain the types of Metal oxide Semiconductor FET (MOSFET).
- 4.6 Describe the Biasing of MOSFET.

5. Thyristor & Special Devices

- 5.1 Describe the working and construction of shockley diode.
- 5.2 Describe the working and construction of Silicon Controlled Rectifier (SCR).
- 5.3 Write the applications of SCR.
- 5.4 Describe the working and construction of Silicon Controlled Switch (SCS)
- 5.5 Describe the working and construction of Diac and Triac.
- 5.6 Describe the working and construction of Unijunction Transistor (UJT).
- 5.7 Describe the working and construction of Photo diode & Phototransistor.
- 5.8 Describe the working and construction of Light Activated SCR (LASCR).
- 5.9 Describe the working and construction of Opto-coupler.

6. Integrated Circuits and Operational Amplifier

- 6.1 Define ICs.
- 6.2 Describe the Types of ICs.
- 6.3 What are the different Types of Integration?
- 6.4 Write the Advantages and Disadvantages of ICs.
- 6.5 Describe the working and construction of operational Amplifier.
- 6.6 Describe the working of differential Amplifier.
- 6.7 Study different Data Sheet Parameters OP-AMP.
- 6.8 Explain the working of OP-AMP with negative Feedback.
- 6.9 Explain the working of Inverting and non-inverting amplifiers.
- 6.10 Explain the working of Voltage follower circuit.
- 6.11 Explain the working of Summing and difference amplifiers.

LIST OF PRACTICAL:

96 Hrs.

1. Identify the various diodes, transistors & IC package, number system and terminals.
2. Familiarization with software tools such as Proteus
3. Draw the forward & reverse characteristics of a P.N junction diode.
4. Assemble a full wave diode rectifier circuit with a PI filter & calculate the ripple factor of output wave.
5. Demonstrate diode as a switch with LED as a load & troubleshoot a faulty diode rectifier circuit.
6. Assemble a diode limiter circuit.
7. Familiarize with a voltage Multiplier circuit.
8. Use a Zener diode as a voltage regulator with diode rectifier.
9. Demonstrate the performance of power supply using IC regulator.
10. Assemble transistor circuit as a switch.
11. Assemble a transistor voltage amplifier (Darlington pair).
12. Assemble a Street light Control using LDR.
13. Assemble a mobile charger circuit using mini solar panel.
14. Demonstrate MOSFET as a switch and study the performance.
15. Plot the characteristics curves for SCR & UJT.
16. Assemble a light dimmer using a DIAC & a TRIAC.
17. Demonstrate the working of an Opto-coupler using
 - a) Photodiode & LED
 - b) Phototransistor & LED
18. Demonstrate the working of an operational amplifier, use of op-Amp as an inverting & non-inverting amplifier and a voltage follower.
19. Demonstrate SCR phase control.
20. Demonstrate the use of digital logic probe & logic pulsar.
21. Prepare a project using electronics devices assigned by instructor.

MTR-283 DIGITAL LOGIC DESIGN

Total Contact Hours

Theory	64	T	P	C
Practical	96	2	3	3

Aims

1. Develop a solid grasp of the fundamental concepts in digital electronics, including essential principles and components.
2. Explore the practical applications of digital electronic devices within various industries, gaining insights into how these devices are utilized to enhance efficiency, automation, and functionality.

Pre-requisites:

None

Course Contents:

1. Introduction

8 Hours

- 1.1 Digital & analog quantities
- 1.2 BIT, BYTE, NIBBLE
- 1.3 Number systems
 - 1.3.1. Binary
 - 1.3.2. Octal.
 - 1.3.3. Decimal
 - 1.3.4. Hexadecimal
- 1.4 Conversion of numbers from one base to another:
 - 1.4.1. Binary <--> Decimal
 - 1.4.1 Binary <--> Octal
 - 1.4.2 Binary <--> Hexadecimal
 - 1.4.3 Octal <--> Decimal
 - 1.4.4 Octal <--> Hexadecimal
 - 1.4.5 Hexadecimal <--> Decimal
- 1.5 Elements of digital electronics

2. Logic Gates

8 Hours

- 2.1 Function of each basic gate
 - 2.1.1. AND Gate
 - 2.1.2. OR Gate
 - 2.1.3. NOT Gate
 - 2.1.4. NAND Gate
 - 2.1.5. NOR Gate
 - 2.1.6. XOR Gates
 - 2.1.7. XNOR Gates
- 2.2 Introduction to Digital ICs
 - 2.2.1. IC numbers for each gate
 - 2.2.2. Data Sheets
 - 2.2.3. Location of pin 1 or index for a given IC.
 - 2.2.4. Different techniques used for mounting each type of IC.

3.	Boolean Algebra	8 Hours
3.1	Laws of Boolean algebra	
3.2	De Morgans Laws	
3.3	Boolean Function Generation from truth tables	
3.4	Introduction to logic simplification	
4.	Arithmetic Logic Circuits	6 Hours
4.1	Arithmetic functions:	
4.1.1.	Binary addition	
4.1.2.	Binary subtraction by 1's complement	
4.1.3.	Binary subtraction by 2's complement	
4.1.4.	Binary multiplication	
4.1.5.	Binary division	
4.2	Operation of the following circuits	
4.3	Half adders	
4.4	Full adders	
4.5	Adder-subtractor	
4.6	Comparators	
5.	Combinational Logic and Data Processing Circuits	6 Hours
5.1	Multiplexers & logic (IC's such as 74150)	
5.2	Demultiplexers (IC's such as 74154)	
5.3	Decoders	
5.4	BCD-to-Decimal Decoders (such as 7445)	
5.5	Seven-Segment Decoders & Displays	
5.6	Encoders (IC's such as 74147)	
5.7	Types of encoder	
6.	Flip-Flops	6 Hours
6.1	Definition of the following terms:	
6.1.1.	Latch	
6.1.2.	flip flop	
6.1.3.	Hold time	
6.2	Operation of following circuits	
6.2.1.	RS Flip-Flop	
6.2.2.	Clocked RS Flip-Flop	
6.2.3.	D Flip-Flop	
6.2.4.	Edge-triggered D Flip-Flop	
6.2.5.	JK Flip-Flop	
7.	Clocks & Timers	6 Hours
7.1	Definition of the following terms	
7.1.1.	Clock	
7.1.2.	Trigger	
7.1.3.	Pulse	
7.1.4.	Frequency	
7.1.5.	Pulse width	
7.2	TTL clock	
7.3	operation of the followings:	
7.3.1.	Inverter Clock	
7.3.2.	Ring Oscillator	
7.3.3.	NAND/NOR Gate clock	
7.3.4.	555 Timer IC	

8.	Shift Registers	6 Hours
8.1	Definition of the following terms	
8.1.1.	Register	
8.1.2.	Storage Capacity	
8.1.3.	Shift right	
8.1.4.	Shift left	
8.2	Operation of following	
8.2.1.	Serial in-serial out	
8.2.2.	Serial-in parallel-out	
8.2.3.	Parallel-in serial-out	
8.2.4.	Parallel in parallel out	
9.	Counters	4 Hours
9.1	Definition of following	
9.1.1.	Synchronous	
9.1.2.	Asynchronous	
9.2	Types of Counters	
9.2.1.	Ripple counter	
9.2.2.	Synchronous counter	
9.2.3.	Presetable counter	
9.2.4.	Ring Counter	
9.2.5.	Up/Down Counter	
9.3	Working of Digital Clock	
10.	ADC & DAC	6 Hours
10.1	Definition of the following terms	
10.1.1	Analog and Digital signals	
10.1.2	Analog-to-digital conversion	
10.1.3	Digital-to-analog conversion	
10.1.3	Resolution	
10.1.4	Sampling rate	
10.2	Operation of the following ADC circuits:	
10.2.1	Flash AD converter	
10.2.2	Successive approximation ADC	
10.2.3	Introduction to ADC0808 IC	
10.3	Operation of the following DAC circuits:	
10.3.1	Weighted Resistor circuit	
10.3.2	R-2R ladder circuit	

INSTRUCTIONAL OBJECTIVES:

1. KNOW THE BASIC TERMS RELATED TO DIGITAL ELECTRONICS.

- 1.1 State in a tabulated form the merits & demerits of analog & digital quantities
- 1.2 Define basic terms related to digital electronics
- 1.3 Define the following terms
 - 1.3.1 Binary
 - 1.3.2 Octal.
 - 1.3.3 Decimal
 - 1.3.4 Hexadecimal
- 1.4 Conversion of numbers from one base to another:
 - 1.4.1 Binary <--> Decimal
 - 1.4.1 Binary <--> Octal
 - 1.4.2 Binary <--> Hexadecimal
 - 1.4.3 Octal <--> Decimal
 - 1.4.4 Octal <--> Hexadecimal
 - 1.4.5 Hexadecimal <--> Decimal

2. UNDERSTAND THE WORKING OF VARIOUS LOGIC GATES

- 2.1 Explain the Function of following basic gate
 - 2.1.1 Describe the working of AND Gate
 - 2.1.2 Describe the working of OR Gate
 - 2.1.3 Describe the working of NOT Gate
 - 2.1.4 Describe the working of NAND Gate
 - 2.1.5 Describe the working of NOR Gate
 - 2.1.6 Describe the working of XOR Gates
 - 2.1.7 Understand the configurations formed by combining gates
- 2.2 Introduction to Digital ICs
 - 2.2.1 IC numbers for each gate
 - 2.2.2 Data Sheets
 - 2.2.3 Location of pin 1 or index for a given IC.
 - 2.2.4 Different techniques used for mounting each type of IC.

3. INTRODUCTION TO BOOLEAN ALGEBRA & ITS LAWS

- 3.1 Study the laws of Boolean algebra
- 3.2 Study the De Morgan's Laws
- 3.3 Understand the Boolean function generation from truth tables
- 3.4 Introduction to logic simplification

4. DETAILED DESCRIPTION OF ARITHMETIC LOGIC CIRCUITS

- 4.1 Arithmetic functions:
 - 4.1.1 Binary addition
 - 4.1.2 Binary subtraction by 1's complement
 - 4.1.3 Binary subtraction by 2's complement
 - 4.1.4 Binary multiplication
 - 4.1.5 Binary division
- 4.2 Describe the working of Half adders
- 4.3 Describe the working of Full adders
- 4.4 Describe the working of Adder-subtractor
- 4.5 Describe the working of comparators

5. UNDERSTAND THE WORKING AND USES OF COMBINATIONAL LOGIC CIRCUITS, INCLUDING DATA PROCESSING CIRCUITS

- 5.1 Define the terms multiplexer, Demultiplexer, decoder, encoders, and BDC converters
- 5.2 Explain multiplexers, using logic circuits & block-diagrams (multiplexers using IC's such as 74150)
- 5.3 Explain Demultiplexer, using block-diagrams (using IC's such as 74154)
- 5.4 Explain using block-diagram <BDC& its conversion to Decimals, using IC's, such as 7445
- 5.5 Explain seven segments decoders, showing block diagrams, giving examples for letters & digits.
- 5.6 Describe the operation of combinational logic circuits as applied to data processing circuits
- 5.7 Explain the working of 7-segment display circuit

6. DETAILED DESCRIPTION OF FLIP-FLOPS

- 6.1 Definition of the following terms:
 - 6.1.1 Latch
 - 6.1.2 flip flop
 - 6.1.3 Hold time
- 6.2 Describe the working of RS Flip-Flop
- 6.3 Describe the working of Clocked RS Flip-Flop
- 6.4 Describe the working of D Flip-Flop
- 6.5 Describe the working of Edge-triggered D Flip-Flop
- 6.6 Describe the working of JK Flip-Flop

7. UNDERSTAND THE WORKING OF CLOCKS & TIMERS

- 7.1 Definition of the following terms
 - 7.1.1 Clock
 - 7.1.2 Trigger
 - 7.1.3 Pulse
 - 7.1.4 Frequency
 - 7.1.5 Pulse width
- 7.2 Study the function of a TTL clock
- 7.3 Study the Timer 555 – Astable, Monostable
- 7.4 Identify the applications of clock and timers
 - 7.4.1 Inverter Clock
 - 7.4.2 Ring Oscillator
 - 7.4.3 NAND/NOR Gate clock

8. KNOW ABOUT SHIFT REGISTERS

- 8.1 Definition of the following terms
 - 8.1.1. Register
 - 8.1.2. Storage Capacity
 - 8.1.3. Shift right
 - 8.1.4. Shift left
- 8.2 Study the basic concepts of shift-right & shift-left registers
- 8.3 Understanding the serial in-serial out configuration
- 8.4 Understand the serial-in parallel-out configuration
- 8.5 Understand the parallel-in serial-out configuration
- 8.6 Understand the parallel-in parallel-out configuration

9. UNDERSTAND THE WORKING OF COUNTERS

- 9.1 Definition of following counters
 - 9.1.1 Synchronous
 - 9.1.2 Asynchronous
- 9.2 Describe the working of the ripple counter
- 9.3 Describe the working of synchronous counter
- 9.4 Describe the working of presentable counter
- 9.5 Describe the working of ring counter
- 9.6 Describe the working of up/down counter
- 9.5 Understand the working of digital clock

- 10. ADC & DAC**
- 10.1 Definition of the following terms
 - 10.1.1 Analog and Digital signals
 - 10.1.2 Analog-to-digital conversion
 - 10.1.3 Digital-to-analog conversion
 - 10.1.3 Resolution
 - 10.1.4 Sampling rate
- 10.2 Explain the Operation of the following ADC circuits:
 - 10.2.1 Flash AD converter
 - 10.2.2 Successive approximation ADC
 - 10.2.3 Introduction to ADC0808 IC
- 10.3 Explain the Operation of the following DAC circuits:
 - 10.3.1 Weighted Resistor circuit
 - 10.3.2 R-2R ladder circuit

List of Recommended Books:

1. Digital Fundamentals by Thomas L. Floyd.
2. Digital Logic Design by Morris Mano.

LIST OF PRACTICAL:

96 Hrs

1. Familiarization with Digital trainer.
2. Familiarization with software tools such as Proteus
3. Identify and verify truth tables for AND, OR, NOT Gates ICs
4. Identify and verify truth tables for NOR, NAND, XOR Gates ICs
5. Construct and verify truth tables of half adder
6. Construct and verify the truth table of full adder
7. To perform and study the function of multiplexer through related IC
8. To perform and study the function of demultiplexer through related IC
9. To perform and study the function of decoder through related IC
10. To perform and study the function of encoder through related IC
11. Identify and verify the functions of RS Flip-Flop
12. Identify and verify the functions of D Flip-Flop
13. Identify and verify the functions of JK Flip-Flop
14. Connect a 555 IC as
 - A-stable multivibrator
 - Monostable multivibrator
 - Bistable multivibrator
15. Connect and observe the working of shift registers (SISO, SIP, PISO, PIPO)
16. Identify, connect and observe working of ripple and synchronous counters
17. Select components, assemble and observe working of a digital clock.
18. Assemble and observe working of frequency counter.
19. Assemble and observe working of moving message display.
20. Use ADC IC to convert analog data to digital.
21. Use DAC IC to convert digital data to analog.

MTR-293 MOTORS AND GENERATORS

Total Contact Hours

Theory	64	T	P	C
Practical	96	2	3	3

Aims

1. Develop a comprehensive understanding of the fundamental working principles behind motors and generators, including their respective mechanisms and functions.
2. Acquire knowledge about the various types of motors and generators, exploring their unique characteristics, applications, and operational principles.
3. Gain insights into different repair techniques employed for motors and generators, enabling the ability to diagnose and troubleshoot common issues, as well as perform maintenance tasks to ensure optimal performance.

Pre-requisites:

None

Course Contents:

1. Introduction

6 Hours

- 1.1 Definition of Motor
- 1.2 Definition of Generator
- 1.3 Types of Motors
- 1.4 Types of Generators
- 1.5 Aspects of motor and generator selection
 - 1.5.1. Torque
 - 1.5.2. Moments of inertia
 - 1.5.3. Electric Flux
 - 1.5.4. Magnetic Flux
- 1.6 Law of Conservation of Energy
- 1.7 Faraday's law of electromagnetic induction and Lenz's law.

2. DC Motors

16 Hours

- 2.1 Operating Principles
- 2.2 Permanent Magnet DC Motor
- 2.3 DC Motor with field coils
 - 2.3.1. Series wound motor
 - 2.3.2. Shunt wound motor
 - 2.3.3. Compound motor
- 2.4 Brushless Permanent Magnet DC Motor
- 2.5 Control of DC Motors
- 2.6 Advantages and Drawbacks of DC motors

- 2.7 Speed control of DC motor (Electrical and Electronics)
- 2.8 Motor starters (3 point and 4 point)
- 2.9 Maintenance and troubleshooting techniques

3. AC Motors

16 Hours

- 3.1 Operating Principles
- 3.2 Single Phase Squirrel Cage Induction Motor
- 3.3 Three Phase Induction Motor
- 3.4 Synchronous Motors
- 3.5 Advantages and Drawbacks of AC motors
- 3.6 Motor starters (DOL and star delta starter)
- 3.7 Speed Control of AC motors
- 3.8 Maintenance and troubleshooting techniques

4. Special Motors

12 Hours

i. Stepper Motor

- 4.1 Operating Principles
- 4.2 Stepper Motor Specifications
- 4.3 Stepper Motor Control

ii. Servo Motor

- 4.4 Operating Principle
- 4.5 Servo vs Stepper motor
- 4.6 Construction of a Servo Motor
- 4.7 Applications of Servo Motor
- 4.8 Servo Motor Control

iii. BLDC Motor

- 4.9 Operating Principle
- 4.10 Construction of BLDC Motor
- 4.11 Applications of BLDC Motor
- 4.12 BLDC Motor Control

iv. Maintenance and troubleshooting techniques

5. Generators

10 Hours

- 5.1 How does a AC Generator work?
- 5.2 Components of a Generator:
 - 5.2.1. Engine
 - 5.2.2. Alternator
 - 5.2.3. Fuel System
 - 5.2.4. Voltage Regulator
 - 5.2.5. Cooling and Exhaust Systems
 - 5.2.6. Lubrication System
 - 5.2.7. Battery Charger
 - 5.2.8. Control Panel
 - 5.2.9. Main Assembly/Frame
- 5.3 Working of DC Generator

- 5.4 Enlist the types of DC generator
- 5.5 Explain the method of field excitation, and characteristics of each
- 5.6 Compare an alternator with dc generator
- 5.7 Using generator to power industrial applications
- 5.8 Maintenance and troubleshooting techniques

6. Motor Starters

04 Hours

- 6.1 Function and need of motor starters
- 6.2 Overload protection in motor starters
- 6.3 Types of motor starters
 - 6.3.1 DOL starters and their advantages and disadvantages
 - 6.3.2 Star delta starter and their advantages and disadvantages
 - 6.3.3 VFD and their advantages and disadvantages

INSTRUCTIONAL OBJECTIVES:

1. Introduction

- 1.1 Define an electric Motor and its working principle.
- 1.2 Define Generator and describe its working.
- 1.3 Explain different types of Motors.
- 1.4 Explain different types of Generators.
- 1.5 Describe how the following parameters are necessary consideration for motor and generator selection:
 - 1.5.1. Torque
 - 1.5.2. Moments of inertia
 - 1.5.3. Electric Flux
 - 1.5.4. Magnetic Flux
- 1.6 Define Law of Conservation of Energy.
- 1.7 Explain Faraday's law of electromagnetic induction and Lenz's law.

2. DC Motors

- 2.1 Describe the operating principle and construction of DC motors.
- 2.2 Explain the working of Permanent Magnet DC Motor.
- 2.3 Describe the following DC Motors types with respect to field coils:
 - 2.3.1. Series wound motor
 - 2.3.2. Shunt wound motor
 - 2.3.3. Compound motor
- 2.4 Describe the working of Brushless Permanent Magnet DC Motor.
- 2.5 Describe the position Control methods of DC Motors.
- 2.6 Write the Advantages and Drawbacks of DC motors.
- 2.7 Explain the following methods of Speed control of DC motors:
 - i. Flux control method
 - ii. Voltage regulation method
 - iii. Armature resistance method
 - iv. PWM
- 2.8 Describe three point and four point Motor starters.
- 2.9 Explain maintenance and troubleshooting techniques

3. AC Motors

- 3.1 Describe the operating Principle and construction of AC motors.
- 3.2 Briefly describe the working of Single Phase Squirrel Cage Induction Motor.
- 3.3 Describe the working of Three Phase Induction Motor.
- 3.4 What is Synchronous Motor? Explain its working.
- 3.5 Write the Advantages and Drawbacks of AC motors.
- 3.6 Describe DOL and star delta starter with diagrams.
- 3.7 Explain the Speed and position Control method of AC motors.
- 3.8 Explain maintenance and troubleshooting techniques

4. Special Motors

i. Stepper Motor

- 4.1 Describe the Operating Principle of unipolar and bipolar stepper motor.
- 4.2 Describe the following specifications of Stepper Motor:

- i. Step angle.
- ii. Steps per revolution.
- iii. Current rating.
- iv. Voltage rating.
- v. Resistance per coil.

4.3 Describe position and speed control of Stepper Motor.

ii. SERVO MOTOR

4.4 Describe the Operating Principle of servo motor.

4.5 Differentiate between Servo and Stepper motor.

4.6 What is inside a Servo?

4.7 Write Applications of Servo Motors.

4.8 Describe position and speed control of Servo Motor.

iii. BLDC Motor

4.9 Describe the Operating Principle of BLDC motor.

4.10 Explain the Construction of BLDC Motor.

4.11 Write the Applications of BLDC Motor.

4.12 Describe position and speed control of BLDC Motor.

iv Explain maintenance and troubleshooting techniques

5. Generators

5.1 How does a AC Generator work?

5.2 Explain the following Components of a Generator:

5.2.1. Engine

5.2.2. Alternator

5.2.3. Fuel System

5.2.4. Voltage Regulator

5.2.5. Cooling and Exhaust Systems

5.2.6. Lubrication System

5.2.7. Battery Charger

5.2.8. Control Panel

5.2.9. Main Assembly/Frame

5.3 Explain the Working of DC Generator.

5.4 Enlist the types of DC generator.

5.5 Explain the method of field excitation, and characteristics of DC generators.

5.6 Compare an alternator with dc generator.

5.7 How generator is used to power industrial applications.

5.8 Explain maintenance and troubleshooting techniques

6. Motor Starters

6.1 Describe the Function and need of motor starters.

6.2 Why Overload protection is used in motor starters.

6.3 Explain the following Types of motor starters and write their advantages and disadvantages.

6.3.1 DOL starters and their advantages and disadvantages

6.3.2 Star delta starter and their advantages and disadvantages

6.3.3 VFD and their advantages and disadvantages

List of Recommended Books: -

1. Principles of Electrical Machines by V.K Mehta and Rohit Mehta

LIST OF PRACTICAL:

1. Identification of the working principle, components of a DC motor and demonstrate it's running in terms of fundamental physical laws and phenomenon.
2. Identification of the working principle, components of an AC motor and demonstrate it's running in terms of fundamental physical laws and phenomenon.
3. Identification of the working principle, components of a generator and demonstrate it's running in terms of fundamental physical laws and phenomenon.
4. Verify the Faraday's Laws of electromagnetic induction by using a simple loop generator.
5. Demonstrate the different types of DC motor.
6. Demonstrate the different types of AC motor.
7. Determine the relationship between different types of DC motor rotational speed and voltage.
8. Determine the relationship between different types of AC motor rotational speed and voltage
9. Determine the relationship between different types of DC motor output torque and input current
10. Determine the relationship between different types of AC motor output torque and input current
11. Practice installation of a DC Motor.
12. Starting a d.c. series and shunt motors through starters.
13. Installation of a stepper and servo motor, study its applications and compare advantages and drawbacks of each.
14. Installation and speed control of BLDC motor.
15. Practice installation of a Generator.
16. Testing of motors & generators.
17. Connect a 3-phase induction motor to supply line through a direct-on starter.
18. Study the line and connection diagram of a star-delta starter.
19. Study the speed control of a-c series motor.
20. Practice maintenance and troubleshooting of DC Motors, AC Motors, BLDC Motors and generators.

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کل وقت 20 گھنٹے

نصاب سال سوئم

حصہ اول اسلامیات

حصہ دوم مطالعہ پاکستان

موضوعات:

1- قرآن مجید:

سورۃ الفاتحہ، آیت الکرسی، سورۃ البقرہ کی آخری آیات از امن الرسول ﷺ تا آخر اور سورۃ اخلاق مع ترجمہ و تشریح

2- دس منتخب احادیث کا ترجمہ (تشریح)

() بنی الاسلام علی خمس شہادت انا لا اله الا الله لمراقلم الصلوٰتہ و ایتا الزکوٰۃ و حج البيت و صوم

رمضان

() الدین النصیحتہ

() المنشاء موتمن

() للمومن علی المومن سنت خصال يعود ماذا مرض و تڑھدہ اذا مات و یحببہ اذا دعا

() لیسلم علیہ اذا لقیہ و لیثمتہ اذا عطس و فصیحلہ اذا غاب او شہد

() لا تخن من خانک

() لا یدخل الجنۃ قاتع

() ان الله حرم علیکم عقوق المہات و اضاعته المال

() لیسر او لا تعسر او لا تنفر

() ذاق طعم الايمان من مرضی باللہ و با الا سلام دینا بمحمد نبیا

() افضل الذکر لا اله الا الله

3- حقوق و فرائض:

حصول تعلیم بطور فرض، والدین اور اولاد کے حقوق و فرائض، ہمسایہ کے حقوق، بچوں کے حقوق، عورتوں کے حقوق، بزرگ

شہریوں کے حقوق، محنت افراد کے حقوق۔

4- اسلام کی اخلاقی اقدار:

صبر و استقلال، غفور و درگزر، ایفائے عہد، اخوت، ایثار و قربانی۔

سال سوئم

حصہ اول اسلامیات

تدریس مقاصد

قرآن حکیم:

عمومی مقاصد: منتخب سورتوں اور آیات کی روشنی میں اسلام کے بنیادی مقاصد اور عبادات جان سکے
 خصوصی مقاصد: طالب علم اس قابل ہو جائے گا کہ۔
 سورۃ الفاتحہ، آیت لکری، سورۃ بقرہ کی آخری آیات ازمن الرسول سے اور سورۃ اخلاق کا ترجمہ و تشریح کر سکے
 طالب علم درج ذیل کا مفہوم بیان کر سکے

- () رب العالمین صرف اللہ تعالیٰ ہے
- () اللہ رحم کرنے والا ہے
- () قیامت کے دن بادشاہی اللہ کی ہوگی
- () عبادات اور استعانت کا حقدار صرف اللہ ہے
- () طالب علم درج ذیل کا مفہوم بیان کر سکے
- () اللہ پاک ہر عیب سے پاک ہے
- () اللہ کے اسمائے حسنہ حق اور قیوم ہیں
- () تمام انبیاء پر ایمان لانا ضروری ہے
- () رسول، ملائکہ، کتب، سماویہ، پر ایمان لانا فرض ہے
- () اطاعت حقیقی صرف اللہ کے لیے ہے
- () اسلامی احکامات پر عمل کرنا انسانی بساط میں ہے
- () کفر کو اللہ کی مدد کے بغیر شکست نہیں دی جاسکتی
- () اللہ ایک ہے
- () اللہ کسی کا محتاج نہیں نہ اس کا کوئی شریک ہے

منتخب احادیث:

عمومی مقصد: احادیث کی روشنی میں اسلامی تعلیمات پر عمل پیرا ہو سکے

خصوصی مقاصد:

- () احادیث کا ترجمہ بیان کر سکے
 - () احادیث کی تشریح کر سکے
 - () معاشرتی اور انفرادی زندگی میں احادیث سے رہنمائی حاصل کر سکے
- حقوق و فرائض:

عمومی مقاصد:

- () اسلامی معاشرے کا ایک اچھا فرد بن سکے

خصوصی مقاصد:

- () والدین کے حقوق و فرائض بیان کر سکے
 - () ہمسایوں کے حقوق بیان کر سکے
 - () بچوں کے حقوق بیان کر سکے
 - () عورتوں کے حقوق کی پاسداری کر سکے
 - () بزرگ شہریوں کے حقوق کا خیال رکھ سکے
 - () محنت حضرات کے حقوق جان سکے اور ان کے حقوق کی پاسداری کر کے انہیں معاشرے کا ایک مفید فرد بنایا جاسکے
 - () اسلام میں حقوق و فرائض کی آگاہی کی صورت میں اپنے اندر خدمت خلق کا جذبہ پیدا کر سکے
- اسلامی اقدار:

عمومی مقاصد:

- () طالب علم جان سکے گا کہ تعلیم کا مقصد حسن اخلاق سے متصف ہونا ہے

خصوصی مقاصد:

- () اخلاق کے معنی و مفہوم کو بیان کر سکے
- () اسلام میں حسن و اخلاق کی اہمیت بیان کر سکے
- () قرآن و سنت کی روشنی میں صبر و استقلال کی اہمیت بیان کر سکے
- () ایفاء عہد کی اہمیت بیان کر سکے
- () اخوت کے معنی و مفہوم بیان کر سکے
- () اخوت اسلامی کی اہمیت بیان کر سکے

() اسلام کی اعلیٰ اقدار کو اپنا کر مثالی معاشرہ پیدا کر سکے

نصاب (سال سوئم)

GEN 301

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کل وقت 12 گھنٹے

مطالعہ پاکستان

حصہ دوم

موضوعات:

- () قیام پاکستان
- () باؤنڈری کمیشن
- () ریڈ کلف ایوارڈ
- () تقسیم بنگال
- () تقسیم پنجاب
- () مسئلہ مہاجرین
- () ریاست کا الحاق
- () ریاست جموں کشمیر
- () نہری پانی کا تنازعہ
- () قرارداد پاکستان
- () علماء کے بایس نکات
- () 1956-1962 اور 1973 کے دساتیر کی اسلامی انسانی حقوق کی دفعات (8 تا 28)۔
- () اقلیتوں کے حقوق۔ دیگر محروم طبقات کے حقوق
- () پاکستان کا محل وقوع اور اسکی جغرافیائی اہمیت۔ GSP+ کا تعارف اور عملی طریقہ کار
- () قدرتی وسائل (تیل، گیس، کوئلہ)

مطالعہ پاکستان (حصہ دوم)

قیام پاکستان

تدریس مقاصد:

عمومی مقاصد:

() قیام پاکستان کے بعد درپیش مسائل سے آگاہی حاصل کرے اور بیان کرے

خصوصی مقاصد:

() باؤنڈری کمیشن تشکیل اور اس کے فرائض بیان کر سکے

() ریڈکلف اور اس کے ایوارڈ کے بارے میں بیان کر سکے

() بنگال اور کلکتہ کی تقسیم کی وجوہات بیان کر سکے

() پنجاب کی تقسیم کی تفصیل بیان کر سکے

() مہاجرین کی آمد سے جو مسائل پیدا ہوئے انہیں بیان کر سکے

() ریاستوں کے الحاق کے بارے میں تفصیل بیان کر سکے

() ریاست جموں کشمیر کے بارے میں بیان کر سکے

() نہری پانی کے تنازعہ کو بیان کر سکے

() قرارداد مقاصد کی تفصیلات بیان کر سکے

() 22 علماء کے متفقہ اسلامی نکات بیان کر سکے

() 1973 کے آئین میں انسانی حقوق کی دفعات (28-8)۔ اقلیتوں کے حقوق اور دیگر محروم طبقات کے حقوق کے بارے میں

جان سکے

() قیام پاکستان کے بعد نفاذ اسلام کی کوششوں کو بیان کر سکے

() پاکستان کے محل وقوع اور اس کی جغرافیائی اہمیت بیان کر سکے اور GSP+ کے تعارف اور عملی طریقہ کار بیان کر سکے

() پاکستان میں قدرتی وسائل (تیل، گیس، کوئلہ) کے بارے میں بیان کر سکے

غیر مسلم طلباء کے لیے

GEN301

نصاب اخلاقیات

سال سوئم

ٹی پی سی

1 0 1

کل وقت 20 گھنٹے

موضوعات:

- () احساس ذمہ داری
- () مثبت ذہن
- () عدل و انصاف
- () قومی خدمت کا جذبہ
- () ذکر و نظر کی پاکیزگی
- () احترام آدمیت
- () شائستگی
- () عفو و درگزر
- () بردباری
- () خود انحصاری
- () اثر و نفوذ
- () جامعیت
- () اپنی ذات کی معرفت (بذریعہ ہم عمر طلباء، اساتذہ، اہم شخصیات)
- () بچوں کے حقوق
- () عورتوں کے حقوق
- () بزرگ شہریوں کے حقوق
- () محنت حضرات کے حقوق

غیر مسلم طلباء کے لیے
نصاب اخلاقیات (سال سوئم)

تدریس مقاصد:

عمومی مقاصد:

- () ملکی ترقی کے لیے اعلیٰ اوصاف کے ساتھ بہتر طور پر ملک و ملت کی خدمت کر سکے
- خصوصی مقاصد: طالب علم اس قابل ہو سکے کہ
- () موضوعات کا مطلب بیان کر سکے
- () عملی زندگی سے مثالوں کی نشاندہی کر سکے
- () موضوعات کی اہمیت بیان کر سکے
- () اپنی شخصیت اور معاشرے پر موضوعات کے مطابق اثرات پیدا کرنے کے طریقے بیان کر سکے
- () مثبت ذہن کے ساتھ کام کر سکے
- () عدل و انصاف سے ادارہ میں، دفتر میں بہتر ماحول پیدا کر سکے
- () ماحول کو اخلاقی طور پر پاکیزہ بنائے
- () کارکنوں کی بہتر طور پر دل جوئی کر سکے
- () کارکردگی میں اضافہ کر سکے
- () باہمی احترام کی برکات سے استفادہ کر سکے
- () بچوں کے حقوق بیان کر سکے
- () عورتوں کے حقوق کی پاسداری کر سکے
- () بزرگ شہریوں کے حقوق کا خیال رکھ سکے
- () محنت حضرات کے حقوق جان سکے اور ان کے حقوق کی پاسداری کر کے انہیں معاشرے کا ایک مفید فرد بنایا جاسکے

MGMC-311 INTELLIGENT PRODUCTION AND MANAGEMENT

Total Contact (Hours):

Theory	32	T	P	C
Practical	0	1	0	1

Aims

1. To understand the concept and content of production management, master the concept of intelligent production management
2. Able to analyze production operation systems, production operation management activities, and other management activities of the enterprise
3. To master the overall layout of the production system, production plan preparation procedure and production operation plan preparation method
4. To understand the functions of ERP and MES systems
5. To understand the basic idea of JIT production mode, Lean manufacturing (LP), computer integrated manufacturing system (CIMS), optimal production technology (OPT), agile manufacturing (AM), industry 4.0 and Made in Pakistan 2025

COURSE CONTENTS

1. INTRODUCTION TO INTELLIGENT PRODUCTION MANAGEMENT 4 HOURS

- 1.1 Production and Production Management
- 1.2 Content of production management
- 1.3 Productive process
- 1.4 Production type
- 1.5 Intelligent production management

2. PLANNING AND ORGANIZATION OF PRODUCTION SYSTEMS 4 HOURS

- 2.1 General layout of production system
- 2.2 Workshop layout
- 2.3 Time organization of the production process
- 2.4 Flow production organization

3. MATERIAL MANAGEMENT 4 HOURS

- 3.1 Overview of Material Management
- 3.2 Material consumption quota and reserve quota
- 3.3 Material Supply Plan and Material requirements planning (MRP)
- 3.4 Production site material management
- 3.5 Inventory management

4. PRODUCTION PLAN AND PRODUCTION OPERATION PLAN 4 HOURS

- 4.1 Comprehensive Production Plan
- 4.2 Production capacity of industrial enterprises
- 4.3 Arrangement of production plan
- 4.4 Production operation plan
- 4.5 Production operation control
- 4.6 Production operation statistics and work in progress management

5. EQUIPMENT MANAGEMENT AND LABOR MANAGEMENT 4 HOURS

- 5.1 Overview of Device Management
- 5.2 Use and maintenance of equipment
- 5.3 Equipment updates and renovations
- 5.4 TPM Management

5.5 Labor Management

5.6 On job training and versatile work

5.7 Skill evaluation method

6. QUALITY MANAGEMENT AND ISO 9000 QUALITY MANAGEMENT SYSTEM CERTIFICATION

4 HOURS

6.1 Overview of Quality Management

6.2 Quality management principles

6.3 Quality management system and methods

6.4 Quality management system audit

6.5 ISO 9000 Quality Standards and Quality Certification

7. ERP AND MES SYSTEMS

4 HOURS

7.1 Overview of ERP system

7.2 Implementation process of ERP

7.3 Evaluation of ERP implementation effectiveness

7.4 Overview of MES system

7.5 MES system functions

7.6 The relationship between MES system and ERP system

8. DEVELOPMENT AND MODE CHANGE OF PRODUCTION MANAGEMENT TECHNOLOGY

4 Hrs.

8.1 The evolution process of production methods

8.2 Basic ideas and main methods of JIT production method

8.3 Lean manufacturing (LP)

8.4 Computer Integrated Manufacturing System (CIMS)

8.5 Optimal Production Technology (OPT)

8.6 Agile Manufacturing (AM)

8.7 Industry 4.0 and Made in Pakistan 2025

RECOMMENDED BOOKS

1. Modern production management (3rd Edition) :Cui PingChina Machine Press(2020)

2. Intelligent Manufacturing Production Management and Control (intermediate) : PZheng Limei, Yu Xinyi, Chen Qiang Higher Education Press (2022)

3. New Manufacturing Intelligent Management Practical Series - Intelligent Production Management Practical Manual:Dang ZhengQi Chemical Industry Press(2020)

INSTRUCTIONAL OBJECTIVES

1. UNDERSTAND INTELLIGENT PRODUCTION MANAGEMENT

- 1.1 Production and Production Management
- 1.2 Content of production management
- 1.3 Productive process
- 1.4 Production type
- 1.5 Intelligent production management

2. APPLY PRODUCTION SYSTEMS

- 2.1 General layout of production system
- 2.2 Workshop layout
- 2.3 Time organization of the production process
- 2.4 Flow production organization

3. APPLY MATERIAL MANAGEMENT

- 3.1 Overview of Material Management
- 3.2 Material consumption quota and reserve quota
- 3.3 Material Supply Plan and Material requirements planning (MRP)
- 3.4 Production site material management
- 3.5 Inventory management

4. APPLY PRODUCTION PLAN AND PRODUCTION OPERATION PLAN

- 4.1 Comprehensive Production Plan
- 4.2 Production capacity of industrial enterprises
- 4.3 Arrangement of production plan
- 4.4 Production operation plan
- 4.5 Production operation control
- 4.6 Production operation statistics and work in progress management

5. UNDERSTAND EQUIPMENT MANAGEMENT AND LABOR MANAGEMENT

- 5.1 Overview of Device Management
- 5.2 Use and maintenance of equipment
- 5.3 Equipment updates and renovations
- 5.4 TPM Management
- 5.5 Labor Management
- 5.6 On job training and versatile work
- 5.7 Skill evaluation method

6. KNOW THE USE OF QUALITY MANAGEMENT AND ISO 9000 QUALITY MANAGEMENT SYSTEM CERTIFICATION

- 6.1 Overview of Quality Management
- 6.2 Quality management principles
- 6.3 Quality management system and methods
- 6.4 Quality management system audit
- 6.5 ISO 9000 Quality Standards and Quality Certification

7. KNOW THE USE OF ERP AND MES SYSTEMS

- 7.1 Overview of ERP system
- 7.2 Implementation process of ERP
- 7.3 Evaluation of ERP implementation effectiveness
- 7.4 Overview of MES system
- 7.5 MES system functions
- 7.6 The relationship between MES system and ERP system

8. UNDERSTAND DEVELOPMENT AND MODE CHANGE OF PRODUCTION MANAGEMENT TECHNOLOGY

- 8.1 The evolution process of production methods
- 8.2 Basic ideas and main methods of JIT production method
- 8.3 Lean manufacturing (LP)
- 8.4 Computer Integrated Manufacturing System (CIMS)
- 8.5 Optimal Production Technology (OPT)
- 8.6 Agile Manufacturing (AM)
- 8.7 Industry 4.0 and Made in Pakistan 2025

MTR-313 EMBEDDED SYSTEMS

Total Contact Hours

Theory	32	T	P	C
Practical	192	1	6	3

Aims: At the end of this course students will be able to understand the architecture and basic parts of a microprocessor. They will also learn basic architecture of Arduino UNO, its functions, programming and interfacing of different peripherals with ESP32.

Pre-requisites:

Digital Logic Design

1. Introduction

4 Hours

- 1.1 Microprocessors and their applications
- 1.2 Microcontrollers and their applications
- 1.3 Micro processing Techniques
- 1.4 Memory and its Types

2. Micro Processing System

4 Hours

- 2.1 Buses
- 2.2 Architecture of a microprocessor
- 2.3 Cache
- 2.4 Peripheral Devices
- 2.5 Polling/Interrupts
- 2.6 Parallel and Serial communication
- 2.7 Shift register

3. PIC Microcontroller

4 Hours

- 3.1 Introduction and applications
- 3.2 Architecture of PIC Microcontroller
- 3.3 Features and Peripherals of PIC Microcontroller
- 3.4 Pin description of PIC16F84
- 3.5 PIC Basic Instruction set
- 3.6 I/O Ports and Programming in assembly and C
- 3.7 Introduction to MPLAB software

4. Introduction to ATmega 328 microcontroller

4 hours

- 4.1 Introduction
- 4.2 Specifications and Features
- 4.3 Block diagram
- 4.4 Pin Configuration
- 4.5 Hardware architecture
- 4.6 Applications

5. Introduction to Arduino UNO

6 Hours

- 5.1 Arduino UNO and its features.
- 5.2 Components of UNO board.

5.3	Arduino Models	
5.4	Steps for setting up of Arduino	
5.5	Communicating with Arduino	
5.6	Different functions used for Arduino programming:	
5.6.1.	Pin Mode ()	
5.6.2.	Digital Write	
5.6.3.	void setup ()	
5.6.4.	void Loop ()	
5.6.5.	Delay ()	
5.7	Introduction to Arduino IDE	
6.	Communication interface , Analog Inputs and Various Buses	4 hours
6.1	Serial Data transfer	
6.2	Arduino Serial	
6.3	Analog Input	
6.4	Arduino SPI	
6.5	Arduino I2C	
6.6	Arduino To Arduino I2C Communication	
6.7	Arduino to Arduino Serial Communication	
6.8	Arduino to Raspberry Pi Communication through Serial USB	
7.	ESP 32	6 hours
7.1	Fundamentals of ESP 32 and Arduino interfacing	
7.2	Hardware and software requirements	
7.3	Concept of MQTT	
7.4	Features and Pinout of ESP32 board	
7.5	Programming and Coding instruction set	
7.6	Troubleshoot and Debugging Techniques	

RECOMMENDED BOOKS

- Arduino beginner guide by Erik Savasgard
- Exploring Arduino: Tools and Techniques for Engineering Wizardry by Jeremy Blum
- Arduino by Ashwin Pajankar

INSTRUCTIONAL OBJECTIVES:

1. INTRODUCE MICROCONTROLLERS AND MICROPROCESSORS

- 1.1 Define microprocessors and microcontrollers
- 1.2 Differentiate between micro-processor and micro controllers
- 1.3 Study the micro-processor techniques
- 1.4 Describe the memory of a micro processing system for storage; understand its various types and functions of each type (ROM, PROM, EPROM, EEPROM, RAM, and Flash)

2. UNDERSTAND THE CONCEPT OF A MICRO PROCESSING SYSTEM

- 2.1 Understand the basics and study the types of buses (data bus, address bus, control bus)
- 2.2 Describe the architecture of a microprocessor and its major components (arithmetic and logic unit (ALU), registers and its types, control units, clock generator)
- 2.3 Describe the input and output ports for external connectivity (peripheral devices, making connections, polling/interrupts, parallel and serial I/O, registers)

3. UNDERSTAND THE CONCEPT OF PIC MICROCONTROLLER

- 3.1 Introduction and applications
- 3.2 Understand Architecture of PIC Microcontroller
- 3.3 Study Features and Peripherals of PIC Microcontroller
- 3.4 Study Pin description of PIC16F84
- 3.5 Study PIC Basic Instruction set
- 3.6 Study I/O Ports and Programming in assembly and C
- 3.7 Study Introduction to MPLAB software

4. INTRODUCTION TO ATMEGA 328 MICROCONTROLLER

- 4.1 Understand the basics of ATmega 328 microcontroller
- 4.2 Describe Specifications and Features of ATmega 328 microcontroller
- 4.3 Describe the Block diagram of ATmega 328 microcontroller
- 4.4 Describe Pin Configuration and specification
- 4.5 Describe Hardware architecture
- 4.6 Explain Applications of ATmega 328 microcontroller

5. UNDERSTAND THE CONCEPT OF ARDUINO UNO

- 1.1 Understand the basics of Arduino UNO and its features.
- 1.2 Understand Components of UNO board
- 1.3 Describe Arduino Models.
- 1.4 Steps for setting up of Arduino
- 1.5 Explain how to communicate with Arduino
- 1.6 Understand the basics of Different functions used for Arduino programming:
 - 1. Pin Mode ()
 - 2. Digital Write
 - 3. void setup ()
 - 4. void Loop ()
 - 5. Delay ()
- 1.7 Understand Arduino IDE

6. UNDERSTAND THE CONCEPT OF COMMUNICATION INTERFACE, ANALOG INPUTS AND VARIOUS BUSES OF ARDUINO UNO

- 6.1 Understand the concept of Serial Data transfer

- 6.2 Understand the concept of Arduino Serial
- 6.3 Describe Analog Input
- 6.4 Understand the concept of Arduino SPI
- 6.5 Understand the concept of Arduino I2C
- 6.6 Explain Arduino to Arduino I2C Communication
- 6.7 Explain Arduino to Arduino Serial Communication
- 6.8 Explain Arduino to Raspberry Pi Communication through Serial USB

7. UNDERSTAND THE CONCEPT OF ESP 32

- 7.1 Explain fundamentals of ESP 32 and Arduino interfacing
- 7.2 Describe Hardware and software requirements
- 7.3 Explain concept of MQTT
- 7.4 Describe features and Pinout of ESP32 board
- 7.5 Explain Programming and Coding instruction set
- 7.6 Explain Troubleshoot and Debugging Technique

LIST OF PRACTICALS

192 Hrs.

1. Learn how to build a circuit on a breadboard
2. Learn how to debug (troubleshoot) a circuit
3. Write a program in C language to create delay of 500ms using PIC for LED control.
4. Understanding and interpreting circuit diagrams for Arduino interfacing.
5. Learn how to write and upload code to an Arduino
6. Learn how to use Arduino functions for digital input and output
7. Learn how to use Arduino functions for analog input and output
8. Write a program by using Arduino for measurement of Temperature using Thermistor
9. Write a program by using Arduino for measurement of Distance using ultrasonic Sensor
10. Interface an LED with Arduino and write a C language program to blink it.
11. Write a program by using Arduino for Seven segment display.
12. Design Traffic light project by using Arduino
13. Interface DC motor with Arduino and write program to change its direction
14. Interface a micro push button with Arduino and make the LED turn ON and OFF by the button.
15. Program the Arduino UNO for reading the state of push button.
16. Control electric load with Arduino using Bluetooth module.
17. Interface PIR sensor with Arduino and detect motion.
18. Understanding and interpreting circuit diagrams for ESP32 interfacing.
19. Make a project based on Arduino/ESP32 as assigned by the instructor.

MTR-302 HYDRAULICS AND PNEUMATICS

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

After studying this course, the student will be able to understand fundamental difference between hydraulic and pneumatic system, understand components of hydraulic and pneumatic system and understand the working of actuators and control valves.

Pre-requisites:

None

Course Contents:

- 1. Fundamental Principles** **4 Hours**
 - 1.1. Gas laws
 - 1.2. Different control systems
 - 1.2.1. A hydraulic system
 - 1.2.2. A pneumatic system
 - 1.3. Definition of terms
 - 1.3.1. Pressure
 - 1.3.2. Work, energy and power
 - 1.3.3. Torque
 - 1.3.4. Hydrostatics and Hydrodynamics
 - 1.4. Symbols and schematics for hydraulic and pneumatic components.
 - 1.5. Fluid flow
- 2. Hydraulic Pumps and Pressure Regulation** **5 Hours**
 - 2.1. Pump types
 - 2.1.1. Gear pumps
 - 2.1.2. Vane pumps
 - 2.1.3. Piston pumps
 - 2.2. Hydraulic System Components
 - 2.3. Selection criteria.
- 3. Air Compressors & Air Service Units** **6 Hours**
 - 3.1. Compressor types
 - 3.1.1. Piston compressors
 - 3.1.2. Screw compressors
 - 3.1.3. Rotary compressors
 - 3.1.4. Dynamic compressors
 - 3.2. Air receivers and compressor control
 - 3.3. Air treatment
 - 3.3.1. Stages of air treatment
 - 3.3.2. Filters
 - 3.3.3. Air dryers
 - 3.3.4. Lubricators
 - 3.3.5. FRL
 - 3.4. Service units
 - 3.5. Define the term Fluid flow and describe turbulent and laminar flow.
- 4. Control Valves** **6 Hours**
 - 4.1. Graphic symbols

- 4.2. Direction control valves and their actuation
 - 4.2.1. Manual actuation (Push button, Lever)
 - 4.2.2. Mechanical actuation (spring, roller lever, foot pedal)
 - 4.2.3. Electrical actuation (Solenoid operated valves)
- 4.3. Pilot-operated valves
- 4.4. Check valves
 - 4.4.1. Pilot-operated check valves
 - 4.4.2. Restriction check valves
- 4.5. Flow Control Valves
 - 4.5.1. Ball Valves.
 - 4.5.2. Butterfly Valves.
 - 4.5.3. Gate Valves
 - 4.5.4. Plug / Globe Valves
 - 4.5.5. Needle Valves
- 4.6. Pressure Control valves
- 4.7. Servo valves
- 5. Pneumatic and Hydraulic Actuators 4 Hours**
 - 5.1. Linear actuators (Cylinders)
 - 5.1.1. Symbol and construction of a hydraulic/pneumatic cylinder
 - 5.1.2. Types of cylinders (single acting and double acting)
 - 5.1.3. Selection of cylinders
 - 5.1.4. Cylinder sequencing
 - 5.1.5. Cascade Control
 - 5.2. Rotary actuators (hydraulic motor)
 - 5.2.1. Function of a rotary
 - 5.2.2. Semi rotary actuator
 - 5.2.3. Vane motor
 - 5.3. Examples of systems employing rotary actuators
- 6. Hydraulic & pneumatic system development 3 Hours**
 - 6.1. System Architecture
 - 6.2. Standard Symbols
 - 6.3. Logical Operations, speed control & sensory feedback
 - 6.4. Applications of Hydraulic Machinery (e.g. Excavator)
 - 6.5. Applications of Complex Pneumatic system (e.g. Ceiling Fan winding Machine, Material handling machine, Pneumatic Process Control valves)
- 7. Safety, Fault-finding, and Maintenance 4 Hours**
 - 7.1. Safety Cleanliness
 - 7.2. Diagnostic Tools and Techniques:
 - 7.3. Preventive maintenance

INSTRUCTIONAL OBJECTIVES:

1. Fundamental Principles

- 1.1 Describe Industrial prime movers.
- 1.2 Describe different Gas laws (Pascal Law, Boyle's Law, Charles Law)
- 1.3 Explain the components of following systems:
 - 1.3.1 A hydraulic and pneumatic system
 - 1.3.2 Describe Fluid power system.
 - 1.3.3 Describe Fluid Transport system.
- 1.4 Define the following terms:
 - 1.4.1 Pressure
 - 1.4.2 Work, energy and power
 - 1.4.3 Torque
 - 1.4.4 Hydrostatics and Hydrodynamics
- 1.5 Draw symbols for hydraulic and pneumatic components.
- 1.6 Write applications of hydraulics and pneumatics in mechatronics.

2. Hydraulic Pumps

- 2.1 Explain the following Pump types:
 - 2.1.1 Gear pumps
 - 2.1.2 Vane pumps
 - 2.1.3 Piston pumps
- 2.2 Explain briefly the components used in Hydraulic System
- 2.3 Describe selection criteria of pumps

3. Air Compressors, Air Treatment, and Pressure Regulation

- 3.1 Explain the following Compressor types:
 - 3.1.1 Piston compressor
 - 3.1.2 Screw compressor
 - 3.1.3 Rotary vane compressor
 - 3.1.4 Dynamic compressor
- 3.2 Describe Air receivers and method to control the compressor through pressure switch.
- 3.3 What is meant by Air treatment and why it is necessary?
 - 3.3.1 Describe three Stages of air treatment.
 - 3.3.2 Describe the purpose of Filters
 - 3.3.3 Describe the purpose of Air dryers
 - 3.3.4 Describe the purpose of Lubricators
 - 3.3.5 Describe the purpose of FRL
- 3.4 What is the purpose of Service units?
- 3.5 Define the term Fluid flow and describe turbulent and laminar flow.

4 Control Valves

- 4.1 Draw the Graphical symbols of 4/2, 4/3 valve and different actuators used for the valves.
- 4.2 Describe the purpose of Direction control valves.
- 4.3 Describe the purpose of Pilot-operated directional control valves
- 4.4 Describe the working of Check valves
 - 4.4.1 Working of Pilot-operated check valves

- 4.4.2 Working of Restriction check valves
- 4.5 Explain the working of the following Flow Control Valves:
 - 4.5.1 Ball Valves.
 - 4.5.2 Butterfly Valves
 - 4.5.3 Gate Valves
 - 4.5.4 Plug / Globe Valves
 - 4.5.5 Needle Valves
- 4.6 Explain the operation and symbol of following Pressure control valves:
 - 4.6.1 Pressure regulation valves
 - 4.6.2 Pressure limiting valves
 - 4.6.3 Pressure sequencing valves
- 4.7 Explain the working of following Servo valves:
 - 4.7.1 Two stage servo valve
 - 4.7.2 Flapper jet servo valve

5. Pneumatic and Hydraulic Actuators

- 5.1 Explain linear actuators (CYLINDERS)
 - 5.1.1. Discuss Symbol and construction of a hydraulic/pneumatic cylinder
 - 5.1.2. Describe the Types of cylinders (single acting and double acting)
 - 5.1.3. How to select the cylinders?
 - 5.1.4. Describe Cylinder sequencing
 - 5.1.5. Define Cascade Control
- 5.2 Explain the Rotary actuators (hydraulic motor)
 - 5.2.1. What is the Function of a rotary actuator?
 - 5.2.2. Describe Semi rotary actuators
 - 5.2.3. Describe Vane motor
- 5.3 Discuss the Examples of systems employing rotary actuators

6. Hydraulic & pneumatic system development

- 6.1 Recognize and explain the key components of hydraulic and pneumatic systems (pumps, reservoirs, actuators, valves, etc.).
- 6.2 Sketch basic hydraulic and pneumatic circuit diagrams using standard symbols.
- 6.3 Identify and interpret common symbols used for hydraulic and pneumatic components.
- 6.4 Demonstrate the ability to read and understand circuit diagrams using these symbols.
- 6.5 Explain the principles of logical operations used in hydraulic and pneumatic systems (AND, OR, NOT).
- 6.6 Describe methods for controlling the speed of actuators in both systems.
- 6.7 Explain the role and different types of sensors used for feedback in hydraulic and pneumatic systems.
- 6.8 Identify and analyze the specific applications of hydraulic machinery in various industries (construction, agriculture, manufacturing, etc.).
- 6.9 Explain the working principles of hydraulic systems used in excavators and similar machinery.
- 6.10 Explain the working principles of pneumatic systems used in ceiling fan winding machines, material handling machines, and pneumatic process control valves.

7. Safety, Fault-finding, and Maintenance

- 7.1 Describe Safety rules and Cleanliness practices for equipment.
- 7.2 Describe different Fault-finding instruments/techniques used for pneumatic or hydraulic system.
 - 7.2.1 Reviewing system history (recent maintenance, operational changes).
 - 7.2.2 Isolating the Fault:
 - 7.2.3 Dividing the system into smaller sections and testing each section individually.
 - 7.2.4 Pressure gauges: Measure pressure at various points in the circuit to identify pressure drops

- or abnormal readings.
- 7.2.5 Flow meters: Assess flow rate variations.
- 7.2.6 Visual inspection: Check for leaks, loose connections, and damaged components.
- 7.2.7 Electrical troubleshooting: Utilize multimeters and other tools to diagnose electrical control issues
- 7.3 Explain the steps involved in Fault-finding of pneumatic or hydraulic system.

List of Recommended Books:

- Hydraulics and Pneumatics by Andrew Parr
- Basic Pneumatics (Textbook and workbook) by FESTO Didactics
- Hydraulics & Pneumatic Systems by W. Bolton

LIST OF PRACTICAL:

96 Hrs.

1. Assemble basic hydraulic circuits using components like hoses, pipes, fittings, and valves to understand how hydraulic systems are constructed and function.
2. Assemble basic pneumatic circuits using components like tubes, fittings, and valves to understand how pneumatic systems are constructed and function.
3. Utilize some hydraulic/pneumatic software like FluidSIM for circuit diagram creation and simulation.
4. Use flow meters to measure the flow rate of hydraulic fluid in a circuit to understand the relationship between flow rate, pressure, and system performance.
5. Use pressure gauges to measure pressure at different points in a hydraulic circuit to interpret the readings and relate them to the operation of the system.
6. Familiarize with the basic components of a hydraulic trainer, including the pump, reservoir, relief valve, directional control valves, pressure gauge, actuators (cylinders and motors), and interconnecting hoses and pipes.
7. Operate different types of hydraulic pumps to check varying the pump displacement and observing the effects on system pressure and flow.
8. Study the working of pressure relief valves and adjust them to various pressure settings to observe the response of the valve to changes in system pressure.
9. Explore the operation of different directional control valves, such as solenoid-operated valves, pressure-operated valves, and flow control valves to learn how these valves control the direction and flow of hydraulic fluid in a circuit.
10. Apply different diagnostic techniques in hydraulic/pneumatic systems such as:
 - Measure pressure at various points in the circuit to identify pressure drops or abnormal readings.
 - Flow meters: Assess flow rate variations.
 - Visual inspection: Check for leaks, loose connections, damaged components.
 - Electrical troubleshooting: Utilize multimeters and other tools to diagnose electrical control issues
11. Using solenoid operated DCV's, and a pilot operated DCV, make the motor change direction of rotation when one cylinder extends and the other retracts.
12. Practice to adjust the flow rate to achieve the desired system performance.
13. Learn about interfacing electrical signals with pneumatic systems using solenoid valves to build and operate simple electro-pneumatic circuits.
14. Diagnose and troubleshoot the faults in a pneumatic system by identifying leaks, analyzing component malfunctions, and rectifying the problems.
15. Observe working principle of single-acting and double-acting hydraulic cylinders with the extension and retraction of the cylinder rod under different pressure conditions.

MTR-322 PROGRAMMABLE LOGIC CONTROLLERS (PLC's)

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

AIMS: After studying this course, the student will be able to explain the accepted format for PLC programs, list the advantages of PLC's over relay control, use Relay Logic Instructions when Programming a PLC, use Timer and Counter instructions in a PLC program, explain how the different Functions of a PLC are used, configure and properly install a PLC System, troubleshoot a PLC system and use of HMI with PLCs.

Course Contents:

1. Introduction to Programmable Logic Controllers 6 Hours

- 1.1. Definition and purpose, block diagram of PLC
- 1.2. Design and size range
- 1.3. PLC invention and early developments
- 1.4. PLC Vs earlier automation systems
- 1.5. Major PLC manufacturers
- 1.6. Role of companies in industrial automation
- 1.7. Early methods of programming
- 1.8. PLC compared with other control systems.
- 1.9. Why PLC is used in Industrial applications.

2. Architecture of PLC 6 Hours

- 2.1. Central processing unit (CPU)
- 2.2. Power supply
- 2.3. Programming device,
- 2.4. Input and output (I/O) module
- 2.5. Fixed, modular and distributed architectures.
- 2.6. Real-time operating systems of PLC
- 2.7. Discrete and analog signals
- 2.8. Programming and Interfacing of Analog and digital Signals

3. Programming Languages of PLC 5 Hours

- 3.1. Programming devices of PLC
- 3.2.1 Introduction to PLC programming languages:
- 3.2.2 Graphical language: Ladder Diagram
- 3.2.3 Graphical language Function Block Diagram (FBD)
- 3.2.4 Graphical language Sequential Function Chart (SFC)

4. Ladder Programming Methods 5 Hours

- 4.1. Syntax of ladder programming
- 4.2. Industrial STOP/START in ladder.
- 4.3. Logical AND, OR, NOT in ladder
- 4.4. Basic parts of a ladder diagram
- 4.5. Motor Control using ladder program.
- 4.6. Ladder program for traffic light

- 4.7. Ladder program for tank filling
- 4.8. To write ladder Program Description
- 4.9. Use of timer, counter in ladder
- 4.10. Program control instructions
- 4.11. Data manipulation instructions
- 4.12. Math instructions
- 4.13. Converting relay ladder into PLC ladder
- 4.14. Latching relays
- 4.15. Interfacing digital & analog I/O devices (proximity sensors, Load cells, Thermocouple, etc.)

5. PLC Installation and Functioning

5 Hours

- 5.1. To describe PLC logic WORKING
- 5.2. Modes of communication
- 5.3. Principles of operation of PLC
- 5.4. PLC installation requirement
- 5.5. Modes of operation of PLC
- 5.6. PLC troubleshooting methods

6. User Interface of PLC

5 Hours

- 6.1. Human-machine interface (HMI) and SCADA introduction
- 6.2. Common Uses of HMI
- 6.3. Difference between HMI and SCADA
- 6.4. Developing trends in HMI technology
- 6.5. HMI programming software overview
- 6.6. Create a new screen with some objects.
- 6.7. HMI programming object and properties
- 6.8. Selection of suitable HMI for a typical use
- 6.9. Features and specifications of HMI

INSTRUCTIONAL OBJECTIVES:

1. Introduction to Programmable Logic Controllers

- 1.1.1. Define Programmable Logic Controller (PLC) and explain its purpose.
- 1.1.2. Illustrate the block diagram of a typical PLC system.
- 1.1.3. Discuss the size range of PLCs, explaining how different sizes cater to diverse industrial applications.
- 1.1.4. Provide a historical overview of the invention of PLCs.
- 1.1.5. Compare PLCs with earlier automation systems.
- 1.1.6. Identify and list major manufacturers of PLCs.
- 1.1.7. Examine the role of companies in driving and adopting industrial automation.
- 1.1.8. Explore the early programming methods used in PLCs.
- 1.1.9. Compare PLCs with other control systems such as DCS (Distributed Control Systems) or PC-based control systems.
- 1.1.10. Enumerate the specific reasons why PLCs are preferred in industrial applications.

2. Architecture of PLC

- 2.1.1. Explain the role and function of the CPU in a computer system and its major components.
- 2.1.2. Explain the importance of a stable power supply in electronic systems.
- 2.1.3. Identify different types of power supplies and their characteristics.
- 2.1.4. Identify common programming devices such as microcontrollers, PLCs, and programmable logic devices etc.
- 2.1.5. Identify different types of input and output devices.
- 2.1.6. Understand the principles of interfacing input and output devices with a central processing unit.
- 2.1.7. Define and differentiate between fixed, modular, and distributed system architectures.
- 2.1.8. Define real-time operating systems (RTOS) and their significance in programmable logic controllers (PLC).
- 2.1.9. Identify features and characteristics of real-time operating systems used in PLCs.
- 2.1.10. Differentiate between discrete (digital) and analog signals.
- 2.1.11. Understand the characteristics and representations of discrete and analog signals.
- 2.1.12. Demonstrate the ability to interface analog and digital sensors and actuators.

3. Programming Languages of PLC

- 3.1.1. Demonstrate the ability to upload and download programs between the programming device and the PLC.
- 3.1.2. Introduction to PLC programming languages
- 3.1.3. Understand the basic symbols and elements used in Ladder Diagram (LD) programming.
- 3.1.4. Explore the sequential execution of ladder logic and the concept of scan cycles.
- 3.1.5. Demonstrate the ability to create and modify FBD programs.
- 3.1.6. Explore the advantages of using FBD compared to other graphical programming languages.
- 3.1.7. Demonstrate the ability to develop and modify SFC programs.

4. Ladder Programming Methods

- 4.1.1. Define ladder programming and its role in industrial automation.
- 4.1.2. Explain the basic principles and components of ladder logic diagrams.
- 4.1.3. Identify the essential elements of ladder logic syntax.
- 4.1.4. Create ladder logic for starting and stopping industrial processes.
- 4.1.5. Explain the significance of STOP/START functionality in industrial automation.
- 4.1.6. Implement AND, OR, and NOT operations in ladder diagrams.
- 4.1.7. Identify and describe the main elements of a ladder diagram.

- 4.1.8. Differentiate between inputs, outputs, and relay logic in ladder programming.
- 4.1.9. Create ladder logic for motor control.
- 4.1.10. Design ladder logic to control traffic lights in a sequential manner.
- 4.1.11. Develop ladder logic to manage the level of a tank.
- 4.1.12. Demonstrate implementation of timers and counters in ladder diagrams.
- 4.1.13. Demonstrate implementation of control instructions such as jump, subroutine, and return in ladder diagrams.
- 4.1.14. Explain the significance of program control instructions.
- 4.1.15. Implement data manipulation instructions such as move, compare, and arithmetic operations.
- 4.1.16. Understand the role of data manipulation in ladder logic.
- 4.1.17. Implement mathematical operations in ladder diagrams.
- 4.1.18. Explain the purpose and advantages of using latching relays in industrial control systems.
- 4.1.19. Describe how to Interface digital & analog I/O devices (proximity sensors, Load cells, Thermocouple)

5. PLC Installation and Functioning

- 5.1.1. Define PLCs and their role in industrial automation.
- 5.1.2. Understand the basic building blocks of PLC logic: inputs, outputs, and processing unit.
- 5.1.3. Explain the concept of ladder logic and its use in programming PLCs.
- 5.1.4. Identify common wired and wireless communication protocols like RS-232, RS-485, Ethernet/IP, and Profibus.
- 5.1.5. Explain the basic principles of data transmission and reception.
- 5.1.6. Describe the PLC scan cycle and its importance in program execution.
- 5.1.7. Identify the environmental factors to consider for PLC installation (temperature, humidity, dust, vibration).
- 5.1.8. Explain the importance of proper grounding and electrical safety.
- 5.1.9. Explain different types of PLC faults and errors (hardware, software, communication).

6. User Interface of PLC

- 6.1.1. Define HMI and SCADA and explain their roles in industrial automation.
- 6.1.2. Identify the basic components of an HMI/SCADA system.
- 6.1.3. Describe the benefits of using HMI/SCADA systems.
- 6.1.4. List common applications of HMI in various industries, such as manufacturing, power generation, water treatment, and building automation.
- 6.1.5. Differentiate between HMI and SCADA based on their functionalities and purposes.
- 6.1.6. Identify emerging trends in HMI technology, such as mobile access, cloud connectivity.
- 6.1.7. Introduce commonly used HMI programming softwares
- 6.1.8. How to add basic objects to the screen, such as buttons, text boxes, graphs, and trends.
- 6.1.9. Explain the different types of objects used in HMI programming.
- 6.1.10. Analyze the requirements of a specific application to determine the most suitable HMI.
- 6.1.11. Identify key features and specifications of HMIs, such as screen size, resolution, communication protocols, and security features.

LIST OF PRACTICAL:

96 Hrs.

1. Producing a ladder diagram and then understanding its principle of operation.
2. Program error checking ways in a PLC simulation software
3. Identify the various components of the PLC in the lab.
4. Identify all the keys in the programming software of PLC trainer.
5. Implement basic logic gates (AND, OR, and NOT) using ladder logic in a PLC to understand the fundamental concepts of digital logic.
6. Program a PLC for Switching ON/OFF light in a PLC trainer.
7. Program a PLC for Traffic Light Control.
8. Program a PLC for Reverse Forward Control of a Motor.
9. Build a PLC program to control a bottle filling system, incorporating sensors to detect the presence of bottles, valves for controlling liquid flow, and monitoring the filling process.
10. Program a PLC for main door control
11. Implement Proportional-Integral-Derivative (PID) control using a PLC to regulate a process variable such as temperature, pressure, or flow rate.
12. Develop an alarm system using a PLC to monitor various inputs (such as temperature, pressure, or level) and activate alarms or warning devices when certain thresholds are exceeded.
13. Program a PLC for Batch mixer control
14. Configure the HMI device and establish communication between the PLC and HMI using a suitable communication protocol such as Modbus, Ethernet/IP, or Profibus.
15. Create an HMI interface to display real-time sensor data from the PLC, such as temperature, pressure, or level readings, and incorporating visual indicators or alarms based on certain thresholds.
16. Set up remote access to the HMI interface, allowing authorized personnel to monitor and control the PLC system from a different location or through a mobile device.
17. Implement corrective actions to resolve basic PLC problems.
18. Perform basic testing and verification of PLC installation.
19. Configure PLC communication settings for different protocols.
20. Use diagnostic tools and techniques to isolate and identify the root cause of faults.

MTR-332 COMPUTERIZED NUMERICAL CONTROL (CNC)

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

This course introduces the fundamental concepts of Computer Numerical Control (CNC) machining, with a strong emphasis on programming and understanding jigs and fixtures. By combining theoretical knowledge with practical exercises, this course equips you with the skills to program and operate CNC machines efficiently and confidently.

Learning Objectives:

1. Understand the principles of CNC machining and its applications.
2. Learn basic G-code programming for CNC machines.
3. Master advanced G-code programming techniques for complex machining operations.
4. Design and utilize jigs and fixtures for accurate and efficient CNC machining.
5. Develop problem-solving skills for optimizing CNC machining processes.
6. Gain hands-on experience with CNC programming and operation (if practical labs are available).

Course Contents:

- 1. Introduction to CNC Machining** **06 Hours**
 - 1.1 Overview of CNC technology and its components (CNC machine, controller, programming interface).
 - 1.2 Benefits of CNC machining over conventional machining.
 - 1.3 Applications of CNC machining in various industries.
 - 1.4 Types of CNC machines (lathes, milling machines, machining centers, etc.).
 - 1.5 Introduction to CNC coordinate systems and axes.
- 2. G-code Programming Fundamentals** **05 Hours**
 - 2.1 Introduction to G-code, the most common CNC programming language.
 - 2.2 G-codes for basic movements (linear, circular, etc.).
 - 2.3 M-codes for auxiliary functions (tool changes, spindle control, etc.).
 - 2.4 Programming basics: datum's, offsets, tool definitions, feed rates, speeds, etc.
 - 2.5 Hands-on exercises: writing simple G-code programs for basic machining operations.
- 3. Advanced G-code Programming** **06 Hours**
 - 3.1 Subroutines and canned cycles for repetitive operations.
 - 3.2 Parameter programming for variables and conditional statements
 - 3.3 Toolpath interpolation methods (linear, circular, helical, etc.).
 - 3.4 Advanced cutting techniques: contouring, pocketing, threading, etc.
 - 3.5 Hands-on exercises: programming complex machining operations using advanced G-code features.
- 4. Jigs and Fixtures for CNC Machining** **05 Hours**
 - 1.1 Importance of jigs and fixtures in CNC machining for accuracy and repeatability.
 - 1.2 Types of jigs and fixtures (clamping jigs, indexing fixtures, etc.).
 - 1.3 Design principles for jigs and fixtures: material selection, locating and clamping methods, rigidity, etc.
 - 1.4 Hands-on exercise: design and analyze a simple jig or fixture for a specific CNC machining operation.
- 5. CNC Programming CAM Software** **05 Hours**
 - 5.1. Introduction to Computer-Aided Manufacturing (CAM) software for CNC programming.
 - 5.2. Graphical user interface for intuitive CNC program creation.
 - 5.3. Importing CAD models and generating toolpaths automatically.
 - 5.4. Simulation and verification of CNC programs before machining.
 - 5.5. Hands-on exercise: using CAM software to generate G-code for a specific machining operation.

5.6.

6. CNC Machining Applications and Optimization

05 Hours

- 6.1. Practical considerations for CNC machining: setup, tool selection, safety procedures, etc.
- 6.2. Optimizing CNC programs for efficiency and accuracy.
- 6.3. Troubleshooting common CNC machining problems.
- 6.4. Inspection techniques for CNC machined parts.

INSTRUCTIONAL OBJECTIVES:

3. Introduction to CNC Machining

- 1.1 Explain the concept of CNC technology and its key components, including the CNC machine, controller, and programming interface.
- 1.2 Identify the advantages and benefits of CNC machining compared to conventional machining techniques.
- 1.3 Describe the various applications of CNC machining across different industries.
- 1.4 Recognize the different types of CNC machines, such as lathes, milling machines, machining centers, and more.
- 1.5 Explain the fundamental principles of CNC coordinate systems and axes.

2. G-code Programming Fundamentals

- 2.1 Define G-code and its role in CNC machining.
- 2.2 Explain the benefits of using G-code for CNC programming.
- 2.3 Identify different types of G-code (e.g., modal, non-modal).
- 2.4 Interpret common G-codes for linear movements (e.g., G00, G01).
- 2.5 Program G-codes for circular movements (e.g., G02, G03).
- 2.6 Explain the purpose of M-codes in CNC programming.
- 2.7 Identify common M-codes for auxiliary functions (e.g., tool changes, coolant control, spindle start/stop).
- 2.8 Define datums and their role in CNC machining.
- 2.9 Program different types of datum offsets.
- 2.10 Create tool definitions using G-code commands.
- 2.11 Write G-code programs for basic milling operations (e.g., facing, pocketing, slotting).

3. Advanced G-code

- 3.1 Define subroutines and canned cycles in CNC machining.
- 3.2 Explain the benefits of using subroutines and canned cycles for repetitive operations.
- 3.3 Describe the concept of parameter programming in CNC machining.
- 3.4 Utilize variables and expressions in CNC programs.
- 3.5 Implement conditional statements (e.g., IF-THEN-ELSE) to control program flow based on specific conditions.
- 3.6 Identify different toolpath interpolation methods used in CNC machining (linear, circular, helical, etc.).
- 3.7 Explain the applications of each interpolation method for various machining operations.
- 3.8 Define and differentiate between advanced cutting techniques like contouring, pocketing, threading, etc.
- 3.9 Program CNC machines for specific advanced cutting techniques.
- 3.10 Select appropriate cutting parameters for different advanced machining operations.
- 3.11 Apply the acquired knowledge of subroutines, parameter programming, toolpath interpolation, and advanced cutting techniques to program complex machining operations.

4. Jigs and Fixtures for CNC Machining

- 1.1 Explain the significance of jigs and fixtures in achieving accuracy and repeatability in CNC machining.
- 1.2 Identify various types of jigs and fixtures commonly used in CNC machining (e.g., clamping jigs, indexing fixtures).
- 1.3 Describe the fundamental principles for designing jigs and fixtures, including material selection, locating and clamping methods, and ensuring rigidity.
- 1.4 Apply the acquired knowledge through a hands-on exercise where you design and analyze a simple jig or fixture for a specific CNC machining operation.

5. CNC Programming CAM Software

- 6.9 Define CAM software and its function in CNC machining.

- 6.10 Describe the benefits of using CAM software for CNC programming.
 - 6.11 Navigate the graphical user interface (GUI) of a CAM software program for intuitive CNC program creation.
 - 6.12 Identify the key elements of a CAM software GUI.
 - 6.13 Utilize basic functions of the CAM software interface to create new programs.
 - 6.14 Explain the process of importing CAD models into CAM software.
 - 6.15 Describe the concept of toolpaths and their importance in CNC machining.
 - 6.16 Explain the purpose of simulation and verification in CNC programming.
 - 6.17 Analyze simulation results to ensure the program will produce the desired part geometry.
 - 6.18 Demonstrate the skills learned throughout the module by using CAM software to generate G-code for a specific machining operation
- 6. CNC Machining Applications and Optimization**
- 6.1 Describe the key steps involved in setting up a CNC machine for a specific machining job.
 - 6.2 Explain the factors to consider when selecting appropriate cutting tools for different materials and machining operations.
 - 6.3 Analyze CNC programs to identify opportunities for improving machining efficiency and part accuracy.
 - 6.4 Identify common problems that can occur during CNC machining, such as dimensional errors, surface finish issues, and tool breakage.
 - 6.5 Implement corrective actions to resolve CNC machining problems and ensure successful part production.
 - 6.6 Demonstrate the use of various measuring tools and techniques to inspect CNC machined parts for dimensional accuracy and surface quality.
 - 6.7 Interpret inspection data to determine if machined parts meet the required specifications.
 - 6.8 Explain the importance of proper inspection procedures in ensuring the quality and consistency of CNC machined parts.

Reference Books:

- 1. Burghadt, Machine Tool Operations, Vol. I & II)
- 2. Luggen, Fundamentals of Numerical Control, 2nd Ed.
- 3. Luggen, CNC A First Look Primer

LIST OF PRACTICAL:

96 Hrs.

1. Identify the components, sketch them, and explain the operation of all the Lathe types found in the Machine shop.
2. Identify the components, sketch them, and explain the operation of all the Milling machine types found in the Machine shop.
3. Identify the components, sketch them, and explain the operation of all the Grinder types found in the Machine shop.
4. Utilize CAM software functionalities to simulate CNC programs and identify potential errors.
5. Utilize CAM software features to generate toolpaths automatically from imported CAD models.
6. Install and Configure the CNC system software.
7. Apply strategies to optimize CNC programs, such as adjusting feed rates, cutting depths, and toolpaths.
8. Test the rotation of the motors of the CNC system through manual jog and through command.
9. Determine the position of points using incremental and absolute methods.
10. Import a provided CAD model.
11. Generate toolpaths for a specific machining operation.
12. Simulate and verify the generated program.
13. Export the program as G-code suitable for a CNC machine.
14. Write G-M Codes for Turning operation.
15. Write G-M Codes for Step-turning operation.
16. Write G-M Codes for Drilling using incremental coordinate system.
17. Write G-M Codes for Drilling using absolute coordinate system.
18. Write G-M Codes for Boring operation.
19. Write G-M Codes for Threading operation.
20. Use cyclic commands for generating part program of a given profile.
21. Develop a part using CAD/CAM

MTR-342 INDUSTRIAL ROBOTICS

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

After studying this course, the student will be able to understand the basic concepts of robotics, application of robots in industry, identify the operating principles and configurations of industrial robots and to understand, program, operate, and maintain industrial robots.

Pre-requisites:

None

Course Contents:

- 1. Architecture and Types of Industrial Robot** **05 Hours**
 - 1.1. Explain robot and robotics.
 - 1.2. Historical development of robots
 - 1.3. Main components of a robot
 - 1.4. Robot terminologies: number of axis, DOF, envelop, Pay load
 - 1.5. Robot manipulation
 - 1.6. Articulated robot's construction, features and applications
 - 1.7. SCARA robot
 - 1.8. Autonomous robot (AGV etc.)
- 2. Technical Description and Performance Specifications** **05 Hours**
 - 2.1. Common aspects in robot construction
 - 2.2. Introduction to Kinematics of robot
 - 2.3. Types of robotic arm motion
 - 2.4. Motion control systems in robots
 - 2.5. Establishing robot position
 - 2.6. Power sources in robot
 - 2.7. Drive mechanisms in robots
- 3. Robot Programming and Interfaces** **05 Hours**
 - 3.1. Types of programming methods; online, offline methods, hand guided programming
 - 3.2. Using a graphical user interface for robot programming
 - 3.3. End-of-arm tooling
 - 3.4. Controlling the movement of end effectors by defining coordinates
 - 3.5. Typical programming examples for any robot task
 - 3.6. Programming languages for industrial robots
- 4. Market Demand and Applications of Robots** **06 Hours**
 - 4.1. Market survey by International Federation of Robotics (IFR)
 - 4.2. Common manufacturers of industrial robots
 - 4.3. Introduction of largest worldwide robot's manufacturer
 - 4.4. Top industrial robotics applications
 - 4.5. Role of robots in Lights out (manufacturing)
 - 4.6. Applications of robot in welding paintings assembly operations
 - 4.7. Applications of robot in picking, packing and palletizing

4.8. Considerations for Choosing a robot.

4.9. Robotics engineering in Pakistan

5. Environmental Interaction and Navigation

5 Hours

5.1. Human-robot interaction

5.2. Robot touch and vision sensing

5.3. Robotic mapping

5.4. GPS navigation

5.5. Speech recognition sensing, Robotic voice

5.6. Gesture recognition, Emotion recognition/ Facial expression, Artificial emotions

6. Robot Control Systems

06 Hours

6.1. Robot control mechanism

6.2. Robot motion control types

6.2.1. Point to point control.

6.2.2. Continuous path control

6.2.3. Controlled path control

6.2.4. Stop to stop control.

6.3. Robot control methods

6.3.1. Manual control

6.3.2. Wireless control

6.4. Fully autonomous control

List of Recommended Books:

- Introduction to Robotics by J.J Craig
- Fundamentals of robotics engineering by Harry H. Poole

INSTRUCTIONAL OBJECTIVES:

1. Architecture and Types of Industrial Robots

- 1.1.1. Define the term "robot" and differentiate it from other automated machines.
- 1.1.2. Describe the field of robotics and its scope of application.
- 1.1.3. Understand the evolution of robots from ancient myths and automata to modern technologies.
- 1.1.4. Identify the essential components of a robot, including actuators, sensors, controllers, and power sources.
- 1.1.5. Understand key terms used in robotics, such as degrees of freedom (DOF), workspace envelope, and payload capacity.
- 1.1.6. Explain the principles of robot manipulation, including grasping, force control, and motion planning.
- 1.1.7. Analyze the different types of grippers and their suitability for different tasks.
- 1.1.8. Analyze the relationship between a robot's workspace envelope and its degrees of freedom.
- 1.1.9. Select the appropriate robot configuration based on task requirements and workspace limitations.
- 1.1.10. Explain the construction and operation of articulated robots, including joint types, link mechanisms, and control systems.
- 1.1.11. Identify the key features and advantages of articulated robots compared to other types.
- 1.1.12. Explore the diverse applications of articulated robots in various industries (e.g., manufacturing, logistics, healthcare).
- 1.1.13. Understand the structure and operation of SCARA robots
- 1.1.14. Enlist the advantages of SCARA robots for high-speed and precise assembly tasks.
- 1.1.15. Define "autonomous robot" and applications of autonomous robots in different fields.

2. Technical Description and Performance Specifications

- 2.1.1. Identify the main subsystems of a robot: manipulator, locomotion system, sensors, actuators, controller, and power source.
- 2.1.2. Explain the different types of robot frames and joints (prismatic, revolute, spherical, etc.).
- 2.1.3. Describe forward and inverse kinematics to calculate robot end-effector position and orientation based on joint angles.
- 2.1.4. Understand the concept of manipulator workspace.
- 2.1.5. Identify and differentiate between linear, rotary, and curvilinear robot arm motions.
- 2.1.6. Explain the concepts of degrees of freedom.
- 2.1.7. Explain the role of feedback sensors (position, velocity, force) in closed-loop robot control.
- 2.1.8. Describe different types of robot controllers (PID, adaptive, learning) and their functionalities.
- 2.1.9. Explain the principles of odometry, and encoder-based position tracking.
- 2.1.10. Describe the use of external sensors like vision cameras, LiDAR, and inertial measurement units (IMUs) for robot localization.
- 2.1.11. Compare and contrast the use of electrical, hydraulic, and pneumatic power sources in robots.
- 2.1.12. Explain the working principles of common drive mechanisms like gears, belts, chains, and cams.
- 2.1.13. Describe the different types of motors used in robots (DC, AC, stepper, servo) and their characteristics.

3. Robot Programming and Interfaces

- 3.1.1. Identify the advantages and disadvantages of online, offline methods, hand guided programming method.

- 3.1.2. Explain the concept of path planning and its role in robot programming.
- 3.1.3. Identify different types of EOAT, such as grippers, vacuum tools, and welding torches.
- 3.1.4. Explain the selection criteria for appropriate EOAT based on the task and material.
- 3.1.5. Describe different robot coordinate systems, such as Cartesian, cylindrical, and joint space.
- 3.1.6. Analyze and break down a robot task into individual steps.
- 3.1.7. Identify key features and functionalities of different industrial robot software packages.
- 3.1.8. Explain the syntax and structure of robot programming languages like Karel, ABB RAPID, and Siemens TP.

4. Market Demand and Applications of Robots

- 4.1.1. Analyze key trends and growth areas in industrial robotics.
- 4.1.2. Identify major robot user industries and applications.
- 4.1.3. Compare and contrast different robot brands based on factors like capabilities, specifications, and market share.
- 4.1.4. Define and explain the concept of lights-out manufacturing.
- 4.1.5. Understand the role of robots in enabling fully automated and unattended production lines.
- 4.1.6. Explore the specific applications of robots in welding, painting, and assembly tasks.
- 4.1.7. Explain the role of robots in material handling tasks like picking, packing, and palletizing.
- 4.1.8. Explore different types of robots and grippers used in these applications.
- 4.1.9. Emphasize the importance of matching robot capabilities to task requirements and production needs.
- 4.1.10. Explore the current state and future prospects of robotics engineering in Pakistan.

5. Environmental Interaction and Navigation

- 5.1.1. Understand the principles of effective human-robot interaction (HRI), including communication, safety, and user experience.
- 5.1.2. Explain the working principles of tactile and visual sensors used by robots.
- 5.1.3. Explain the principles of GPS technology and its application in robot navigation.
- 5.1.4. Describe the process of speech recognition and its role in robot interaction.
- 5.1.5. Explain the principles of gesture recognition and its potential applications in HRI.

6. Robot Control Systems

- 6.1.1. Understand the basic principles of robot control mechanisms, including sensors, actuators, and controllers.
- 6.1.2. Explain how point-to-point control algorithms work to move a robot from one point to another.
- 6.1.3. Identify the different types of point-to-point control algorithms and their applications.
- 6.1.4. Explain how continuous path control algorithms follow a predefined path while moving a robot.
- 6.1.5. Explain how controlled path control algorithms adjust the robot's motion based on feedback from sensors.
- 6.1.6. Explain how stop-to-stop control algorithms bring a robot to a controlled stop at a specific point.
- 6.1.7. Explain how a human operator controls a robot using joysticks, buttons, or other interfaces.
- 6.1.8. Identify the applications of manual control in different robotic tasks.
- 6.1.9. Explain how a human operator controls a robot using a remote control or other wireless interfaces.

LIST OF PRACTICAL:

1. Identify basic components of Robotic trainer in your lab.
2. Installation procedure of trainer and Interpret specifications and technical data sheets of robots.
3. Installation and setting the origin of robot using teach pendent.
4. Utilize some robotic software functionalities to simulate programs and identify potential errors.
5. Understand the keys of teach pendent which you use for jogging the robot.
6. Practice of jogging the robot using teach pendent.
7. To control the gripper and perform various playback functions.
8. Practice to perform an automatic task with setting a specific time.
9. Select the appropriate type of robot arm motion for a given task based on performance and efficiency criteria.
10. Design basic motion control algorithms for simple robot tasks.
11. Navigate and utilize the features of a robot programming GUI.
12. Create basic robot programs using drag-and-drop methods or visual blocks.
13. Program robots to follow specific paths for accurate and efficient movement.
14. Develop and test programs for tasks like pick-and-place, object manipulation, and path following.
15. Test and debug robot programs virtually before deployment on real robots.
16. Set up and operate a robot simulation software package (e.g RoboDK).
17. Program a robot to perform tasks completely autonomously.
18. Perform maintenance and troubleshooting of selected Robot.

MTR-372 Emerging Technologies in Mechatronics & AI

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

- ❖ To acquaints students with the emerging fields in mechatronics & automation
- ❖ To apprise students of the core importance of mechatronics and automation in emergingfields
- ❖ To enable students to understand importance of interdisciplinary studies

1. 3D Printing

2 Hours

- 1.1 basics of 3-D printing
- 1.2 concept of 2-D and 3-D
- 1.3 the tools used for 3-D designing
- 1.4 software used for 3-D designing

2. Basics of Computer Vision

5 Hour

- 2.1 Introduction to image processing
 - 2.1.1 concepts of images, points, pixels and functions
 - 2.1.2 histogram analysis and mapping
 - 2.1.3 filtering
- 2.2 Introduction to Computer vision
 - 2.2.1 basics of computer vision
 - 2.2.2 Feature extraction and image segmentation
 - 2.2.3 Object detection and recognition

3. Internet of Things

4 Hours

- 3.1 Introduction to IOT and Rust programming
- 3.2 Applications of IOT
- 3.3 Voice computing for device control
- 3.4 Artificial Intelligence (AI) for Internet of Things (IoT)

4. Artificial Intelligence

6 Hours

- 4.1 The terminology of AI
- 4.2 Major AI application areas
- 4.3 AI and developing economies
- 4.4 Features of an Intelligent system
- 4.5 Agents and abstraction
- 4.6 Searching and states

5. Machine Learning

6 Hours

- 5.1 Introduction to machine Learning
- 5.2 Interesting applications of machine learning
- 5.3 Machine Learning techniques
 - 5.3.1 Supervised Learning

- 5.3.2 Un supervised Learning
- 5.3.3 Reinforcement Learning
- 6. 4th Industrial Revolution 3 Hours**
 - 6.1 History of Industrial revolution
 - 6.2 Role of AI in 4th Industrial revolution
 - 6.3 Role of Cloud Computing in 4th Industrial revolution
 - 6.4 Role of Block Chain Technology in 4th Industrial revolution
- 7. Medical Applications of Mechatronics 3 Hours**
 - 7.1 Medical Robotics
 - 7.2 Cardiac pacemakers
 - 7.3 Defibrillators
 - 7.4 Ultrasonic probes
 - 7.5 Medical imaging
- 8. Green Technological Innovations 3 Hours**
 - 8.1 Importance of Green Technology
 - 8.2 Examples of Green Technologies
 - 8.3 Case study of EcoATMs

BOOKS RECOMMENDED

- Mechatronic Design Automation: Emerging Research and Recent Advances (Mechanical Engineering Theory and Applications: Zhun Fan (2010)
- Mechatronics 2013: Recent Technological and Scientific Advances: TomásBrezina and RyszardJablonski (2013)
- Other materials as per the topic under discussion

INSTRUCTIONAL OBJECTIVES:

1. Understand 3-D Printing

- 1.1 Study the basics of 3-D printing
- 1.2 Understand the concept of 2-D and 3-D
- 1.3 Identify the tools used for 3-D designing
- 1.4 Understand the software used for 3-D designing

2. INTRODUCE IMAGE PROCESSING & COMPUTER VISION

- 2.1 Study the basics of image processing
 - 2.1.1 Study the concepts of images, points, pixels and functions
 - 2.1.2 Understand histogram analysis and mapping
 - 2.1.3 Understand filtering
- 2.2 Introduction to Computer vision
 - 2.2.1 Study the basics of computer vision
 - 2.2.2 Understand Feature extraction and image segmentation
 - 2.2.3 Understand Object detection and recognition

3. INTRODUCE INTERNET OF THINGS

- 3.1 Explanation of the Concept of IOT and Rust programming
- 3.2 Overview of Applications of IOT
- 3.3 Understanding the concept of Voice computing for device control
- 3.4 Understand the concept of Artificial Intelligence (AI) for Internet of Things (IoT)

4. EXPLAINING ARTIFICIAL INTELLIGENCE

- 4.1 Explain definitions and provide an overview of artificial intelligence
- 4.2 Provide an overview of major AI application areas
- 4.3 Explain the concept of AI and developing economies
- 4.4 Identify the features of an intelligent system and different approaches for tests
- 4.5 Understand the concepts of agents and abstraction
- 4.6 Understand the concept of searching and states

5. EXPLAINING MACHINE LEARNING

- 5.1 Provide definition and overview of machine Learning
- 5.2 Introduce interesting applications of machine learning
- 5.3 Explain concept of Machine Learning techniques
 - 5.3.1 Explain supervised Learning
 - 5.3.2 Explain unsupervised Learning
 - 5.3.3 Explain reinforcement Learning

6. INTRODUCE 4TH INDUSTRIAL REVOLUTIONS

- 6.1 Provide history of Industrial revolutions
- 6.2 Explain the role of AI in 4th Industrial revolution
- 6.3 Explain role of Cloud Computing in 4th Industrial revolution
- 6.4 Explain role of Block Chain Technology in 4th Industrial revolution

7. INTRODUCE MEDICAL APPLICATIONS OF MECHATRONICS & AUTOMATION

- 7.1 Study the mechatronic applications in medicine (Medical Robotics, Cardiac pacemakers, Defibrillators, Ultrasonic probes, medical imaging)

LIST OF PRACTICALS:

1. Model a 3D object in a 3D modeling software
2. Print the 3D model on a 3D printer after slicing and printer configuration
3. Acquire images through a camera and perform basic operations
4. Apply different filters on the acquired images to enhance certain aspects of the images.
5. Perform image segmentation on images via computer vision toolbox/library/package
6. Extract features on acquired images via computer vision toolbox/library/package
7. Perform object detection on acquired images via computer vision toolbox/library/package
8. Perform object tracking on acquired images via computer vision toolbox/library/package
9. Interfacing Street light system with IOT
10. Interfacing a biomedical sensor with IOT
11. Explore various case studies, such as:
 - 11.1 Alexa, Siri
 - 11.2 Self-driving car
 - 11.3 ChatGPT-4.
12. Home Automation using IOT

MTR-382 INDUSTRIAL PROCESS CONTROL & TROUBLESHOOTING

Total Contact Hours

Theory	32	T	P	C
Practical	96	1	3	2

Aims

The subject of Industrial Process Control & Troubleshooting equips you with the knowledge and skills to:

1. Understand the principles of industrial process control: This includes learning about feedback loops, control systems (e.g., PID controllers), and process variables.
2. Operate and monitor industrial processes: You'll gain the ability to interpret data from sensors and instruments, ensuring processes run efficiently and according to specifications.
3. Troubleshoot process problems: The course will teach you systematic methods to identify, diagnose, and rectify issues within industrial processes. This involves analyzing data, recognizing abnormal behavior, and implementing corrective actions.
4. Optimize process performance: By understanding how to adjust control systems and operating parameters, you'll be able to fine-tune processes for maximum efficiency, quality, and yield.
5. Maintain process safety and integrity: The course will emphasize safety protocols, hazard identification, and procedures for safe troubleshooting and process intervention.

Pre-requisites:

None

Course Contents:

- 1. Introduction to Industrial Process Control** **04 Hours**
 - 1.1 Overview of industrial processes and their control systems
 - 1.2 Importance of process control in manufacturing industries
 - 1.3 Basic principles of process control: feedback loops, set points, sensors, actuators, etc.
 - 1.4 Process variables and disturbances
- 2. Sensors and Instrumentation** **05 Hours**
 - 2.1 Types of sensors used in industrial processes (e.g., temperature, pressure, flow, level)
 - 2.2 Principles of operation and selection criteria for sensors
 - 2.3 Introduction to instrumentation: transmitters, controllers, recorders, etc.
 - 2.4 Calibration and maintenance of sensors and instrumentation devices
- 3. Control Systems and Components** **05 Hours**
 - 3.1 Types of control systems: open-loop, closed-loop (feedback), and cascade control
 - 3.2 Components of a control loop: controllers, actuators, final control elements
 - 3.3 PID (Proportional-Integral-Derivative) control and its applications
 - 3.4 Tuning of controllers for optimal performance
 - 3.5 Stability and tuning methods (Ziegler-Nichols, Cohen-Coon)
 - 3.6 Advanced PID control strategies (cascade control, feedforward control)
- 4. Control Strategies and Tuning** **05 Hours**
 - 4.1 Introduction to control strategies: on-off control, proportional control, integral control, derivative control
 - 4.2 Tuning of PID controllers: methods and techniques for achieving desired control performance
 - 4.3 Advanced control strategies: cascade control, feedforward control, ratio control, etc.
- 5. Troubleshooting in Industrial Processes** **05 Hours**
 - 5.1 Common issues and challenges in industrial processes
 - 5.2 Techniques for troubleshooting control system problems
 - 5.3 Root cause analysis methodologies

- 5.4 Reading and interpreting PFD (Process Flow Diagrams) symbols and notations
- 5.5 Identifying key process components and control points
- 5.6 Using PFDs for troubleshooting and process analysis
- 5.7 Common process control problems and their symptoms
- 5.8 Troubleshooting using PID control principles
- 6. Safety in Process Control** **04 Hours**
 - 6.1 Importance of safety in industrial process control
 - 6.2 Hazard identification and risk assessment techniques
 - 6.3 Safety measures and protocols for process control systems
 - 6.4 Emergency shutdown systems and procedures
- 7. Advanced Topics in Process Control** **04 Hours**
 - 7.1 Advanced control algorithms: adaptive control, predictive control, fuzzy logic control
 - 7.2 Real-time optimization techniques
 - 7.3 Integration of process control with SCADA (Supervisory Control and Data Acquisition) systems

BOOKS RECOMMENDED

- Process Control Theory and Applications by Jean-Pierre Corriou
- Process Control, Principles and Applications By Surekh Bhanot

INSTRUCTIONAL OBJECTIVES:

1. Introduction to Industrial Process Control

- 1.1 Define what an industrial process is and identify different types of industrial processes (e.g., continuous, batch).
- 1.2 Explain the purpose and function of control systems in industrial settings.
- 1.3 Describe the basic components of an industrial control system (e.g., sensors, controllers, actuators).
- 1.4 Analyze the benefits of effective process control in manufacturing (e.g., improved product quality, increased efficiency, reduced costs).
- 1.5 Discuss the potential consequences of poor process control (e.g., safety hazards, product defects, production delays).
- 1.6 Explain the concept of a feedback loop and its role in process control.
- 1.7 Define set points and their significance in maintaining desired process conditions.
- 1.8 Describe the function of sensors in measuring process variables.
- 1.9 Identify key process variables commonly encountered in different industries (e.g., temperature, pressure, flow rate).
- 1.10 Explain the concept of disturbances and their impact on process control.
- 1.11 Describe different types of disturbances (e.g., load changes, raw material variations).

2. Sensors and Instrumentation

- 2.1 Identify the four basic types of sensors commonly used in industrial processes: temperature, pressure, flow, and level.
- 2.2 Describe the operating principles of different sensor technologies for each type (e.g., thermocouple, RTD for temperature, diaphragm gauge for pressure, etc.).
- 2.3 Analyze the key factors to consider when selecting a sensor for a specific industrial application (e.g., measurement range, accuracy, response time, operating environment).
- 2.4 Choose the appropriate sensor type based on process requirements and limitations.
- 2.5 Define the function of various instrumentation devices used in industrial process control systems (e.g., transmitters, controllers, recorders).
- 2.6 Explain how sensors, transmitters, and controllers work together in a control loop.
- 2.7 Describe the basic functionalities of different types of controllers (e.g., on/off, proportional, PI, PID).
- 2.8 Explain the importance of calibration for sensor and instrument accuracy.
- 2.9 Identify the basic procedures involved in calibrating common industrial sensors.
- 2.10 Describe preventative maintenance practices for ensuring optimal performance

3. Control Systems and Components

- 3.1 Define open-loop, closed-loop (feedback), and cascade control systems.
- 3.2 Explain the advantages and disadvantages of each type.
- 3.3 Identify real-world examples of each control system type.
- 3.4 Describe the function of controllers, actuators, and final control elements in a control loop.
- 3.5 Identify the components in a specific control system diagram.
- 3.6 Explain the concept of PID control and its three modes (proportional, integral, and derivative).
- 3.7 Identify suitable applications for PID control.
- 3.8 Explain the importance of controller tuning for achieving optimal system response.
- 3.9 Describe the concept of stability in control systems.
- 3.10 Apply basic tuning methods like Ziegler-Nichols and Cohen-Coon to PID controllers.
- 3.11 Explain the relationship between controller settings and system stability.
- 3.12 Identify limitations of basic PID control.

- 3.13 Describe the principles behind advanced control strategies like cascade control and feedforward control.
- 3.14 Explain how these advanced strategies can improve control performance.
- 4. Control Strategies and Tuning**
 - 4.1 Define control strategies and their role in feedback systems.
 - 4.2 Explain the concept of on-off control and its limitations.
 - 4.3 Describe the principle of proportional control and its impact on system response.
 - 4.4 Discuss the purpose of derivative control and its influence on system dynamics.
 - 4.5 Differentiate between the various control strategies (on-off, proportional, integral, derivative)
 - 4.6 Explain the concept of PID controllers (Proportional-Integral-Derivative).
 - 4.7 Identify the tuning parameters (K_p , K_i , K_d) of a PID controller.
 - 4.8 Describe different methods for tuning PID controllers (e.g., Ziegler-Nichols method).
 - 4.9 Define and differentiate between cascade control, feedforward control, and ratio control.
 - 4.10 Explain the working principle of cascade control and its benefits for complex systems.
 - 4.11 Describe how feedforward control utilizes disturbance information for improved performance.
 - 4.12 Discuss the application of ratio control in maintaining specific ratios between process variables.
- 5. Troubleshooting in Industrial Processes**
 - 5.1 Identify the major categories of issues encountered in industrial processes (e.g., equipment malfunctions, material defects, process control deviations).
 - 5.2 Explain the impact of these issues on production efficiency, safety, and product quality.
 - 5.3 Utilize various techniques for gathering information during troubleshooting (e.g., data analysis, visual inspection, interviews).
 - 5.4 Differentiate between symptoms and root causes of control system issues.
 - 5.5 Recognize and interpret common symbols and notations used in Process Flow Diagrams (PFDs).
 - 5.6 Translate the information presented in PFDs into a clear understanding of the process flow.
 - 5.7 Identify key components within an industrial process (e.g., reactors, pumps, valves).
 - 5.8 Distinguish between manipulated variables, measured variables, and controlled variables in a control loop.
 - 5.9 Utilize PFDs to identify potential bottlenecks and areas for improvement within a process.
 - 5.10 Recognize the symptoms associated with common process control problems (e.g., cycling, instability, offset).
 - 5.11 Differentiate between various types of control loop issues based on their observed behavior.
 - 5.12 Explain the basic principles of Proportional-Integral-Derivative (PID) control
- 6. Safety in Process Control**
 - 6.1 Define and explain the concept of process safety in industrial settings.
 - 6.2 Analyze the potential consequences of accidents in process control systems (e.g., injuries, environmental damage, production loss).
 - 6.3 Discuss the ethical and legal implications of ensuring safety in industrial processes.
 - 6.4 Identify common hazards associated with industrial process control systems (e.g., pressure leaks, electrical faults, chemical spills).
 - 6.5 Recommend control measures to mitigate identified risks.
 - 6.6 Explain the purpose and function of various safety equipment used in industrial process control (e.g., pressure relief valves, emergency shut-off switches, personal protective equipment).

- 6.7 Describe safe work practices for operating and maintaining process control systems.
- 6.8 Discuss the importance of following established safety protocols and procedures.
- 6.9 Identify different types of emergency shutdown systems (ESD) used in process control.
- 6.10 Explain the activation criteria and procedures for using ESD systems.
- 6.11 Demonstrate proper actions to take during various process control emergencies.
- 7. Advanced Topics in Process Control**
 - 7.1 Explain the limitations of conventional control methods.
 - 7.2 Describe the concept and principles of adaptive control.
 - 7.3 Explain the concept of model predictive control (MPC).
 - 7.4 Analyze the advantages and limitations of MPC compared to traditional methods.
 - 7.5 Explain the fundamentals of fuzzy logic theory.
 - 7.6 Design a fuzzy logic controller for a specific control problem.
 - 7.7 Describe the role of real-time optimization in process control.
 - 7.8 Identify different real-time optimization techniques (e.g., linear programming, nonlinear programming).
 - 7.9 Explain the functionalities of SCADA systems in process control.
 - 7.10 Describe the communication protocols used for integrating process control systems with SCADA.

LIST OF PRACTICAL:

1. Using a Servo drive, analyze the positioning accuracy in open-loop operation and closed-loop operation.
2. Use process simulation software to model a simple process like a level control system.
3. Simulate the process response to various step changes in the set point.
4. Practice tuning the Proportional Integral Derivative (PID) controller by adjusting gains and observing the impact on system stability and response time.
5. Practice tuning PID controllers for different processes. This involves adjusting proportional, integral, and derivative gains to achieve optimal control performance.
6. Using a servo drive, analyze the speed regulation characteristics under P, PI, PD, and PID control.
7. Using a variety of sensors (transducers), couple them to an appropriate physical parameter and measure the output.
8. Build on the level control simulation by introducing a flow control loop feeding into the level tank or use the flow meter and the level sensor to regulate the tank filling process through a pump.
9. Use pressure control rig to regulate the pneumatic pressure.
10. Regulate the temperature of heater enclosure using a temperature sensor feedback.
11. Simulate a tank filling and emptying system. Manipulate inflow and outflow valves and observe the impact on level readings. Implement different control strategies like proportional-integral-derivative (PID) control to maintain a desired level.
12. Simulate a heating or cooling system. Adjust heater/cooler power and observe the impact on temperature readings. Implement PID control to maintain a desired temperature.
13. Install SCADA (Supervisory Control and Data Acquisition) system simulations to interact with virtual process plants, monitor data, and adjust control parameters.
14. Install the Data Acquisition Software into a PC and interface it with Data Acquisition Hardware.
15. Connect the strain gauge assembled in the previous lab and the necessary components to measure and analyze physical parameters using the Data Acquisition interface and software.
16. Use the software to determine 3 weights, maintain a record of the weights measured and output to the screen the weight of the current measurement.
17. Connect various sensors (transducers) to the Data Acquisition interface and plot the outputs of the sensors over a range of set points.
18. Install the process control software and configure it.
19. Program the environment as outline by the instructor
20. Using the appropriate sensor(s), couple them to the Process and the control environment (PLC, PC)

EPF-311 ENTREPRENEURSHIP AND FREELANCING

Total Contact Hours

Theory	0	T	P	C
Practical	96	0	3	1

Aims and Objectives

This course equips Mechatronics students with the knowledge and skills to navigate the exciting worlds of entrepreneurship and freelancing. This course is designed to equip you with the knowledge, skills, and mindset required to thrive as an entrepreneur or a freelancer in the modern marketplace.

Our core objective is to enable DAE Mechatronics engineering students to leverage their skills and offer services to overseas clients through freelancing, providing them with practical exposure, experience, and additional income. Point-wise objectives are given as follows:

- Understand the fundamentals of entrepreneurship and freelancing.
- Identify business opportunities in the Mechatronics field.
- Develop a business plan or freelancing strategy.
- Master the skills necessary to market your technical abilities.
- Learn how to manage finances and legalities for your business or freelance practice.

List of Practical:

1. Understand Entrepreneurship and Freelancing by exploring several entrepreneurial examples and mechatronics industry landscape.
2. Identify a niche and develop Portfolio by conducting market research and competitor analysis. Additionally build online portfolio on a suitable platform.
3. Students brainstorm and generate ideas for potential Mechatronics startups or freelancing ventures.
4. Conduct market research to validate the feasibility of selected business ideas.
 - Gather data on target market demographics, competitors, and industry trends.
 - Analyze market demand and potential customer needs for Mechatronics products or services.
5. Identify customer segments, value propositions, revenue streams, and key resources required.
6. Develop prototypes or minimum viable products (MVPs) for Mechatronics startup ideas.
 - Utilize Mechatronics skills to build functional prototypes or proof-of-concept models.
 - Test and iterate prototypes based on user feedback and market validation.
7. Create financial projections and budgets for Mechatronics startups or freelancing ventures.

- Calculate startup costs, operating expenses, and revenue forecasts.
 - Explore funding options such as bootstrapping, crowdfunding, or seeking investment.
8. Provide constructive feedback and peer evaluation to enhance presentation skills.
 9. Explore legal requirements and considerations for starting Mechatronics businesses.
 - Discuss intellectual property protection strategies for inventions, designs, and innovations.
 - Review sample contracts, agreements, and terms of service relevant to Mechatronics entrepreneurship.
 10. Develop marketing plans and branding strategies for Mechatronics startups or freelancing ventures.
 - Create promotional materials, such as logos, websites, and social media profiles.
 - Explore digital marketing techniques, content creation, and online advertising platforms.
 11. Simulate sales scenarios and customer interactions relevant to Mechatronics products or services.
 - Role-play sales pitches, negotiation tactics, and objection handling techniques.
 - Analyze sales metrics and conversion rates to optimize sales strategies.
 12. Manage projects and tasks related to Mechatronics entrepreneurship effectively.
 - Utilize project management tools and techniques to plan, organize, and track progress.
 - Prioritize activities, set deadlines, and allocate resources efficiently.
 13. Organize networking events or industry talks with successful Mechatronics entrepreneurs and professionals.
 - Facilitate opportunities for students to connect, collaborate, and learn from experienced practitioners.
 - Encourage active participation in entrepreneurship communities and startup ecosystems.
 14. Provide peer feedback and constructive criticism to support continuous improvement.
 - Encourage students to critically evaluate their entrepreneurial mindset and readiness for future endeavors.
 15. Onboarding sessions on popular freelancing platforms, providing step-by-step guidance for creating account and searching for the suitable project.
 16. Learn to write project pitch/gig for applying on freelance project.

MTRPJ-392 Project of Industrial Relevance

Total Contact Hours: 192

Theory	0	T	P	C
Practical	192	0	6	2

Aims

- Enable students to practically implement the knowledge & skills acquired through various theoretical and laboratory courses
- Introduce students to conduct independent survey for contemporary industrial problems and issues related to implementation of the allotted projects.
- Encourage the students to acquire a comprehensive understanding about design, operation, simulation, data collection and analysis on the important areas of the project.
- Help students in the development of solutions of the industrial problems
- Enable students to practically implement the proposed solutions in the form of proof-of-concepts or prototypes

Final Year Project Instructions:

Choose a project that makes usage of the acquired knowledge& skills and in line with current needs of prospective employers and relevant industry. Projects shall incorporate the technological advancements while applying Mechatronics and ICT extensively.

Suggested Fields

1. Industrial Automation & Machinery
2. Robotics
3. Renewable Energy and Environment
4. Construction and Transport
5. Telecommunication
6. Electric Power
7. Medicine, Health and Biomedical
8. Nanotechnology
9. Chemical & Petro-Chemical
10. Oil & Gas
11. Bio-Technology
12. Others relevant areas

1. Project list should be prepared by subject teacher, recommended by HOD, approved by Principal; so that along with HOD, principal is aware about current year projects of his college, as this activity is related to the dignity of college and not limited to a department.

2. Project must be after surveying the local market, gathering the demands of industries/people in the area of Mechatronics and Automation. This may also enable one to start his/her own business according to the real demands of market related to Mechatronics.
3. Project should be industry based; after surveying the nearby approachable industries. Students will ask the industries (via their focal persons) about some important problems they are facing and then try to find solutions to solve these. In this way that group of students will be of higher value for the industry while applying for jobs there.
4. Project made by students in a year, can be upgraded in the next year by coming students. This will ensure that the developed solutions are robust and reliable.
5. Students must remember, that the projects without local market need are no more beneficial to their future; because the 1st thing in making any project is the *Need Analysis* of customers or market.
6. Physical implementation of the proposed solution is recommended; however, in case of high cost of implementation, a proof-of-concept may be acceptable.
7. Project report is mandatory for each project – including why a project is needed for society; what are the different ideas to fulfill this need; why and how one adopts this idea to implement this project including the details of the project's budget; and how this project can be enhanced in future.
8. Project marks distribution should be under the following criteria:
 - (i) Project was developed after proper research and market survey, while keeping in view the relevance with business organizations, industries and/or local market. **[40% Marks]**
 - (ii) Project report is complete and well managed. **[20% Marks]**
 - (iii) Project introduction, operation, installation, block and circuit diagrams are clearly mentioned in the project report. **[20% Marks]**
 - (iv) Project is operational or not. **[20% Marks]**

Note: In above marks distribution 60% marks (sessional marks) will be awarded by the subject teacher and 40% marks will be awarded by External Examiner appointed by PBTE.

9. If any student has some certificate or possess any operational, installation or troubleshooting skill in any Mechatronics area like:
 - i. Industrial automation e.g. PLC/SCADA/HMI technician/operator
 - ii. CNC operator
 - iii. Auto CAD
 - iv. Creo or Pro/Engineer
 - v. Advance welding
 - vi. Artificial intelligence
 - vii. Robotics and Automatic System Operator
 - viii. Renewable Energy
 - ix. Web graphics and mobile app development
 - x. Occupational health safety and environment
 - xi. Automotive Mechatronics
 - xii. Uninterruptable power supply fabrication/troubleshooting/up grading
 - xiii. Home automation areas like lighting control, HVAC, outdoor lawn irrigation, kitchen appliances, and security systems, etc.

Then he can be given maximum marks in component (iv) Project is operational or not, after verifying his skill and certificate by the project teacher. This is because he has acquired a desired skill for life-long learning.

MINIMUM QUALIFICATION OF INSTRUCTORS / Teachers

For Technical Subjects

- B.Sc. /BE degree in Engineering (Mechatronics) preferably with minimum of 1 years Industrial / Teaching experience in the related field
- MSc. / Ph.D degree in disciplines related to Mechatronics & Control/Automation Systems Engineering
- DAE in Automation / Mechatronics 3-4-years Industrial / Teaching experience in the related field

For Subjects pertaining to Humanities / Related Studies /Management

- MA degree in English/ Islamiyat / Pst. with 2 years of teaching experience
- M.Sc./B.Sc. degree in IT / Computer Sciences or BE in Computer Engineering with 2-years of teaching experience
- M.Sc. degree in Mathematics with 2-years of teaching experience
- M.Sc. degree in Physics / Chemistry with 2-years of teaching experience
- MBA degree with 2-years of teaching experience

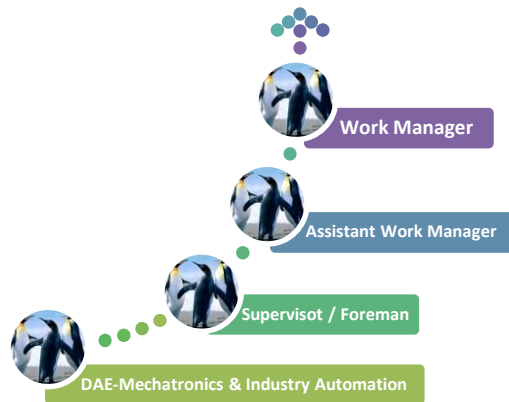
EMPLOYABILITY OF THE PASS-OUTS with Market designations and vertical progression

The students holding DAE qualifications in Mechatronics can seek employment in firms/companies / industry dealing in any of the following Areas / Sectors:

- Mechanical, Electrical, Electronics, Computer & Controls Engineering
- Industrial Automation and Controls
- Electromechanical systems
- Digital and Embedded Systems
- Industrial robots / Robotics
- Instrumentation
- Medical devices
- Programming or Control Networks
- Aircraft simulators, Aircraft & Space craft manufacturing
- Control and Network System / Control System Integration

- Automated assembly lines
- Innovative Product Development
- Building control systems,
- Embedded Systems Development
- Automated vehicles
- Food & Beverage
- Construction & Cement sector
- PLC based Automated system

Starting with Supervisory position, the vertical mobility for these qualification holders is shown below:



- This pass-out graduate may also get job opportunity of teacher / instructor in TVET sector as Junior Instructor with vertical mobility upto Senior Instructor.
- They may be employed for installation, operation, repairing & maintenance jobs pertaining to industrial automation / mechatronic systems. There are always positions available for sales & marketing of parts, devices and systems pertaining to M&IA and Electro-Mechanical product

DETAIL OF CURRICULUM REVISION COMMITTEE (CRC)

Sr.No	Name & Designation
1	Dr. Ali Raza, Associate Professor Chairman Mechatronics Department UET, Lahore.
2	Muhammad Razi Abbas, Assistant Professor, Mechatronics Department UET, Lahore.
3	Mr. Abdul Wajid, CEO (Infusion (Pvt) Ltd) 54-E 1 AWT Phase II Ada Plot Raiwind Road Lahore.
4	Mr. Usman Rashid Baig, Director Mechatronic Engineering Solution, Lahore.
5	Hafiz Muhammad Faisal Farooq, Director, Standard Engineering Pvt Ltd 14-Km Multan Road Behind uniform factory Lahore.
6	Muhammad Usman, Sr.Instructor GCT Taxila.
7	Engr. Engr.Furqan Wahid, Instructor, GSPCT Gujrat.
8	Kanwal Waqar, Instructor, GCT Attock.