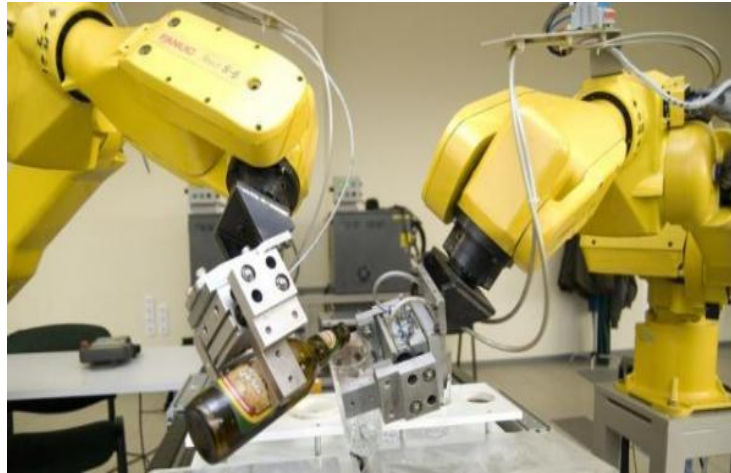


CURRICULUM
For
THREE YEAR'S DIPLOMA
OF
ASSOCIATE ENGINEER
IN
MECHATRONICS TECHNOLOGY

REVISED BY, TEVTA PUNJAB
ADOPTED BY, SBTE KARACHI
OCTOBER 2020

Curriculum for DAE in **Mechatronics** Technology



**Technical Education and Vocational Training Authority, Gulberg, Lahore.
(TEVTA-Punjab)**

Submitted By:



Revised/Developed June,2015

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Course Details & Contents: Year-I

11	Islamiat/Pakistan Studies- I	14
12	English	23
13	Applied Mathematics-I	26
14	Applied Physics	34
15	Applied Chemistry	41
16	Basic Engineering Drawing & CAD	50
17	Introduction to Computers and Programming	60
18	Electrical Essentials & Networks	70
19	Occupational Health Safety & Environment	79
20	Introduction to Mechatronics & Industrial Automation	83
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Course Details & Contents: YEAR-II

22	Islamiat& Pakistan Studies- II	99
23	Applied Mathematics - II	106
24	Business Communication & Report Writing	112
25	Engineering Materials	118
26	Drives & Linkages	126
27	Sensors & Actuators	135
28	Motors & Generators	143
29	Instrumentation & Measurement	148
30	Electronic Devices & Circuits	158
31	Digital Logic Design	171

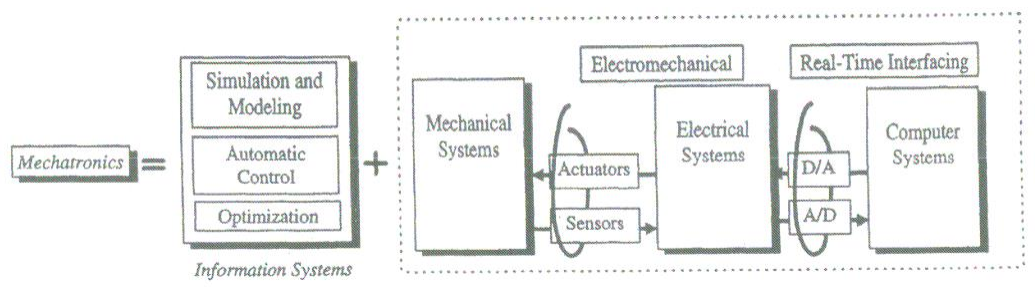
Course Details & Contents: YEAR-III

32	Islamiat& Pakistan Studies- III	
33	Industrial Management& Human Relations	178
34	Microprocessors & Microcontrollers	185
35	Hydraulics & Pneumatics	198
36	Programmable Logic Controllers (PLCs)	204
37	Computer Integrated Manufacturing (CIM)	214
38	Industrial Robotics	224
39	Emerging Mechatronics & Automation Technologies	233

INTRODUCTION

TEVTA-Punjab is currently offering two separate courses, namely, DAE in Mechatronics Technology and DAE in Automation Technology. It was decided by the TEVTA management to merge these two courses into one i.e., DAE in Mechatronics to align with the emerging requirements of the industry, increase intake and enhance chances of graduates' employment. The other objective was to update the contents in the light of new developments in the field and the needs of the local industry.

Keeping in view the above scenario, the present curriculum has been designed for students to acquire the essential knowledge & skills in the broader context of a synergic approach in the fields of ***Mechatronics & Automation*** as depicted below as well as present and future applications.



Mechatronics Applications

Smart consumer products: home security, camera, microwave oven, toaster, dish washer, laundry washer-dryer, climate control units, etc.

Medical: implant-devices, assisted surgery, haptic, etc.

Defense: unmanned air, ground, and underwater vehicles, smart munitions, jet engines, etc.

Manufacturing: robotics, machines, processes, etc.

Automotive: climate control, antilock brake, active suspension, cruise control, air bags, engine management, safety, etc.

Network-centric, distributed systems: distributed robotics, tele-robotics, intelligent highways, etc.

The curriculum is thus addresses the following learning objectives:

- Understand the principles of applied sciences, basic electrical circuitry and operation of electrical and electronic devices including ICT etc., which form the basics of architecture for M&IA systems
- Understanding the concepts of engineering drawings and developing technical drawing using conventional & new drafting & drawing methods (CAD etc.)
- 3. Comprehend the relationships between components of the automated system(s) such as the sensors, transducers, actuators, drives etc., and the systems themselves
- Developing the basic understanding of microcontrollers and its programming and practice programming on different software(s)
- Understand the manufacturing environment and technology, the applications of instruments/tools commonly applied in the industry for diagnostics, R&D and measurement purposes
- Understand PLCs and its programming for automating an industrial unit
- Developing ability to know about the working/operation and development of industrial robots and other automation systems

This 3-year DAE level programme is meant to provide a well-defined progression route for the higher qualifications and employment in various domains related to M&IA.

TRAINING OBJECTIVES

General Objectives

This curriculum aims at providing the knowledge, skills, abilities, attitudes and experiences to students, enabling them to serve as technicians/supervisors in the field of Mechatronics.

It has been designed in a way which promotes competency based understanding and knowledge in order to gain confidence for working in a technology-savvy world as they develop interest in scientific & technical aspects of this technology. They shall also recognize the efficacy of applied sciences with reference to their applicability in other disciplines

3. In addition to above, the other general objectives which the curriculum shall meet are stated below:

Developing aptitudes relevant to technology such as accuracy and precision, objectivity, integrity, enquiry, initiative and insight.

Promoting general awareness about study and practice of science / technology as co-operative, complementary and cumulative activities that are subject to social, economic, technological, ethical and cultural influences and limitations. Both the beneficial and detrimental aspects of scientific and technological applications at the individual and at the community levels shall be highlighted.

Promoting the presentation of information and ideas appropriate for different audiences and purposes by using latest ICT tools.

Simulating genuine interest in, and care for, the local & global environment, energy conservation and clean energy measures.

Encouraging learners to take and sustain interest in the course of study so that they are well-prepared for suitable employment and/or for further studies beyond current level.

Specific Objectives

This 3-year diploma level curriculum on “Mechatronics” is developed to prepare skilled manpower for employment in the automation industries along with automated sectors of the industry. The course covers almost all the important aspects which relates to the production & operation of reliable and efficient automated systems. The curriculum is intended to serve as a base for class room and laboratory instructions as well as an essential reference for use by the institutions offering this course of studies. It is intended to serve the following two purposes:

To provide students with a sound understanding of the basic concepts, types, applications of mechatronics & industrial automation;

To help students develop proficiency in handling mechatronic equipment and systems and making rational choices regarding situations they are likely to encounter in their professional practices.

Deviating from conventional pattern, it includes newcore subjects & advanced topics related to Mechatronics

Industrial Automation along with other subjects such as applied sciences, ICT, management, work ethics, OHSE etc. to impart comprehensive learning objectives of each subject are included to make sure that students are able to meet all the expectations before they appear in examinations. This is done to align the curriculum to meet the criteria for international accreditation as well to address the current and emerging needs of the sector.

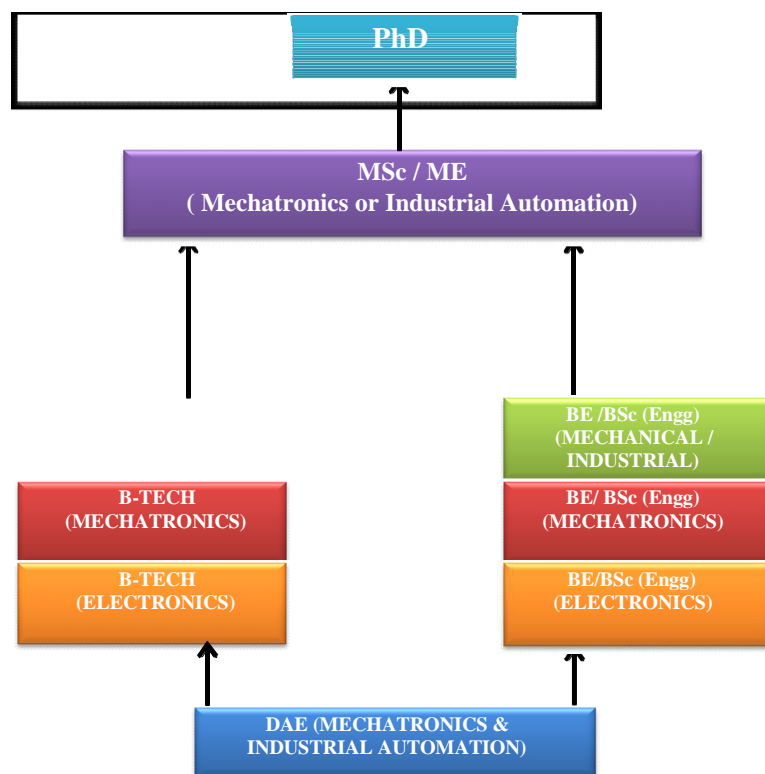
Overall, the curriculum reflects an inclination towards practical training while imparting basic knowledge - this approach was duly endorsed by the key stakeholders who participated in the development process of this important initiative.

CURRICULUM SALIENT

Qualification Title	3-Year Diploma of Associate Engineer (DAE) in Mechatronics Technology
Qualification Stream	Technical
Duration of Course	3-Years (Annual System)
Total Training Credit Hours	69
Entry Level	Matric with Sc.
Annual intake	As approved by the respective TEVTA
Time Allocation	Theory 40% : Practical 60%
Instructional Medium	English / Urdu

PROGRESSION ROUTE FOR HIGHER QUALIFICATIONS

The progression routes for higher qualifications up to Ph. D degree are illustrated below for students starting with DAE qualification in the field of Mechatronics & Industrial Automation:



CURRICULUM DELIVERY SCHEDULE

YEAR - I

Week	Curriculum Delivery	Co-curriculum Activities / Vacations/ Mid Examination	Prep Holidays and Annual Examination	Total
Number	1-16 & 19-34	17-18	35-37	37
Total	32	2	3	

YEAR - II

Week	Curriculum Delivery	Co-curriculum Activities / Vacations/	Prep Holidays and Annual Examination	Total
Number	1-16 & 19-34	17-18	35-37	37
Total	32	2	3	

YEAR - III

Week	Curriculum Delivery	Co-curriculum Activities / Vacations/ Mid Examination	Prep Holidays and Annual Examination	Total
Number	1-16 & 19-34	17-18	35-37	37
Total	32	2	3	

SCHEME OF STUDIES

YEAR I

CODE	TITLE	T	P	C
GEN-111	Islamiat&PakistanStudies	1	0	1
ENG-112	English	2	0	2
MATH-123	AppliedMathematics-I	3	0	3
PHY-122	AppliedPhysics	1	3	2
CH-112	Applied Chemistry	1	3	2
MECH-163	BasicEngineeringDrawing &CAD-I	1	6	3
MTR-113	Introduction to Computer Studies & Programming	2	3	3
MTR-121	IntroductiontoMechatronics&IndustrialAutomation	1	0	1
MTR-132	Electrical Essentials & Networks	1	3	2
MTR-143	WorkshopPractice (a) MetalWorkandMachining (b) Materials Joining (e.g. Soldering) (c) ElectricWiring	1	6	3
MTR-151	Occupational Health Safety & Environment	1	0	1
Total		15	24	23

YEAR II				
CODE	TITLE	T	P	C
GEN-211	Islamiat&PakistanStudies	1	0	1
MATH-212	AppliedMathematics-II	2	0	2
MGM-212	BusinessCommunication&ReportWriting	1	3	2
MTR-202	EngineeringMaterials	1	3	2
MTR-213	Drives&Linkages	2	3	3
MTR-222	Sensors&Actuators	1	3	2
MTR-233	Motors&Generators	2	3	3
MTR-253	Instrumentation & Measureme t	2	3	3
MTR-263	Electronic Devices & Circuits	2	3	3
MTR-272	Digital Logic Design	1	3	2
Total		15	24	23
YEAR III				
CODE	TITLE	T	P	C
GEN-311	Islamiat&Pakistan Studies	1	0	1
MGM-311	IndustrialManagement & Human Relations	1	0	1

MTR-303	Microprocessors&Micro-Controllers	2	3	3
MTR-312	Hydraulics&Pneumatics	1	3	2
MTR-323	ProgrammableLogicControllers	2	3	3
MTR-333	Computer Integrated Manufacturing	2	3	3
MTR-343	IndustrialRobotics	2	3	3
MTR-352	EmergingMechatronics&AutomationTechnologies	2	0	2
MTR-362	Manufacturing Technology & Practices	1	3	2
Pht-341	Entrepreneurship	1	0	1
MTR-392	Project	0	6	2
Total		15	24	23

YEAR - 1

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 شأن قوم علی ان لا تعدلوا
- 1.4 ان اللہ یا مرمکم ان تودوا الامانات الی اهلها
- 1.5 ان اللہ یا مرم بالعدل والاحسان
- 1.6 ان الصلوٰۃ تنہی عن الفحشاء وامنکر
- 1.7 لقد کان لکم فی رسول اللہ سوة حسنة
- 1.8 ان اکرمکم عند اللہ اتقاکم
- 1.9 وما آتاکم الرسول فخرز و ما نہی عنہوا نتهوا
- 1.10 و او فو بالعہد
- 1.11 و ما شروہن بالمعروف
- 1.12 یمحق اللہ الربو ویربى الصمدقات
- 1.13 و اصبر علی ما اصابک
- 1.14 و قولو لا سدیدنا
- 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 امنت بالله سلم استقم
- 6- خير كم خير كم لا اله
- 7- سباب المسلم فسوق وقتاله كفر
- 8- المومن اخو المومن
- 9- كل المسلم على المسلم حرام بمعه وماله وفرقه
- 10- ايتيه المنافق ثلاث اذا حديث كذب وافا او تمن خان واذا وفدا خلف

دين اسلام

2.1 اسلام کے بنیادی مقاصد کی وضاحت اور انسان کی انفرادی و اجتماعی زندگی پر ان کے اثرات

1- توحید

2- رسالت

3- آخرت

4- ملائکہ

5- آسمانی کتب

2.2 عبادات

1- نماز 2- روزہ 3- حج 4- زکوٰۃ

مندرجہ بالا عبادات کی اہمیت و فضیلت، حکمتیں اور انسان کی انفرادی و معاشرتی زندگی پر اس کے اثرات

تدریسی مقاصد

۱- 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 مکی 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

۲- 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
- ☆ منتخب احادیث نبویہ

- ۳- 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 (سہل اول)

تدریسی مقاصد

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

خصوصی مقاصد: طالبِ اس علم سے اس قاتل 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

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 - مدرستہ 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

- ☆ محمد بن قاسم کے ہندوستان پر حملہ کی وجہ بیان کر سکے
- ☆ محمد بن قاسم کے ہندوستان پر حملہ کے اثرات بیان کر سکے
- ☆ بیان کر سکے کہ ہندوستان میں ہندو مسلم دو قومی نظریہ کا نکتہ آغاز کیا ہے
- ☆ مجدد الف ثانی کی علمی خدمات بیان کر سکے
- ☆ شاہ ولی اللہ کی علمی خدمات بیان کر سکے
- ☆ مجدد الف ثانی اور شاہ ولی اللہ نے جو تبلیغ دین اور مسلمانوں میں سیاسی شعور پیدا کیا اسے بیان کر سکے

علمی تحریکیں

عمومی مقصد

- ☆ برصغیر کی علمی تحریکوں سے آگاہی حاصل ہو سکے
- ☆ خصوصی مقاصد:
- ☆ علی گڑھ - دیوبند - ندوۃ العلماء مدرسۃ السلام - اسلامیہ کالج - انجمن حمایت اسلام نے تعلیم کے ذریعہ سیاسی شعور مسلمانوں میں پیدا کیا اسے بیان کر سکے
- ☆ آزادی ہند کے سلسلہ میں تحریک مجاہدین کی خدمات بیان کر سکے

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

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

ENG-112 ENGLISH

INSTRUCTIONAL OBJECTIVES

PAPER-A

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

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

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.

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

APPLIES RULES OF TRANSLATION

- 1 Describe confusion.
- 2 Describe rules of translation.
- 3 Use rules of translation from Urdu to English in simple paragraph and sentences.

Math-123 APPLIED MATHEMATICS-I

T	P	C
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

Solve problems of Algebra, Trigonometry, vectors, Mensuration, Matrices and Determinants.

Develop skill, mathematical attitudes and logical perception in the use of mathematical instruments as required in the technological fields.

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 | |
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 | | |
| 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 Intercoversion of numbers
- 10.5 OR Gates and AND Gates
- 10.6 Logical Expressions and their simplifications
- 10.7 Demorgan's Theorems
- 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, TahirHameed, Syed TanvirHaider, Javed Iqbal, Vol - I, National Book Foundation

INSTRUCTIONAL OBJECTIVES

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.

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.

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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.

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.

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.

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.

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.

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.

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 complementation 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

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.

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.

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.

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

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

Phy-122 APPLIED PHYSICS

INSTRUCTIONAL OBJECTIVES

USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS

- 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.

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

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

USE CONCEPTS OF TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA TO PRACTICAL SITUATIONS/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.

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.

Phy-122 APPLIED PHYSICS

LIST OF PRACTICALS

- Draw graphs representing the functions:
- $y=mx$ for $m=0, 0.5, 1, 2$
 - $y=x^2$
 - $y = 1/x$
- Find the volume of a given solid cylinder using Vernier calipers.
- Find the area of cross-section of the given wire using micrometer screw gauge.
- Prove that force is directly proportional to (a) mass, (b) acceleration, using Fletcher's trolley
- Verify law of parallelogram of forces using Gravesands apparatus.
- Verify law of triangle of forces and Lami's theorem
- Determine the weight of a given body using
- Law of parallelogram of forces
 - Law of triangle of forces
 - Lami's theorem
- Verify law of polygon of forces using Gravesands apparatus.
- Locate the position and magnitude of resultant of like parallel forces.
- Determine the resultant of two unlike parallel forces.
- Find the weight of a given body using principle of moments.
- Locate the centre of gravity of regular and irregular shaped bodies.
- Find Young's Modulus of Elasticity of a metallic wire.
- Verify Hooke's Law using helical spring.
- Study of frequency of stretched string with length.
- Study of variation of frequency of stretched string with tension.
- Study resonance of air column in resonance tube and find velocity of sound.
- Find the frequency of the given tuning fork using resonance tube.
- Find velocity of sound in rod by Kundt's tube
- 20, Verify rectilinear propagation of light and study shadow formation.
- Study effect of rotation of plane mirror on reflection.
- Compare the refractive indices of given glass slabs.
- Find focal length of concave mirror by locating centre of curvature.
- Find focal length of concave mirror by object and image method
- Find focal length of concave mirror with converging lens.
- Find refractive index of glass by apparent depth.
- Find refractive index of glass by spectrometer.
- Find focal length of converging lens by plane mirror.
- Find focal length of converging lens by displacement method.
- Find focal length of diverging lens using converging lens.
- Find focal length of diverging lens using concave mirror.
- Find angular magnification of an astronomical telescope.
- Find angular magnification of a simple microscope (Magnifying Glass)
- Find angular magnification of a compound microscope.

Study working and structure of camera.
 Study working and structure of sextant.
 Compare the different scales of temperature and verify the conversion formula.
 Determine the specific heat of lead shots.
 Find the coefficient of linear expansion of a metallic rod.
 Find the heat of fusion of ice.
 Find the heat of vaporization.
 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;

Understand the significance and role of chemistry in the development of modern technology.

Become acquainted with the basic principles of chemistry as applied in the study of relevant Technology.

Know the scientific methods for production, properties and use of materials of industrial & technological significance.

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

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

**Ch-112 APPLIED CHEMISTRY
INSTRUCTIONAL OBJECTIVES**

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

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

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

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

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

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

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

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

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

UNDERSTAND THE NATURE AND IMPORTANCE OF PLASTICS POLYMERS

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

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

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
- J2.5 Describe methods to prevent/control corrosion

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

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

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

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

- ### **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

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

Mech-163BASIC ENGINEERING DRAWING & CAD-I

Total Contact Hours

Theory:	32Hours	T	P	C
Practical:	192Hours	1	6	3

Pre-requisites:None

AIMS: At the end of this course the students will be able to understand the *Fundamentals of Engineering Drawing* with specific reference to the Mechanical/Mechatronic Technology. The students shall become familiar with the use of conventional drawing equipment as well as the modern techniques (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.

Course Contents

PART-A Manual Drawing 70%

- | | |
|--|---|
| <p>1.</p> <p>ATION OF TECHNICAL DRAWING</p> <p>1.1 Importance of Technical Drawing</p> <p>1.2 Language of engineering terminology</p> <p>1.3 Uses of Technical Drawing</p> <p>1.4 Type of Drawing</p> <p>1.5 Application of Technical drawing</p> | <p>APPLICA</p> <p>2HOURS</p> |
| <p>2.</p> <p>G EQUIPMENT, CONSTRUCTION USES, AND CARE</p> <p>2.1. Introduction and importance of drafting equipment</p> <p>2.2. List of drawing equipment</p> <p>2.3. Construction, uses and care of all equipment</p> <p>2.4. Drafting board, Table and machine</p> <p>2.5. Tee, Triangles and protractors</p> <p>2.6. Instruments Box and its accessories</p> <p>2.7. Drawing Pencil, their grading, sharpening and using techniques</p> <p>2.8. Scale and its types</p> | <p>DRAFTIN</p> <p>2 HOURS</p> |
| <p>3.</p> <p>OF LINES</p> <p>3.1. Basic lines</p> <p>3.2. Importance of lines</p> <p>3.3. Common Types of lines</p> <p>3.4. Uses and correct line weight age</p> <p>3.5. Use of pencil for different lines</p> <p>3.6. Application of lines</p> <p>3.7. Objectives in drafting</p> | <p>TYPES</p> <p>2 HOURS</p> |

4.	NG	LETTERI 2HOURS
	<ul style="list-style-type: none"> 4.1. Importance of a good lettering 4.2. General Proportion of lettering 4.3. Composition of letters 4.4. Guide lines 4.5. Classification of lettering 4.6. Style of letters 4.7. Lettering devices 	
5.	G GEOMETRY	DRAFTIN 2HOURS
	<ul style="list-style-type: none"> 5.1. Introduction to geometry, plane and solid type 5.2. Definition of terms 5.3. Different conventional shapes, surfaces and objects 5.4. Basic geometrical construction 	
6.	NG AND SHAPE DESCRIPTION	SKETCHI 2 HOURS
	<ul style="list-style-type: none"> 6.1. Introduction to sketching techniques 6.2. Techniques of sketching straight lines in different directions 6.3. Sketching circles and arcs 6.4. Sketching Ellipse 6.5. Sketching of pictorial views 6.6. Proportions in sketching 	
7.	ENGINEERING CURVES	2 HOURS
	<ul style="list-style-type: none"> 7.1. Introduction to the curve 7.2. Application of engineering curves 7.3. Cone and conic section 7.4. Spiral and Involute 7.5. Cycloid, Epicycloids, Hypocycloid 	
8.	CTION TO MULTI-VIEW DRAWINGS	INTRODU 3 HOURS
	<ul style="list-style-type: none"> 8.1. Introduction to the plane and its types 8.2. Dihedral and Trihedral angles 8.3. Projection of point, lines, plane and solids 8.4. Definition and concept of multi-view drawings 8.5. Perceptual views of plan of projections 8.6. Orthographic projections 8.7. 1st angle and 3rd angle projection 8.8. Principal views and its arrangements 8.9. Multi-view drawings and missing lines 	

9. INTRODUCTION TO PICTORIAL DRAWING 3 HOURS

- 9.1. Uses of pictorial /3D
- 9.2. Three types of pictorial views
- 9.3. Isometric sketching of rectangular block with Arcs and circles
- 9.4. Oblique sketching of rectangular block
- 9.5. One point perspective sketching of rectangular block
- 9.6. Two points perspective sketching of rectangular block
- 9.7. Preparation of pictorial drawings of simple objects

10. BASIC DIMENSIONING 2HOURS

- 10.1. Definition of dimensioning
- 10.2. Types of dimensioning
- 10.3. Elements of dimensioning
- 10.4. System of measurements
- 10.5. Dimensioning of multi view drawing
- 10.6. Dimensioning pictorial views
- 10.7. Dimensioning rules and practices
- 10.8. Note & specification

11. INTRODUCTION TO MULTI-VIEW DRAWINGS 2HOURS

- 11.1. Introduction to the surface development
- 11.2. Role of development in Packaging Industry
- 11.3. Methods to develop the surfaces
- 11.4. Geometrical solids and development

PART- B AUTOCAD MECHANICAL 2010 (OR) PRO-E

30%

1. Introduction of AutoCAD Mechanical 2010 2Hrs

- 1.1. User Interface
- 1.2. Template
- 1.3. Layers and Object
- 1.4. Mechanical Structure

2. Drawing and Edit 3Hrs

- 2.1. Object Snap
- 2.2. Drawing Command
- 2.3. Edit Command

2.4.	Object Command	
3.		Layers
		1Hr
3.1.	Layers	
4.		Dimension
		2Hrs
	and Symbols	
4.1.	Create Dimension	
4.2.	Edit Dimension	
4.3.	Create Symbols	
5.		Drawing
		2Hrs
	Layout	
5.1.	Make Layout	
5.2.	Create Drawing Frame	
5.3.	Create Contents and Template	

RECOMMENDED BOOKS:

Mechanical Drawing (12th Edn.): French. Svensen, Helsel and Urbanick

Drafting Fundamentals: Scot. Foy, Schwendan

Engineering Drawing and Design 2nd Edn.: Cecil Jenson / Jay Helsel

Engineering Drawing: Colin Simmous, Dennis Maguire

Technical Drawing: Frederik E. Alva & Henry Cecil

Text Book of Machine Drawing: R.K. Dhawan

Engineering Drawing: M.B. Shah & B.C. Rana

Autodesk Official Training Courseware (AOTC) Volume 1

Autodesk Official Training Courseware (AOTC) Volume 2

Learning PRO/Manufacturing Using PRO/CREO Elements: M.M. Janjua

Mech-163BASIC ENGINEERING DRAWING & CAD

Instructional Objectives:

KNOW THE APPLICATION OF TECHNICAL DRAWING

- 1.1 Describe the technical drawing and its importance
- 1.2 Describe the role of Inventor, Engineer, Designer, Technician, Craftsman etc.
- 1.3 Describe the uses of drawing in manufacturing and construction fields
- 1.4 Describe the free hand and instrumental drawing
 - 1.4.1 Explain the types of instrumental drawing
 - 1.4.2 Describe Multi-view, Pictorial and Schematic drawing
- 1.5 Recognize the different application of technical drawing

KNOW AND USE THE COMMON DRAFTING EQUIPMENT AND ACCESSORIES

- 2.1 Explain the introduction and importance of drafting equipment
- 2.2 Identify the different instruments used in drafting
- 2.3 Describe the construction, uses and care of all equipment
- 2.4 Describe the Drafting Board, Table and Drafting machine
- 2.5 Explain the Tee, Triangles and Protractor
- 2.6 Describe the Compasses Divider, Lengthening Bar, Attachments etc.
- 2.7 Describe the use of pencils, their Grading and sharpening techniques
- 2.8 Explain the scale and its different types

UNDERSTAND THE TYPES OF LINES, CORRECT WEIGHTAGE & THEIR APPLICATION IN TECHNICAL DRAWINGS

- 3.1 Describe the point, line and types of straight lines

- 3.2 Describe the importance of lines
- 3.3 Describe the common types of lines
- 3.4 Identify the each line Characteristics
- 3.5 Describe Horizontal, Vertical and inclined lines with proper grade pencil
- 3.6 Describe each line with his correct weight
- 3.7 Describe the objectives in drafting, Accuracy, Speed, Legibility and Neatness

APPLIES THE GOOD LETTERING ON A DRAWING

- 4.1. Know the importance of good lettering in Engineering drawing
- 4.2. Know the general proportion of lettering such as normal, condensed and extended lettering
- 4.3. Describe and Identify the composition of letters
 - 4.3.1. Perform the best spacing between letters and words
 - 4.3.2. State the size and stroke of a letter
- 4.4. Describe the Guide lines
- 4.5. Describe the Gothic, Roman and free hand lettering
 - 4.5.1 Print single stroke, Double stroke lettering, Light face, Bold face lettering, Upper case, Lower case lettering
- 4.6. Print vertical and Inclined style of Gothic lettering
 - 4.6.1 State the proper pencil for lettering with holding techniques
 - 4.6.2 Describe the general rules for lettering
- 4.7. Describe and use of different lettering devices such as lettering guide and lettering instrument

APPLY DRAWING SKILL WITH THE AID OF DRAWING INSTRUMENTS IN GEOMETRICAL CONSTRUCTION

- 5.1 Define the concept of common terms used in Geometrical construction
- 5.2 Explain different geometrical shapes, surfaces of objects
- 5.3 Bisecting a line, angles
- 5.4 Describe basic geometrical constructions
 - 5.4.1 Define Triangles, Quadrilateral, Polygons
 - 5.4.2 Name and draw the parts of circle

UNDERSTAND SKETCHING OF CIRCLES, ARCS AND VIEW OF OBJECTS

- 6.1 Describe sketching material
- 6.2 State Sketching Technique of Horizontal, Vertical and inclined lines
- 6.3 Describe circular arc using circular line method
 - 6.3.1 Draw a circular arc using square method
- 6.4 Draw an ellipse using rectangular method
- 6.5 Described the sketching of pictorial views
- 6.6 Proportions in sketching of views
 - 6.6.1. Enlargement and Reduction

KNOW & DRAW THE DIFFERENT ENGINEERING CURVES USED IN VARIOUS MECHANISMS

- 7.1 Describe the different engineering curves
- 7.2 Describe the application of different Engineering curves
- 7.3 Define cone and conic sections
 - 7.3.1 Describe the Ellipse, Parabola & Hyperbola by different methods
- 7.4 Define the Archimedean Spiral and involutes
 - 7.4.1 Define the Involute curves of square, Triangle, Circle and Hexagon
- 7.5 Describe the Cycloid curves
 - 7.5.1 Define Cycloid, Epicycloids and Hypocycloid curves

UNDERSTAND THE MULTI-VIEW PROJECTIONS OF SPECIFIC OBJECT

- 8.1 Describe the plane and its types
- 8.2 Define Dihedral and Trihedral angles
- 8.3 Explain the projection of point, lines, plane and solids in different shapes
- 8.4 Define the concept of multi-view drawings
- 8.5 Knows Plane of projections
- 8.6 Know the orthographic method of projection
- 8.7 Explain the 1st and 3rd angle projections
- 8.8 State six principal views
- 8.9 Practice of multi-view projections and missing lines

APPLY THE USE, TYPES AND METHODS OF PICTORIAL VIEWS

- 9.1 Describe the importance of pictorial views
- 9.2 State three types of pictorial drawings
- 9.3 Describe isometric view of rectangular blocks, arcs, circles
- 9.4 Describe oblique sketching of a rectangular blocks
- 9.5 Describe one point perspective view of rectangular block
- 9.6 Describe two point perspective view of a rectangular block
- 9.7 Prepare/draw pictorial drawings of simple objects

APPLY GOOD DIMENSIONING ON MULTI-VIEW & PICTORIAL DRAWINGS

- 1.1. Define dimensioning
- 1.2. Identify the types of dimensioning
- 1.3. Enlist the elements of dimensioning
- 1.4. Identify the system of measurements
- 1.5. Indicate complete dimension on multi-view drawings

- 1.6. Indicate complete dimension on pictorial drawings
- 1.7. Follow the general rules of dimensioning
- 1.8. Indicate notes and specification on multi-view drawings

KNOW THE SURFACE DEVELOPMENT & THEIR PROCEDURE TO DEVELOP & ITS ROLE IN AN INDUSTRY (FOR EXAMPLE PACKING INDUSTRY)

- 1.1. Define the surface development
- 1.2. Explain the role of development in Packaging Industry
- 1.3. Describe the methods to draw the development
 - 1.3.1 Parallel line or Rectangle method
 - 1.3.2 Radial line or Triangle method
 - 1.3.3 Triangulation method
- 1.4. Define and draw the different Geometrical solids and their development

PART B: AutoCAD

Introduction of AutoCAD Mechanical 2010

- 1.1 User Interface
- 1.2 Understand Template
- 1.3 Understand Layers and Object
- 1.4 Understand Mechanical Structure

Drawing and Edit

- 2.1 Understand the Object Snap
- 2.2 State the Drawing Command
- 2.3 Understand the Edit Command
- 2.4 Describe the Object Command

Layers

- 14.1. Describe the creation and modifying Layers

Dimension and Symbols

- 4.1 Understand create Dimension
- 4.2 Understand create editing Dimension
- 4.3 Understand create Symbols

Drawing Layout

- 5.1 Understand creation of Layout
- 5.2 Understand creation of Drawing Frame
- 5.3 Understand creation of Contents and Template

Mech-163 Basic Engineering Drawing & CAD-I

LIST OF PRACTICAL:

PART-A

- Practice of single stroke capital vertical lettering on graph and drawing sheet
- Practice of single stroke capital inclined lettering on graph and drawing sheet
- Practice of single stroke capital vertical & inclined lettering
- Double stroke lettering
- Use of Tee-square and set squares for drawing horizontal, vertical and inclined lines
- Use of compass, circles, half circles, radius
- Use of Tee-square and compass for drawing of lines, centers, curves, and crossing of lines
- Draw round corners, figure inside and outside circle
- Construction of angles and triangles
- Construction of quadrilaterals and circles elements
- Construction of parallel-lines, perpendicular, bisects line, angles and equal division of lines
- Construction of inscribe and circumscribe figures (square, triangle and hexagon)
- Construction of pentagon by different methods
- Construction of Hexagon, Octagon, by general and different methods
- Construction of Tangents of circles (Inside & Outside)
- Construction of Ellipse by four different methods
- Construction of parabola curve by four different methods
- Construction of hyperbola curve
- Construction of Archimedean Spiral curve
- 20. Construction of involutes curve of square rectangle hexagon and circle
- Construction of cycloid, epicycloids, and hypocycloid
- Different types of drawing lines

Orthographic projection 1 and 3rd angle wooden block-1
Orthographic projection 1 and 3rd angle wooden block-2
Orthographic projection 1 and 3rd angle wooden block-3
Orthographic projection 1 and 3rd angle wooden block-4
Orthographic projection 1 and 3rd angle wooden block-5.
Orthographic projection and Isometric Drawing-I
Orthographic projection and Isometric Drawing-II
Orthographic projection and Oblique Drawing-I
Orthographic projection and Oblique Drawing-II
Construction of perspective drawings. (One point)
Construction of perspective drawings. (Two point)
Construction of multi view drawing of Gland
Construction of multi view drawing of Simple Bearing
Construction of multi view drawing of Open Bearing
Missing lines and portions on given views-I
Missing lines and portions on given views-II
Development of prism-I
Development of prism-II
Development of cylinder
Development of cone
Development of pyramid-I
Development of pyramid-II

PART-B

Starting AutoCAD Mechanical 2010 / PRO-E
Title Bar, Tool Bar, Menu Bar, Browser, Status Bar, Command Line
Zoom, Pan, Orbit
Object Snap, Grid, Orthogonal
Layer and Object Property
Construction Line and Center Line
Save AutoCAD Mechanical 2010
Line and Poly line Command
Circle, Arc and Ellipse Command
Rectangular and Polygon Command
Dimension and Hatching
Text Command
Copy, Mirror Command
Offset Command
Move, Rotate and Scale Command
Trim and Extend Command
Join and Break Command
Fillet and Chamfer Command
Explode Command
Exercise of Basic Drawings
Exercise of Mechanical Drawings.

MTR-113**Introduction to Computer Studies & Programming**

Total Contact Hours	160	T	P	C
Theory Hours:	64			
Practical Hours:	96	2	3	3

Aims

To gain a good understanding of the computer architect and related terminologies

To know about various hardware items and their functions

To learn basic techniques required for computer operations & running commonly used application packages

To introduce the basic concepts of programming and writing algorithms

To develop ability to solve problems using computing/ programming techniques

Course Contents**INTRODUCTION TO COMPUTER SYSTEM**

- 1.1. History of Computing
- 1.2. Generations of Computers
- 1.3. Computers for individuals

3 Hours

- 1.4. Computers for organizations
- 1.5. Applications of Computers

INTERFACING DEVICES

- 2.1. Keyboard
- 2.2. Mouse
- 2.3. Light Pen
- 2.4. Touch Screens
- 2.5. Game Controllers
- 2.6. Bar Code Reader
- 2.7. Image Scanner
- 2.8. Monitors and types
- 2.9. Data projectors
- 2.10. Speakers
- 2.11. Printers and types

7 Hours

DATA PROCESSING

- 3.1. Data Representation
 - 3.1.1. Number System
 - 3.1.2. Text Code
- 3.2. Data processing
 - 3.2.1. CPU
 - 3.2.2. Memory
- 3.3. Define following terms
 - 3.3.1. Registers
 - 3.3.2. Data Bus
 - 3.3.3. Address Bus
 - 3.3.4. Cache Memory

6 Hours

STORING DATA

- 4.1. Types of Storage Devices
 - 4.1.1. Magnetic Storage Media
 - 4.1.2. Optical Storage Media
 - 4.1.3. Solid State Storage Media

6 Hours

OPERATING SYSTEM

- 5.1. Introduction of Operating System and its function
- 5.2. List of current Operating Systems
 - 5.2.1. DOS
 - 5.2.2. Microsoft Operating System
 - 5.2.3. The Macintosh Operating System
 - 5.2.4. UNIX
 - 5.2.5. Linux
 - 5.2.6. Operating systems for Server (Windows/UNIX)

6 Hours

NETWORKS

- 6.1. Introduction to NETWORKS
- 6.2. Common Types of Networks
 - 6.2.1. Local Area Networks (LANs)
 - 6.2.2. Wide Area Networks (WANs)
 - 6.2.3. Hybrid Networks
 - 6.2.3.1. CANs
 - 6.2.3.2. MANs
 - 6.2.3.3. HANs
 - 6.2.3.4. Intranets & Extranets

NETWORK TOPOLOGIES

- 7.1 Network Medias
 - 7.1.1 Wired-Based Media
 - 7.1.2 Wireless Media
- 7.2 Network Hardware
 - 7.2.1 Network Cards
 - 7.2.2 Network Linking Devices
 - 7.2.2.1 Hubs
 - 7.2.2.2 Bridges
 - 7.2.2.3 Routers
 - 7.2.2.4 Switches

5 Hours

DATA COMMUNICATIONS

- 8.1 Modems
- 8.2 DSL
- 8.3 Wireless Networks

8. APPLICATION SOFTWARE

- 8.1 Introduction to Application Software
 - 8.1.1 Commercial Software
 - 8.1.2 Freeware Software
 - 8.1.3 Open Source Software
- 8.2 Word Processing Programs
 - 8.2.1 Word Processing Interface
 - 8.2.2 Entering and Editing Text
 - 8.2.3 Formatting Text
 - 8.2.4 The Spreadsheet Interface
 - 8.2.5 Entering data in a Worksheet

16 Hours

- 8.2.6 Presentation Programs
- 8.2.7 Presentation Program Interface
- 8.2.8 Slide Layouts and Design

9. INTERNET

- 9.1 What is the Internet
- 9.2 History of Internet
- 9.3 Working of World Wide Web
- 9.4 Internet Search Engines

3 Hours

10. PROGRAMMING LANGUAGES

- 10.1 Computer Program
- 10.2 Components of a computer program
- 10.3 Compilers and Interpreters
- 10.4 Programming Categories
 - 10.4.1 Machine Language
 - 10.4.2 Assembly Language
 - 10.4.3 Higher-Level Language
- 10.5 Data types
- 10.6 Arithmetic operations and functions
- 10.7 Assignment statement
- 10.8 Input/output statements
- 10.9 Syntax errors
- 10.10 Logical statements
- 10.11 Loops and decisions
- 10.12 Functions
- 10.13 Recursion
- 10.14 Arrays
- 10.15 Declaring arrays
- 10.16 Manipulating arrays
- 10.17 Searching an array
- 10.18 Sorting arrays

12 Hours

RECOMMENDED BOOKS

Peter Norton, *Introduction to Computers*, The McGraw-Hill

Robert Lafore, *Object Oriented Programming in C++*

Tony Gaddis, Judy Walters, Godfrey Muganda, *Starting Out with C++*

Deitel and Deitel, *Introduction to C++*

Gary B. Shelly, Steven M. Freund and Misty E. Vermaat: *Introduction to Computers*,

- Shelley Cashman Series, (2010)
6. Michael Miller, Absolute Beginner's Guide to Computer Basics: 5th Edition, (2009)

MTR-113	Introduction to Computer Studies & Programming
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INSTRUCTIONAL OBJECTIVES

INTRODUCTION TO COMPUTER SYSTEM

1.1 Describe the History of Computing

- 1.1.1 ABACUS
- 1.1.2 Napier's Bone
- 1.1.3 Slide Rule
- 1.1.4 Pascal's and Leibniz's Calculators
- 1.1.5 Babbage's Analytical Engine

1.2 Explain the Evolution of Computers' Generations

- 1.2.1 First Generation (1946-1959): Vacuum tube based.
- 1.2.2 Second Generation (1959-1965): Transistor based.
- 1.2.3 Third Generation (1965-1971): Integrated Circuit based
- 1.2.4 Fourth Generation (1971-1980): VLSI microprocessor based.
- 1.2.5 Fifth Generation (1980-onwards): ULSI microprocessor based

1.3 Explain Use of Computers for Individuals

- 1.3.1 Desktop Computers
- 1.3.2 Notebook Computers
- 1.3.3 Tablet PCs
- 1.3.3 Handheld PCs (PDAs)
- 1.3.4 Smart Phones

1.4 Explain Use of Computers For Organizations

- 1.4.1 Network Servers
- 1.4.2 Mainframes
- 1.4.3 Minicomputers
- 1.4.4 Super Computers

1.5 Describe the Applications of Computers in following fields:

- 1.5.1 Home
- 1.5.2 Education
- 1.5.3 Business
- 1.5.4 Industry
- 1.5.5 Government

INTERFACING DEVICES

- 2.1 State the purpose of Keyboard
- 2.2 State the purpose of Mouse
- 2.3 State the purpose of Light Pen
- 2.4 State the purpose of Touch Screens
- 2.5 State the purpose of Game Controllers
- 2.6 State the purpose of Bar Code Reader
- 2.7 State the purpose of Image Scanner
- 2.8 State the purpose of Monitors and types
 - 2.8.1 CRT Monitors
 - 2.8.2 Flat Panels
 - 2.8.3 Other types
 - 2.8.4 State the purpose of Data projectors
 - 2.8.5 State the purpose of Speakers
 - 2.8.6 State the purpose of Printers and types
 - 2.8.6.1 Dot Matrix Printers
 - 2.8.6.2 Ink Jet Printers
 - 2.8.6.3 Laser Printers
 - 2.8.6.4 Plotters

DATA PROCESSING

- 3.1 Describe Data Representation in Computer
- 3.2 Explain the Number System
 - 3.2.1 Decimal, Binary, Octal & Hexadecimal
 - 3.2.2 Bit & Byte
- 3.3 What are the Text Codes
 - 3.3.1 BCDIC
 - 3.3.2 EBCDIC
 - 3.3.3 ASCII
 - 3.3.4 Extended ASCII
 - 3.3.5 Unicode

- 3.4 Explain the parts required for data processing
- 3.5 Describe the components of CPU
 - 3.5.1 The Control Unit
 - 3.5.2 The Arithmetic Logic Unit
 - 3.5.3 The Machine Cycle
- 3.6 Explain the types of Memories
 - 3.6.1 Nonvolatile Memory
 - 3.6.2 Flash Memory
 - 3.6.3 Volatile Memory
- 3.7 Define following terms
 - 3.7.1 Registers
 - 3.7.2 Data Bus
 - 3.7.3 Address Bus
 - 3.7.4 Cache Memory

STORING DATA

- 4.1 Explain the Types of Storage Devices
- 4.2 Describe the types of Magnetic Storage Media
 - Diskettes
 - Hard Drives
 - Describe the types of Optical Storage Media
 - CD-ROM, CD-R, CD-RW
 - DVD-ROM, DVD-R, DVD-RAM
- 4.3 Describe the types of Solid State Storage Media
 - Flash Memory
 - Smart Cards
 - Solid State Disks

OPERATING SYSTEM

- 5.1 Define operating system and explain its functions
- 5.2 Describe the current Operating Systems
 - DOS
 - Microsoft Operating System
 - The Macintosh Operating System
 - UNIX
 - Linux
 - Operating systems for Server (Windows/UNIX)

NETWORKS

- 6.1 Explain the use of NETWORKS
- 6.2 Identify and explain the Common Types of Networks
 - 6.2.1 Local Area Networks (LANs)
 - 6.2.2 Wide Area Networks (WANs)
 - 6.2.3 Hybrid Networks
 - 5.2.3.1 CANs

- 6.2.2.2 MANs
 - 6.2.2.3 HANs
 - 6.2.2.4 Intranets & Extranets
- 6.3 Briefly Explain the Network Topologies
- 6.4 Describe the Mediums of Networks
 - 6.4.1 Wired-Based Media
 - 6.4.2 Wireless Media
- 6.5 Describe the Hardware use in Networks
- 6.6 Network Cards
- 6.7 Network Linking Devices
 - 6.7.1 Hubs
- 6.7.2 Bridges
- 6.7.3 Routers
 - 6.7.4 Switches
- 6.8 Explain the Data Communications technologies
 - 6.8.1 Modems
 - 6.8.2 DSL
 - 6.8.3 Wireless Networks

7 APPLICATION SOFTWARE

- 7.1 What is Application Software, Explain its types
 - 7.1.1 Commercial Software
 - 7.1.2 Freeware Software
 - 7.1.3 Open Source Software
- 7.2 What is meant by Word Processing Programs? Explain how to use it.
- 7.3 Explain the Interface of Word Processing Program
 - 7.3.1 Menu Bar
 - 7.3.2 Tool bar
 - 7.3.3 Ruler
 - 7.3.4 Scroll bar
 - 7.3.5 Status bar
- 7.4 Explain the basic of Entering and Editing Text
- 7.5 Explain the Text formatting options
 - 7.5.1 Text Appearance
 - 7.5.2 Text Layout on the page
 - 7.5.3 Use of graphic elements
- 7.6 Explain the Interface of the Spreadsheet
- 7.7 Explain the basic of Entering data in a Worksheet
 - 7.7.1 Labels
 - 7.7.2 Values

- 7.7.3 Dates
- 7.7.4 Formulae
- 7.7.5 What is meant by Presentation Programs
- 7.7.6 Explain the Interface of Presentation Program
- 7.7.7 Describe the Slide Layouts and its Design

8 INTERNET

- 1 What is the Internet?
 - Describe the History of Internet
 - Explain the Working of World Wide Web
 - Explain Internet Search Engines

PROGRAMMING LANGUAGES

- Define a Computer Program
- Explain the Components of a computer program
- Describe the use of Compilers and Interpreters
- Explain the Programming Categories
 - 4.1 Machine Language
 - 4.2 Assembly Language
 - 4.3 Higher-Level Language
- 5. Data types
 - Arithmetic operations and functions
 - Assignment statement
 - Input/output statements
 - Syntax errors
 - Logical statements
 - Loops and decisions
 - Functions
 - Recursion
 - Arrays
 - Declaring arrays
 - Manipulating arrays
 - Searching an array
 - Sorting arrays

LIST OF PRACTICALS

Create a document using a suitable word processing package, like MS Word, with at least three paragraphs and perform editing operations.

Create a formal letter using a suitable word processing package, like MS Word, to place a purchase order for procurement of books. Use tables for list of books.

Create a Spreadsheet in MS-EXCEL and enter the marks of a student, calculate total and print grade if the student has passed in all subjects.

Create a Power-point presentation with at least 6 slides.

Write the program to print some text on the screen.

Practice the correct use of headers and identify different compiler errors
Understanding Variables, Constants, Data Types and sizes

Determine the size, minimum and maximum value following data types. Please specify if your machine is 32 bit or 64 bits in the answer.

char

unsigned char

short

int

unsigned int

unsigned long

float

Write a program to show the logical expressions that tests whether a given character variables are lower case letter

upper case letter

digit

white space (includes space,tab,new line)

Write a program to show the expressions using bitwise operators.

Practice Arithmetic Operations

Practice Relational and Logical Operations.

Practice Conditional Operations.

Practice Loops (for, while, do-while)

Practice Arrays and their manipulation.

Practice to determine output of the given programs

MTR-132		ELECTRICAL ESSENTIALS & NETWORKS			
Total Contact Hours:	128		T	P	C
Theory (Hours):	32		1	3	2

Practical (Hours):	96			
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Aims

- To familiarize students with the basic concepts of electrical circuits and devices
- To enable the students to make/solve basic circuits
- To enable students to use various electrical devices in circuits and know how do these work

COURSE CONTENTS

BASIC CONCEPTS OF ELECTRICITY

1.1 Charge

1.2 Electric Current

1.3 Voltage/Potential Difference

1.4 Work/Energy

1.5 Power

2 Hours

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 Specific resistance, conductance and conductivity

2.2.2 Effect of temperature on resistance and temp. coefficient of resistance

2.2.3 Problems on $R = \frac{\rho l}{A}$ and $R_t = R_o (1 + \alpha t)$

2.2.4 Resistance in series, parallel and series-parallel

2.2.5 Power and Energy their units and calculations

2.2.6 Power dissipation in resistors

2.3 Resistors

2.3.1 Application of resistors

2.3.2 Color coding

2.4 Batteries

2.4.1 Types of DC sources

2.4.2 Types of cells, primary and secondary cells (Mercury, silver oxide, nickel-cadmium, etc)

2.4.3 Lead acid batteries

2.4.4 Solar cell

2.4.5 Internal resistance of a cell

NETWORK THEOREMS.

3.1 Superposition theorem for complex circuits.

3.2 Calculation based on the superposition theorem.

3.3 Thevenin's Theorem circuits simplification.

3.4 Calculation base on the Thevenin's theorem.

3.5 Norton theorem and current source concept.

3.6 Calculation based on the Norton's Theorem.	
MAGNETISM AND ELECTROMAGNETISM 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 ($R=Nd/dt$) 4.2.5 Lenz's law	
ELECTROSTATICS 5.1 Principal of electrostatic, positive and negative charges. 5.2 Laws of electrostatics 5.3 Electrostatic induction and field strength 5.4 Properties of electric line of force and comparison with magnetic lines 5.5 Dielectric, dielectric strength and its importance permeability and break down voltage 5.6 Capacitance and capacitors. Capacitance of parallel plate capacitor 5.7 Equivalent capacitance for series, parallel and series parallel combination of capacitors 5.8 Energy stored in capacitors 5.9 Color code, tolerance and rating of capacitors	
AC FUNDAMENTALS 6.1 The simple AC generator 6.2 Sine wave, cycle, wavelength, period, frequency and units 6.3 AC sine wave form and its characteristics. (Instantaneous, peak, average, rms or effective values and their inter relation) 6.4 Types of alternating wave forms (sinusoidal and non-sinusoidal waves) 6.5 AC circuits 6.6 AC through pure resistor, phasor quantities 6.7 AC through pure inductor, phasor quantities 6.8 AC through pure Capacitor, phasor quantities	

RECOMMENDED BOOKS

Richard C. Dorf and James A. Svoboda, *Introduction to Electric Circuits*

Stan Gibilisco, *Teach Yourself Electricity and Electronics*, 5th Edition (2011)

MTR-132

ELECTRICAL ESSENTIALS & NETWORKS

INSTRUCTIONAL OBJECTIVES

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

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 $R = \frac{\rho l}{A}$ 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
- 2.2.8 Power dissipation in resistors

2.3 Resistors

- 2.3.1 Application of resistors
- 2.3.2 Resistors, color coding

2.4 Batteries

- 2.4.1 Types of DC sources

- 2.4.2 Types of cells, primary and secondary cells (Mercury, silver oxide, nickel-cadmium, etc.)
- 2.4.3 Lead acid batteries
- 2.4.4 Solar cell
- 2.4.5 Internal resistance of a cell

NETWORK THEOREMS.

- 3.1 Superposition theorem for complex circuits.
- 3.2 Calculation based on the superposition theorem.
- 3.3 Thevenin's Theorem circuits simplification.
- 3.4 Calculation base on the Thevenin's theorem.
- 3.5 Norton theorem and current source concept.
 - 3.5.1 Calculation based on the Norton's Theorem.

MAGNETISM AND ELECTROMAGNETISM

- 4.1 Understand magnetism
 - 4.1.1 Define lines of force, flux, flux density, permeability, & reluctance
 - 4.1.2 List the unit for the above terms.
 - 4.1.3 Explain the properties of magnetic lines of force
 - 4.1.4 Describe magnetic induction.
- 4.2 To understand electromagnetism
 - 4.2.1 Define electromagnetism
 - 4.2.2 Define magneto-motive force & give its formula and unit
 - 4.2.3 Describe field intensity ($H=AT/L$)
 - 4.2.4 Explain electromagnetic induction
 - 4.2.5 Explain magnetic field around a current carrying conductor
 - 4.2.6 Define inductor

- 4.2.7 Describe solenoids
- 4.2.8 Describe cork screw rule and left hand rule
- 4.2.9 Define faraday's law of electromagnetism induction $\{e=N(d/dt)\}$
- 4.2.10 State Lenz's law

ELECTROSTATICS

5.1 Understand electrostatics

- 5.1.1 Explain the Principal of electrostatic charges.
- 5.1.2 State the effect of negative & positive charges.
- 5.1.3 Describe the laws of electrostatics.
- 5.1.4 Describe the electrostatic induction & field strength
- 5.1.5 Compare the electric and magnetic lines of force
- 5.1.6 Define dielectric & dielectric strength/dielectric constant
- 5.1.7 Describe the importance of dielectric & dielectric strength
- 5.1.8 Describe capacitor and capacitance.
- 5.1.9 Define breakdown voltage
- 5.1.10 Enlist the uses of capacitors
- 5.1.11 Calculate the total capacitance in a series, parallel combination
- 5.1.12 Explain energy stored in a capacitor

AC FUNDAMENTALS

6.1 Understand AC waveform

- 6.1.1 Describe sine wave (cycle, wave length, period, frequency and their units)
- 6.1.2 Draw AC sine waveform (sinusoidal, square, saw-tooth)
- 6.1.3 Describe instantaneous value, peak value, average value, r.m.s value, effective value and their inter-relation

6.2 Understand AC circuits

- 6.2.1 Describe AC through resistors
- 6.2.2 Explain phase angle, in-phase & out of phase waves
- 6.2.3 Explain phase lag & lead
- 6.2.4 Calculate voltage, current & power (v, i, w) for resistive circuit
- 6.2.5 Explain inductive resistance ($X_L = 2\pi fL$), phase relation between voltage & current
- 6.2.6 Draw its phasor diagram
- 6.2.7 Calculate power for pure inductor
- 6.2.8 Calculate power factor for R-L series circuit
- 6.2.9 Calculate time constant for L/R
- 6.2.10 Define impedance
- 6.2.11 Draw impedance triangle
- 6.2.12 Explain AC through pure capacitor
- 6.2.13 Explain phase relation between voltage, current & power for AC through capacitor

ELECTRICAL ESSENTIALS & NETWORKS

MTR-132

INSTRUCTIONAL OBJECTIVES

REVIEWING THE BASIC CONCEPTS OF ELECTRICITY

- 1.1 Understand the concept of Charge
- 1.2 Understand the concept of Electric Current
- 1.3 Understand the concept of Voltage/ Potential Difference
- 1.4 Understand the concept of Work/Energy
- 1.5 Understand the concept of Power
- 1.6 Understand the concept of Electromotive Force
- 1.7 Understand the concept of Resistance
- 1.8 Understand the concept of Capacitance
- 1.9 Understand the concept of Inductance

IDENTIFY THE COMPONENTS OF A BASIC ELECTRICAL CIRCUIT

- 2.1 Define electric circuit and describe its components
 - Power supply
 - Connectors
 - Load
 - Control device (switches)
- 2.2 Describe the types of load (resistive, capacitive, and inductive) and their behavior
- 2.3 Define and describe a network (LAN, WAN, CAN etc) and its topology
- 2.4 Identify the symbols of various circuit components (load, measuring devices, wires, switches, power, diode, battery, capacitor, inductor etc)

UNDERSTAND THE CORRELATION BETWEEN CURRENT, VOLTAGE & RESISTANCE

- 3.1 Understand the concepts of Ohms law and its applications
- 3.2 Understand the concepts of linear approximations
- 3.3 Understand the effects of temperature on resistance
- 3.4 Understand the concept of Resistivity
- 3.5 Understand the concept of internal resistance

DIFFERENTIATE BETWEEN THE TYPES OF CIRCUITS

- 4.1 Define Node, Loop and Branch
- 4.2 Understand the Series Circuits
- 4.3 Understand the Parallel Circuits
- 4.4 Describe the Kirchhoff's Laws (Current and Voltage Law)
 - 4.4.1 Understand how to Solve Circuits
- 4.5 Describe the conservation of energy in series and parallel circuits

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STUDY THE VARIOUS ELECTRICAL DEVICES

5.1 Understand the use of Resistor

5.2 Understand the use and working of Variable Resistor

5.3 Understand the use of Capacitor

5.4 Understand the use of Power Supply

5.5 Understand the use and working of Inductor

5.6 Understand the use and working of Diode

5.7 Understand the use of Relay

5.8 Understand the use of Fuse

5.9 Understand the use and working of Transformer

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NETWORK THEOREMS.

6.1 Understand Superposition, Thevenin & Norton theorems

6.2 Explain Superposition theorem

6.3 Solve problems based on superposition theorem

6.4 Explain Thevenin's theorem

6.5 Solve problems based on Thevenin's theorem

6.6 Explain Norton's theorem

6.7 Solve problems based on Norton's theorem

6.8 Explain transformation of star to delta and delta to star networks

6.9 Solve problems based on star, delta transformation

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UNDERSTAND THE WORKING OF DC/AC CIRCUITS

7.1 Describe DC and AC Current and Voltage

7.2 Understand the concept of Rectification

7.3 Understand the construction and working of an Oscilloscope and its signal forms
Of current and voltage

LIST OF PRACTICALS

Identification of a capacitor, inductor and resistor and how to determine rating

Make a simple circuit to operate a load e.g. a bulb

Demonstrate the effect in Ohms Law with Rise in temperature

Assembly of a series and parallel circuit

Measuring voltage and current by using voltmeter and ammeter in a series and parallel circuit

Demonstrate the use of a Variable resistor

Learn how to use an oscilloscope and its various features

Demonstrate output on a resistive, capacitive and inductive load

Demonstrate using a relay as switch in a circuit

Study DC/AC output waves on an oscilloscope and the rectified wave

Demonstrating the use of a diode

Demonstrating the use of a transformer

Implement and prove the Thevenin's Theorem

Implement and prove the Norton's Theorem

Implement and prove the Superposition's Theorem

Demonstrate the working of an oscilloscope by generating a AC/DC signal on it. Vary the amplitude and wavelength and note the effects

MTR-121

INTRODUCTION TO MECHATRONICS & INDUSTRIAL AUTOMATION

Total Contact Hours:	32	T	P	C
Theory (Hours):	32	1	0	1

AIMS

- To introduce the basic concept of Mechatronics and Industrial Automation.
- To understand the applications of mechatronics in industries.

COURSE CONTENTS

1.Introduction to Mechatronics &Automation 3 Hours

- 1.1 Definition of Mechatronics
- 1.2 Definition of Automation
- 1.3 Significance of Mechatronics and Automation in modern industries
- 1.4 Applications of Mechatronics & Automations
- 1.5 Relationship between Mechatronics and Automation

2. Characteristics of Measuring Devices 3 Hours

- 2.1 Static characteristics
- 2.2Dynamic characteristics
- 2.3 Comparison between static & dynamic characteristics

3.Introduction to CNCMachines

- 3.1 Definition of CNC machines
- 3.2 Types of CNC machines
- 3.3 Element of CNC system
- 3.4 Advantages & Disadvantages of CNC machines
- 3.5 CAD/CAM

5 Hours

Introduction to Sensor and

Transducers 4.1Define Sensor

4.2	Define Transducer	Hours
4.3	Force Transducer	
4.4	Pressure Transducer	
4.5	Motion Transducer	
4.6	Ultrasonic Transducer	4Hours
4.7	Temperature Transducer / Sensor	

Introduction to Actuators

5.1	Definition of Actuator	
5.2	Classification of Actuator	
5.3	Electro pneumatic	
5.4	Servo Motor	4Hours

Case Studies: Applications of Mechatronics

6.1	Case Study 1:Mechatronics Design of Coin Counter	
6.2	Case Study 2:Mechatronics Design Of Automatic Washing Machine	
6.3	Case Study 3:Strain Gauge Based Weighing Machine	4Hours

Standards for Machine Tool

7.1.	Tolerances
7.2.	Fits

8.Introduction to Signal Processing

8.1	Definitions of Analog & Digital Signals
8.2	Conversion of Analog to Digital & Digital to Analog
8.3	Amplifier & Signal Conditioning

RECOMMENDED BOOKS

Introduction to Mechatronics: K.K. Appukuttan, Oxford Higher Education (2007)

S. Cetinkunt, Mechatronics. Hoboken, NJ: Wiley, 2007.

Industrial Automation: Frank Lamb (2013)

Mechatronics: W. Bolton (5th Edition)

Mechatronics HMT Tata McGraw-Hill Education, 1998

Bassily, H., Sekhon, R., Butts, D., and Wagner, J., “A Mechatronics Educational Laboratory – Programmable Logic Controllers and Material Handling Experiments”, 2007.

Material Handling Institute of America (MHIA), www.mhia.org, 2008.

Wagner, J., "Evolving Industry Expectations for Engineers - The Impact of Global Manufacturing", proceedings of the ASEE conference, Charlotte, NC, June 1999.

D. G. Alciatore and M. B. Hstand, Introduction to Mechatronics and Measurement Systems, 3rd ed. New York: McGraw-Hill, 2005.

C. W. De Silva, Mechatronics: An Integrated Approach. Boca Raton, FL: CRC Press, 2004.

G. Onwubolu, Mechatronics: Principles and Applications. London, U.K.: Butterworth-Heinemann, 2005.

INTRODUCTION TO DATA ACQUISITION

Define & Explain the Analog and Digital Signals

Describe the ADC and DAC

Describe the Amplifiers & Signal Conditioning

MTR-143

WORKSHOP PRACTICE

Total Contact Hours: 224

T P C

Theory (Hours): 32

Practical (Hours): 192

1 6 3

AIMS

To familiarize students with workshop layout, sections, tools, equipment and safe working conditions;

To understand commonly employed workshop processes and techniques for repairs and production of parts, components;

To encourage the students to get hands-on experience with machining , metal working, wiring, soldering& Welding etc.

COURSE CONTENTS

1. INTRODUCTION TO WORKSHOP

3Hours

- 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
 - Metal Cutting
 - Forging
 - Rolling
 - Extrusion and Drawing
 - Indenting
 - Shrinking and Stretching
 - Recessing
 - Spinning
 - Shearing and Bending
- 2.3 Introduction to Metal Forming Machines
- 2.4 Metal Working Quality Standards

3. MACHINING

6 Hours

- 3.1 Define Machining
- 3.2 Introduction to Machining Processes & Their Techniques
 - Turning (Rough Turning, Finish Turning)
 - Facing, Parting, Boring
 - Drilling
 - Cutting
 - Tapping&Making Tapers
- 3.3 Introduction to Machining Equipment, Their Working/ Functions
 - Lathe Machine and its Types

Milling Machine and its Types
Shaping Machine
Drilling Machine
3.4 Machining Quality Standards

4. ELECTRIC WIRING

5 Hours

- 4.1 Symbols/Schematics
- 4.2 Electrical Tools
- 4.3 Types of Cables/Wires
- 4.4 Wiring Regulations
- 4.5 Common Electrical Components
- 4.6 Protective Devices
- 4.7 Farthing& Electrical Safety
- 4.8 Measurement and Testing Methods
- 4.9 Common Circuits (Single Way, Two Way, Ringed, Etc.,)
- 4.10 Electrical Wiring Quality Standards

5. SOLDERING

4 Hours

- 5.1 Define Soldering and Different Types of Solders
- 5.2 Common Soldering Tools and Equipment
- 5.3 Method-and Techniques for Soldering
- 5.4 De-Soldering Techniques
- 5.5 Inspection of Soldered Joints
- 5.6 Rectification of Soldered Joints
- 5.7 PCB Soldering: How to Translate a Circuit Onto aPCB?
- 5.8Etching, Drilling and Soldering Component on PCB

6. WELDING & JOINING PROCESSES

8 Hours

- 6.1 Define Welding and Classification of Welding Processes
- 6.2 Welding Machines / Equipment &their Characteristics
- 6.3 Welding Symbols & Common Welding Joints
- 6.4 Methods and techniques for Gas Welding & Electric Arc Welding
- 6.5Advanced Welding Techniques: TIG, MIG, Laser & Electron Beam Welding
- 6.6Weld-ability of Alloys & Selection of Electrodes
- 6.7Inspection of Welded Joints
- 6.8 Mechanical Joining: Riveting
- 6.9 Adhesive Bonding

RECOMMENDED BOOKS

Workshop Technology: William Arthur James Chapman (1954)

Machining Fundamentals: John R. Walker (2004)

Wiring Simplified: Based on 2011 National Electrical Code®:H. P. Richter, W. C. Schwan and F. P. Hartwell (2011)

Learn to Solder: Tools and Techniques for Assembling Electronics: Brian Jepson, Tyler Moskowitz and Gregory Hayes (2012)

MTR-143

WORKSHOP PRACTICE

INSTRUCTIONAL OBJECTIVES

UNDERSTAND HOW A WORKSHOP OPERATES 1.1

Identify the purpose of a workshop and its layout

- 1.2 Describe the major sections of a workshop and the tasks performed therein
- 1.3 Understand the commonly used measurement in industry along with their unit
- 1.4 Identify and describe general tools used in workshop
- 1.5 Understand safety procedures for working in a workshop

KNOW ABOUT THE PROCESS OF 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
- 2.3 Understand the working of various metal forming machines

DESCRIPTION OF MACHINING PROCESSES

- 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)
- 3.3 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

KNOW ABOUT THE PROCESS OF ELECTRIC WIRING

- 4.1 Understand the various electrical symbols/schematics
- 4.2 Identify various electrical tools for electrical wiring
- 4.3 Identify the various types of cables/wires for electrical wiring
- 4.4 Understand the various wiring regulations
- 4.5 Identify the various common electrical components

- 4.6 Describe the protective devices to be used while wiring
- 4.7 Understand the concept of Earthing with reference to electrical safety
- 4.8 Identify the various measurement and testing methods for electrical wiring
- 4.9 Describe the common electrical circuitry (Single way, two way, ringed, etc.)
- 4.10 Identify and describe Electrical Wiring Quality standards

KNOW ABOUT THE PROCESS OF SOLDERING

- 5.1 Define soldering and identify different types of solders
- 5.2 Identify and describe the common soldering tools and equipment
- 5.3 Understand the methods and techniques for soldering
- 5.4 Understand various De-soldering techniques
- 5.5 Understand the different Inspection techniques of soldered joints
- 5.6 Understand how to rectification of a soldered joint
- 5.7 Define Printed Circuits Board (PCB)
- 5.8 Understand the process of making a PCB
- 5.9 Understand PCB soldering
- 5.10 Describe how to translate a circuit onto a PCB
- 5.11 Understand etching, drilling and soldering component on PCB
- 5.12 Identify and Describe Soldering Quality standards

6. KNOW ABOUT THE COMMONLY USED WELDING & JOINING PROCESSES

- 6.1 Define Welding and Classify Welding Processes
- 6.2 Understand the working / Characteristics & functions of various Welding Machines
- 6.3 Describe and Enlist Important Welding Symbols & Common Welding Joints
- 6.4 Methods and techniques for Gas Welding & Electric Arc Welding
- 6.5 Describe TIG, MIG, Laser & Electron Beam Welding Processes
- 6.6 Explain the Weld-ability of Alloys
- 6.7 Explain the Selection Criteria for Electrodes with Reference to Base metal/alloys
- 6.7 Describe various Inspection methods to determine the Integrity of Welded Joints
- 6.8 Describe Mechanical joining including Riveting
- 6.9 Describe commonly employed adhesive joining processes.

MTR-143

WORKSHOP PRACTICES: LIST OF PRACTICALS

Layout & Measurements

18 Hours

Workshop Layout: Sketch a layout of the workshop showing all the important sections such as Machine shop, Metal Working shop, Electrical shop etc. The layout shall include the entrances and exits, the training area, location for work benches, tools Store, machinery etc. [Initially a rough layout shall be drawn on a A-3 sheet while labelling all the important areas and machinery. It should later be submitted in printed form.] Include in your report a brief

description of each section and the relevant safety precautions. **9 Hours**

Taking Measurements: Get yourself familiarize with the working of different measurement tools / equipment. Using the different objects provided, make accurate measurements regarding weight, size/ dimensions, etc. Practice conversion of units from the readings taken. Observe errors and error deviations from the readings taken by other groups on similar tools and objects. Prepare and submit a comprehensive report. **9 Hours**

Metal Work & Machining

36 Hours

Practice commonly used operations usually performed in a workshop such as *Filing, Marking, Cutting, Grinding, Sawing, Drilling, Rolling & Forging* etc. (A pre-requisite to performing later experiments to produce a part/ component)

Practice by performing machining processes using different machines available in the workshop such as *Lathe Machine, Milling Machine, Shape and Drilling Machine*. Learn how to mount jobs and take measurements to reach target dimensions.

Perform various quality checks for dimensional accuracy, internal integrity and surface finish on the part(s) produced in experiment #4). Evaluate the part(s) produced on basis of internally accepted quality standards and write down your own observations.

- Preparation of Name plate
- Preparation of Inside calipers
- Produce an auto part such as connecting rod or Gear using an appropriate Casting method. Demonstrate various steps involved (such as Pattern making, molding, melting/pouring and fettling) to complete the job.

Machining

21 Hrs.

Practice of Cleaning & Oiling the Lathe Machine

Practice of centering the job by Tool Method and held in a four Jaw Chuck or Face plate.

Practice of center drilling

Practice of Step turning

Practice of Boring & counter boring

Practice of Reaming & tool grinding

Practice of Taper turning & thread cutting

Electrical Wiring

30 Hrs.

Identify various types of electrical wires provided and develop a table noting their current, resistance & voltage rating and comparing these with the actual measurements.

Using electrician's 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.

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.

To construct fuse indication circuit

To install 1-phase Energy meter, Main switch and Distribution fuse board.

Soldering

21 Hr.

Identify the common solders, soldering tools and equipment and practice soldering techniques by soldering various electrical components on board.

Practice of Soldering and de-Soldering on PCB

Familiarization and practice on Hot air Soldering & de-soldering station.

Perform various operations such as etching, drilling and soldering on a PCB

Using a PCB, demonstrate working of series and parallel circuits. This is done also to show how neat soldering and de-soldering is done.

Make a buzzer circuit incorporating safety devices and test the circuit for any faults.

To Study & connect starter less fluorescent lamp.

WELDING & JOINING

66 Hours

Identify the commonly employed welding rods, tools and equipment.

Familiarize yourself with different functions / parameters of commonly used and more sophisticated welding machines.

Practice welding techniques on the steel plates using

Gas Welding

Electrical Arc Welding

Repeat the above experiments using MIG & TIG welding processes and develop different joints for example T-joint, Lap-joint etc.

Demonstrate the efficacy of different mechanical joints for various applications

Practice joining two metallic sheets using riveting

Practice joining two pieces of different materials using adhesive joining technique

Conduct inspection & testing of the joints made in experiments 2 & 3, using the following non-destructive techniques:

- Fluorescent Test

- Radiography

MTR-151 OCCUPATIONAL HEALTH SAFETY & ENVIRONMENT

Total Contact Hours	32	T	P	C
Theory Hours:	32			
Practical:	Nil	1	0	1
AIMS				

To understand the background and necessity of occupational health ,safety and environment (OHSE) at workplace

To know about important factors that contribute to OHSE

To understand risk management and monitoring of OHSE systems

COURSE CONTENTS

1. INTRODUCTION TO OHSE 2 Hours

- 1.1 Define OHSE
- 1.2 Importance of OHSE
- 1.3 Automation Industries & Occupations
- 1.4 OHSE in Industry
- 1.5 International Guidelines on OHSE (ILO/WHO)
- 1.6 Occupational Health, Safety & Environment Management Systems
- 1.7 Certifications for OHSE

2. OCCUPATIONAL HEALTH 6 Hours

- 2.1 Personal Hygiene
- 2.2 Food safety
- 2.3 Medical examinations, health assessments and tests
- 2.4 Occupational diseases
- 2.5 Hazards & Exposures
 - 2.5.1 Fumes
 - 2.5.2 Toxic Substances
 - 2.5.3 Electric Magnetic Fields
 - 2.5.4 Excessive Heat
 - 2.5.5 Radiations
- 2.6 Impacts of hazards on health and productivity
- 2.7 Preventive measures & techniques

3. OCCUPATIONAL SAFETY

6 Hours

- 3.1 Human behavior and safety
- 3.2 Types of industrial accidents
- 3.3 Electrical safety
- 3.4 Safety procedures during material handling
- 3.5 Laboratory Safety
- 3.6 Safety procedures while operating machinery/automated machines
- 3.7 Safety procedures while using hand tools
- 3.8 First Aid
- 3.9 Fire protection
- 3.10 Heat & ventilation
- 3.11 Emergency Handling

4. OCCUPATIONAL ENVIRONMENT

6 Hours

- 4.1 Environmental Systems & Regulations
- 4.2 Human Factors & Ergonomics
- 4.3 Housekeeping & Cleanliness
- 4.4 Pollution Control
- 4.5 Water Treatment
- 4.6 Solid waste management
- 4.7 Industrial Noise
- 4.8 Contaminated land treatment
- 4.9 Industrial Lighting

5. RISK MANAGEMENT

5Hours

- 5.1 What is Risk management for OHSE?
- 5.2 Identification of health, safety and environmental hazard
- 5.3 Risk Assessment and Risk Control Processes
- 5.4 How to Plan Risk management?

6. MONITORING OHSE PROGRAMS

7 Hours

- 6.1 Statistical Review
- 6.2 Management/Staff meetings
- 6.3 Stakeholders surveys
- 6.4 Internal & External Reviews & Audits
- 6.5 Suppliers'/Manufacturers products inspection
- 6.6 Industrial procedures & operations review

RECOMMENDED BOOKS

Occupational Health and Safety Management-A Practical Approach:

Charles D. Reese Second Edition (2008)

Practical Guide to Occupational Health and Safety: Paul A. Erickson (1996)

MTR-151 OCCUPATIONAL HEALTH SAFETY & ENVIRONMENT

INSTRUCTIONAL OBJECTIVES

PROVIDE GENERAL INTRODUCTION OF OHSE

- 1.1 Define Occupational, Health, Safety and Environment (OHSE)
- 1.2 Understand the importance of OHSE
- 1.3 Identify different occupations w.r.t automation industries
- 1.4 Understand the relevance of OHSE in industries
- 1.5 Understand the international guidelines pertaining to OHSE
- 1.6 Identify the International Guidelines on OHSE (ILO/WHO)
- 1.7 Understand the concept of OHSE management systems
- 1.8 Identify different certifications available for OHSE standards

INTRODUCE THE CONCEPTS OF OCCUPATIONAL HEALTH 2.1

- Understand the concept and importance of personal hygiene
- 2.2 Identify the importance and principles of food safety
- 2.3 Describe different medical examinations, health assessments and tests
- 2.4 Describe different occupational diseases
- 2.5 Identify different industrial hazards & exposures such as fumes, toxic substances, electric & magnetic fields, heat, radiations, etc
- 2.6 Understand the impacts of industrial hazards on health and productivity
- 2.7 Describe the various preventive measures & techniques

INTRODUCE THE CONCEPTS OF OCCUPATIONAL SAFETY

- 3.1 Describe human behavior towards safety issues
- 3.2 Identify different types of industrial accidents
- 3.3 Understand electrical safety measures
- 3.4 Understand the different safety procedures adopted during material handling
- 3.5 Understand the rules of laboratory safety
- 3.6 Describe safety procedures while operating machinery/automated machines
- 3.7 Describe safety procedures while using hand tools
- 3.8 Understand the concept of First Aid
- 3.9 Understand the concept of Fire protection
- 3.10 Understand the importance of Heat & ventilation
- 3.11 Describe emergency handling procedures

INTRODUCE THE CONCEPTS OF OCCUPATIONAL ENVIRONMENT 4.1

- Identify and describe environmental systems & regulations
- 4.2 Understand the concepts of human factors & ergonomics
- 4.3 Describe the importance of housekeeping & cleanliness
- 4.4 Describe the importance of pollution control

- 4.5 Describe the importance of water treatment
- 4.6 Describe the importance of solid waste management
- 4.7 Understand the concept of industrial noise
- 4.8 Understand the concept of contaminated land treatment
- 4.9 Understand the significance of proper industrial lighting

UNDERSTAND WHY RISK MANAGEMENT IS IMPORTANT 5.1

Understand the concept of risk management for OHSE

5.2 Identify health, safety and environmental hazards

5.3 Understand the risk assessment process and risk control methods

5.4 Understand the planning techniques for risk management

UNDERSTAND HOW TO MONITOR AN OHSE PROGRAMS

6.1 Describe the process of statistical review of the industry for OHSE

6.2 Understand the importance of management/staff meetings for implementation of OHSE

6.3 Identify the stakeholders and understand the process of conducting surveys for the stakeholders

6.4 Understand the importance of internal & external reviews & audits

6.5 Outline the method of suppliers'/manufacturers products inspection

6.6 Outline the methods of industrial procedures & operations review

YEAR - 2

PART – L ISLAMIATCOURSE
CONTENTS

اسلامیات / مطالعہ پاکستان

ٹی پی سی
1 0 1
کل وقت: 20 گھنٹے

GEN 211

مطب (سال دوئم)

حصہ اول اسلامیات

حصہ دوم مطالعہ پاکستان

موضوعات

- 1- سورة المومنون ایک تاگیارہ آیات کا مع ترجمہ
- 2- دس منتخب احادیث مع ترجمہ و تشریح
- ☆ خیارکم من تعلیم القرآن وعلمہ
- ☆ لا ایمان لمن لا امانتہ لہ ولا دین لمن لا عہدہ
- ☆ ویاکم والظن ان الظن اکرب الحدیث
- ☆ من احدث فی امرنا ہذا مالیس منه فہورد
- ☆ من حمل علینا السلاح فلیس منا
- ☆ اناو کافل الیتیم فی الجنۃ
- ☆ لا ضرور ولا ضرار فی السلام
- ☆ کلکم راع وکلکم راع وکلکم مسول عن رعیتہ
- 3- سیرۃ طیبہ
- ☆ مکی زندگی - ولادت - بعثت - ہجرت
- ☆ مدنی زندگی - مواخات - میثاق مدینہ - فتح مکہ (اسباب و نتائج)
- 4- حضور ﷺ بحیثیت
- ☆ خطبہ حجۃ الوداع
- ☆ معلم کامل، سربراہ خاندان
- ☆ اسلامی معاشرہ
- 5- نظام تعلیم اور اس کے مقاصد - عدل و انصاف - امر بالمعروف - نہی عن المنکر
- ☆ جہاد - کسب حلال - مسجد (اہمیت و فضیلت)
- 6- اسلامی ریاست کی تعریف - اسلامی ریاست کی خصوصیات - اسلامی حکومت کے فرائض - اسلامی طرز حکومت

INSTRUCTIONAL OBJECTIVE

اسلامیات

تدریس مقاصد

عمومی مقاصد: طالب علم یہ جان سکے کہ آیات قرآنی کی روشنی میں مومن کے اوصاف کیا ہیں
قرآن مجید
منتخب آیات قرآنی

خصوصی مقاصد:

- ☆ قرآنی آیات کا ترجمہ بیان کر سکے
- ☆ قرآنی آیات کی تشریح کر سکے
- ☆ قرآنی آیات کی روشنی میں ایک مومن کے اوصاف بیان کر سکے
- ☆ قرآنی آیات میں بیان کردہ مومن کے اوصاف اپنے اندر پیدا کر سکے
- ☆ احادیث نبویہ
- ☆ عمومی مقصد احادیث کی روشنی میں اسلامی اخلاقی اقدار (انفرادی و اجتماعی) سے آگاہ ہو سکے
- ☆ خصوصی مقاصد:
- ☆ احادیث کا ترجمہ بیان کر سکے
- ☆ احادیث کی تشریح کر سکے
- ☆ احادیث کی روشنی میں اسلام کی اخلاقی اقدار کی وضاحت کر سکے
- ☆ ان احادیث کی دی گئی تعلیمات کے مطابق اپنی زندگی گزار سکے
- ☆ سیرت طیبہ
- ☆ عمومی مقصد: حضور ﷺ کی سیرت طیبہ کے بارے میں جان سکے
- ☆ خصوصی مقاصد:
- ☆ حضور ﷺ کی ابتدائی زندگی اختصار کے ساتھ بیان کر سکے
- ☆ حضور ﷺ کی ہجرت کا واقعہ بیان کر سکے
- ☆ حضور ﷺ کی مدنی زندگی اختصار سے بیان کر سکے
- ☆ حضور ﷺ کی بطور معلم خصوصیات بیان کر سکے

COURSE CONTENTS

(غیر مسلم طلباء کے لئے)

ٹی پی سی

1 0 1

کل وقت: 20 گھنٹے

نصاب اخلاقیات

سال دوم

موضوعات

معاشرتی اقدار، الجناح، ہمسایہ، قوم، قومی سطح، شہری سطح، صنعتی ارادوں 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 اگاہی

☆ تغیرات کو قبول کرنا

☆ خود شناسی

حصہ دوم
مطالعہ پاکستان

تدریس مقاصد

تحریک پاکستان

عمومی مقصد: قیام پاکستان کے اسباب و محرکات 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 اہمیت بیان کر سکے
- ☆ ہندوستانی مسلمانوں کی محرومیوں کو بیان کر سکے
- ☆ قومی تشخص کو بحال رکھنے کے لئے مسلمانان ہند کی مساعی بیان کر سکے
- ☆ آزادی ہند اور قیام پاکستان علامہ اقبال اور قائد اعظم کی مساعی بیان کر سکے
- ☆ قیام پاکستان سے مستقبل اسلامی مملکت کے قیام کے لئے مسلم عوام کی کوششوں کو بیان کر سکے
- ☆ مسلم لیگ کے قیام پاکستان کے لئے جدوجہد بیان کر سکے

GEN – 211 ISLAMIAT& PAKISTAN STUDIES (CONTINUED)

PART – LL PAKISTAN STUDIES

COURSE CONTENTS

نصاب مطالعہ پاکستان

ٹی بی سی
1 0 1
کل وقت: 12 گھنٹے

سال دوم	
حصہ دوم	
موضوعات	
دو قومی نظریہ	☆
تحریک پاکستان	☆
انڈین کانگریس	☆
مسلم لیگ	☆
تقسیم بنگال	☆
میشاق لکھنؤ	☆
تحریک خلافت	☆
سندھو تحریک	☆
تجاویز دہلی	☆
نسرورپورٹ	☆
قائد اعظم کے چودہ نکات	☆
خطبہ آلہ آباد	☆
انتخابات 1938 اور انتقال اقتدار	☆
قرار داد پاکستان	☆

- ☆ حضور ﷺ کی انجور سربراہ خاندان بیان کر سکے
- ☆ اسلامی معاشرہ
- ☆ عمومی مقصد: اسلامی معاشرہ کی خصوصیات سے آگاہی حاصل کر سکے
- ☆ خصوصی مقاصد:
- ☆ اسلامی معاشرہ کا معنی و مفہوم بیان 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 و ضرورت بیان کر سکے
- ☆ جہاد کے لفظی و اصطلاحی معنی بیان کر سکے
- ☆ جہاد کی اہمیت بیان کر سکے
- ☆ جہاد اور قتال میں فرق بیان کر سکے
- ☆ جہاد کی مختلف اقسام بیان کر سکے
- ☆ لفظ مسجد کی تعریف کر سکے
- ☆ مسجد کی سابقہ حیثیت کو بحال کرنے کے بارہ میں اقدامات کو مان 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
- ☆ اسلامی ریاست کے اغراض و مقاصد بیان کر سکے
- ☆ اسلامی ریاست کے قیام کیلئے جدوجہد کر سکے

OBJECTIVES

INSTRUCTIONAL OBJECTIVES

نصاب اخلاقیات

سال دوم

تدریس مقاصد

عمومی مقاصد:

طالب علم: اخلاقیات کی اہمیت و ضرورت سے آگاہ ہو سکے اور بیان کر سکے

خصوصی مقاصد: طالب علم اس قاتل ہو کہ

موضوعات کا مطلب بیان کر سکے

☆

عملی زندگی سے مثالوں کی نشاندہی کر سکے

☆

اپنی شخصیت اور معاشرے پر موضوعات کے مطابق مثبت اثرات پیدا کرنے کے طریقے بیان کر سکے

☆

اعلیٰ اخلاقی اقدار میں سے

☆

قوت برداشت۔ قوت ارادی۔ لگن جذبہ۔ وسیع النظری۔ بے غرض۔ انسانی دوستی حفاظتی۔ شعور۔ پاس آزادی۔

کامل آگاہی اور خود شناسی کی اہمیت بیان کر سکے

اخلاقیات سے متصف ہو کر قومی خدمت بہتر طور پر انجام دے سکے

☆

MATH-212 APPLIED MATHEMATICS-II

Total Contact Hours:

T	P	C
2	0	2

Theory: 64 Hours.

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 X^a , $(ax + b)^a$
- 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

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.

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

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

INSTRUCTIONAL OBJECTIVES**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

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.

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.

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.

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.

UNDERSTAND RATE OF CHANGE OF ONE VARIABLE 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.

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.

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.

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.

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.

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.

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

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

Aims

- 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. TECHNIQUES FOR EFFECTIVE COMMUNICATION** 2 Hours
 - 1.1 Identifying audience
 - 1.2 Establishing purpose
 - 1.3 Formulating message
 - 1.4 Selecting style and tone
 - 1.5 Writing process
 - 1.6 Communicating in the electronic office
- 2. BASIC WRITING PRACTICES** 4Hours
 - 2.1 Types and functions of paragraphs
 - 2.2 Topic sentence
 - 2.3 Appearance and patterns
 - 2.4 How to make Sentences: construction and punctuation
 - 2.5 Active and passive voice
 - 2.6 Parallelism
 - 2.7 Context; modifiers; pronoun reference
 - 2.8 How to Use Proper Words: Spelling, Right meaning
 - 2.9 Eliminating unnecessary words: Jargon and slang
- 3. TYPES OF BUSINESS CORRESPONDENCE** 8Hours
 - 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

4. PRESENTATIONS TECHNIQUES	4Hours
4.1 Effective speaking and listening	
4.2 Briefings	
4.3 Formal Presentations	
5. REPORT WRITING	6Hours
5.1 Report Process and Research Methods	
5.2 Planning	
5.3 Pre-writing	
<input type="checkbox"/> Collecting Information & Documenting Sources	
<input type="checkbox"/> Preparing Structure	
<input type="checkbox"/> Conducting Interviews	
<input type="checkbox"/> Summarizing Materials	
5.4 Report Structure	
5.5 Table of Contents	
5.6 Front Matter	
Objectives	
Scope of Work	
Statement of Problem	
Abbreviations	
5.7 Executive Summary	
5.8 Introduction	
5.9 Report Body	
5.10 Conclusion & Recommendations	
5.11 Back Matter	
Annexes, Appendixes, Glossary of Terms	
5.12 Drafting	
5.13 Revising	
5.14 Managing data and using graphics	
6. GOOD REPORT WRITING TECHNIQUES	2 Hours
6.1 Organization of facts/data	
6.2 Accuracy of information	
6.3 Style of writing	
6.4 Vocabulary & grammar	
6.5 Presentation	
7. FORMAL COMMUNICATIONS RELATED TO EMPLOYMENT	6 Hours
7.1 Cover Letters	
7.2 Resume Writing	
7.3 How to make a Curriculum Vitae (CV)	
7.4 Methods Job Search	
7.5 Interviewing techniques	

RECOMMENDED BOOKS

Essentials of Business Communication: Mary Ellen Guffey&Dana Loewy (2012)

2. Business Communication, Amy Newman and Scot Ober (2012)

Report writing skills training course. How to write a report and executive summary, And plan, design and present.MargaretGreenhall(2010)

INSTRUCTIONAL OBJECTIVES**UNDERSTAND AND ACQUIRE THE TECHNIQUES FOR EFFECTIVE COMMUNICATION**

- 1.1 Understand the relevance of Identifying audience for effective communication
- 1.2 Understand the relevance of establishing purpose for effective communication
- 1.3 Understand the method to formulate the message
- 1.4 Identify how to select the style and tone
- 1.5 Describe effective writing process
- 1.6 Describe the communication through electronic media

UNDERSTAND THE BASIC WRITING PRACTICES

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

KNOW ABOUT THE VARIOUS TYPES OF BUSINESS CORRESPONDENCE

- 3.1 Learn writing memorandums (Parts & composition of a memorandum and text)
- 3.2 Learn writing an agenda (Parts & composition and text)
- 3.3 Learn arranging a meeting and writing minutes of meeting (requirements of a meeting, parts & composition and text of minutes)
- 3.4 Learn writing emails
- 3.5 Learn composing different types of business letters (general correspondence, letters of inquiry, customer relations letters, and letters of instruction)

UNDERSTAND AND ACQUIRE THE BASIC PRESENTATIONS TECHNIQUES

- 4.1 Learn effective speaking and listening techniques
- 4.2 Understand how to give briefings (in a meeting)
- 4.3 Learn techniques of giving formal presentations

KNOW ABOUT EFFECTIVE REPORT WRITING SKILLS

- 5.1 Understand the reporting process and methods
 - 5.1.1 Understand how to plan a report

5.1.2 Understand the procedure before beginning actual writing (Collecting information & documenting sources, preparing structure, conducting interviews and summarizing materials)

5.1.3 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)

5.1.4 Learn how to draft a report

5.1.5 Understand the revision process

5.1.6 Understand the representation of data and using graphics

UNDERSTAND GOOD REPORT WRITING TECHNIQUES

6.1 Describe the organization of facts/data

6.2 Understand the importance of accuracy of information

6.3 Understand the importance style of writing

6.4 Understand the proper use of vocabulary & grammar

6.5 Understand good report presentation

KNOW ABOUT THE FORMAL COMMUNICATIONS RELATED TO EMPLOYMENT

7.1 Learn writing cover letters

7.2 Learn making resume

7.3 Learn making a Curriculum Vitae (CV)

7.4 Understand different mediums of job search

7.5 Acquire important interviewing skills

MGM-212 BUSINESS COMMUNICATION & REPORTWRITING

LIST OF PRACTICAL

- | | |
|--|------------|
| 1. Introduction of each of the class participants. Written & Oral | (03Hours.) |
| 2. Demonstrate basic language skills
(i.e., Grammar, Spellings, capitalization, sentence structure, etc.) | (15Hours.) |
| 3. Practice exercises for “Writing Business Letters” | (06Hours.) |
| 4. Practice Exercise: StandardBusiness Communication/Letters | (06Hours.) |
| 5. Practice Exercise: Email& Business Letters | (06Hours.) |
| 6. Practice Exercise: Writing a Memorandum | (06Hours.) |
| 7. Practice Exercise: Arranging a meeting, writing Agenda /Minutes | (09Hours.) |
| 8. Select Interesting Topics: For individual presentations | (09Hours.) |
| 9. Select interesting topics: For group presentation | (09Hours.) |
| 10. Assign topic to individual students for writing short reports | (09Hours.) |
| 11. Assign topics to groups of students for submitting a technical report | (09Hours.) |
| 12. Writing CVs along with a cover letter | (06Hours.) |
| 13. Class Group Project: Practice interviewing skills | (06Hours.) |

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

AIMS

To learn about the properties and applications of engineering materials

To understand & perform testing & evaluation of engineering materials

To know about the method of selection of different engineering materials

COURSE CONTENTS

1. INTRODUCTION 1.1 Classification of Materials 1.2 Properties of Materials 1.2.1 Physical properties 1.2.2 Mechanical properties 1.2.3 Electrical properties 1.2.4 Magnetic properties 1.2.5 Chemical properties	4 Hours
HEAT TREATMENT 2.1. Definitions 2.2. Objects 2.3. Constituents of iron and steel 2.4. Iron carbon equilibrium diagram 2.5. Theory of heat treatment of steel 2.6. Heat treatment processes	6 Hours

2.6.1 Annealing 2.6.2 Normalizing 2.6.3 Quenching 2.6.4 Tempering 2.6.5 Surface hardening	
FERROUS MATERIAL 3.1. Iron ores 3.2. Pig iron 3.3. Composition of Pig Iron 3.4. Cast iron 3.5. Classification, composition ,properties and uses of cast iron 3.6. Wrought iron 3.7. Aston process 3.8. Classification, composition ,properties and uses of carbon steel 3.9. Comparison of cast iron, wrought iron, mild steel and hard steel 3.10. Alloy steel	6 Hours
NON FERROUS MATERIAL 4.1. Aluminum 4.2. Copper 4.3. Lead 4.4. Tin 4.5. Zinc 4.6. Magnesium 4.7. Nickel	6 Hours
5. NON FERROUS ALLOYS	5 Hours

5.1. Copper alloys 5.1.1. Brasses 5.1.2. Bronzes 5.2. Aluminum alloys 5.2.1. Duralumin 5.2.2. Y alloy 5.2.3. Hindalium 5.2.4. Magnelium 5.3. Magnesium alloys 5.4. Nickel alloys	
6. TESTING OF MATERIAL 6.1. Introduction 6.2. Classification of test 6.3. Nondestructive test 6.4. Destructive test 6.4.1. Mechanical test 6.4.2. Tensile test 6.4.3. Impact test 6.4.4. Hardness test 6.4.5. Fatigue test 6.4.6. Creep test	5 Hours

RECOMMENDED BOOKS

Engineering Materials: Properties and Selection: K. G. Budinski and M. K. Budinski,
Prentice Hall (9th Ed, 2009)
Handbook of Engineering Materials: Miner and Seastone, Wiley

Engineering Materials and their Applications: Flinn / Trojan, (2nd Edition) Houghton Mifflin.

Mechanical Metallurgy, Dieter, McGraw-Hill

Mechanical Behavior of Materials, Dowling E.D., Prentice-Hall.

MTR-202

ENGINEERING MATERIALS

INSTRUCTIONAL OBJECTIVES

INTRODUCTION

1.3 Classification of material

- 1.3.1 Define metals with examples.
- 1.3.2 Define non metals with examples.
- 1.3.3 Define metals and alloys with examples.
- 1.3.4 Define ceramic material with examples.
- 1.3.5 Define organic material with examples.

1.4 Properties of material

1.4.1 Define the following physical properties.

- 1.4.1.1 Melting point
- 1.4.1.2 Boiling point
- 1.4.1.3 Density
- 1.4.1.4 Thermal conductivity
- 1.4.1.5 Electrical resistivity
- 1.4.1.6 Linear coefficient of expansion

1.4.2 Define the following mechanical properties

- 1.4.2.1 Strength
- 1.4.2.2 electricity
- 1.4.2.3 Plasticity
- 1.4.2.4 Ductility
- 1.4.2.5 Malleability
- 1.4.2.6 Toughness
- 1.4.2.7 Brittleness
- 1.4.2.8 Hardness
- 1.4.2.9 Fatigue
- 1.4.2.10 Creep

1.4.3 Define the following electrical properties

1.4.3.1 Resistivity

1.4.3.2 Conductivity

1.4.3.3 Temperature coefficient of resistance

1.4.3.4 Dielectric strength

1.4.3.5 Thermoelectricity

1.4.3.6 Superconductivity

1.4.4 Define the following magnetic properties

1.4.4.1 Permeability

1.4.4.2 Coercive force

1.4.4.3 Magnetic hysteresis

1.4.5 Define the following chemical properties

1.4.5.1 Corrosion resistance

1.4.5.2 Chemical composition

1.4.5.3 Acidity

HEAT TREATMENT

2.1. Definitions

2.2. Explain the purposes of heat treatment.

2.3. Define the following constituents of iron and steel

2.3.1. Ferrite

2.3.2. Cementite

2.3.3. Pearlite

2.3.4. Martensite

2.3.5. Austenite

2.3.6. Troosite

2.3.7. Sorbite

- 2.4. Draw the iron carbon equilibrium diagram
- 2.5. Explain the theory of heat treatment of steel
- 2.6. Describe the following heat treatment processes

- 2.6.1 Annealing

- 2.6.2 Normalizing
 - 2.6.3 Quenching
 - 2.6.4 Tempering
 - 2.6.5 Surface hardening

3. FERROUS MATERIAL

- 3.1 Describe the iron ores
- 3.2 Describe pig iron
- 3.3 Explain the composition of pig iron
- 3.4 Write down the effects of impurities of iron
- 3.5 Describe the cast iron
- 3.6 Write down the classification, composition ,properties and uses of following cast iron

- 3.6.1 Grey cast iron
 - 3.6.2 White cast iron
 - 3.6.3 Mottled cast iron
 - 3.6.4 Nodular cast iron
 - 3.6.5 Malleable cast iron

- 3.6.6 Alloy cast iron

- 3.7 Describe wrought iron
- 3.8 Explain Aston process
- 3.9 Describe the classification, composition ,properties and uses of carbon steel
- 3.10 Describe the comparison of cast iron, wrought iron, mild steel and hard steel
- 3.11 Describe alloy steel
- 3.12 Describe alloy steels and effects of alloying elements.

NON FERROUS MATERIALS

- 4.1 Aluminum

- 4.1.1 Describe the basic properties of Aluminum (Al.) metal
 - 4.1.2 Describe physical and mechanical properties of important Al-based alloys
 - 4.1.3 Describe its most common applications.

- 4.2 Copper

- 4.2.1 Describe the basic properties of Copper (Cu.) metal.
 - 4.2.2 Describe its physical and mechanical properties of important Cu-based Alloys
 - 4.2.3 Describe its most common applications.
- 4.3 Lead
 - 4.3.1 Describe the basic properties of Lead (Pb.) metal.
 - 4.3.2 Describe its physical and mechanical properties of important Pb-based Alloys
 - 4.3.3 Describe its most common applications.
- 4.4 Tin
 - 4.4.1 Describe the basic properties of Tin (Sn) metal.
 - 4.4.2 Describe its physical and mechanical properties of important Tin-based Alloys
 - 4.4.3 Describe its most common applications
- 4.5 Zinc
 - 4.5.1 Describe the basic properties of Zinc (Zn.) metal.
 - 4.5.2 Describe its physical & mechanical properties of important Zn-based Alloys
 - 4.5.3 Describe its most common applications
- 4.6 Magnesium
 - 4.6.1 Describe the basic properties of Magnesium (Mg.) metal.
 - 4.6.2 Describe its physical & mechanical properties of important Mg-based Alloys
 - 4.6.3 Describe its most common applications
- 4.7 Nickel
 - 4.7.1 Describe the basic properties of Nickel (Ni.) metal.
 - 4.7.2 Describe its physical & mechanical properties of important Ni-based Alloys
 - 4.7.3 Describe its most common applications

NONFERROUS ALLOYS 5.1

Copper alloys

5.2 Describe the classification of brasses.

- 5.2.1 Write down the composition, properties and uses of manganese brass
 - 5.2.2 Write down the composition, properties and uses of iron brass
 - 5.2.3 Write down the composition, properties and uses of tin brass
 - 5.2.4 Write down the composition, properties and uses of aluminum brass
 - 5.2.5 Write down the composition, properties and uses of lead brass

5.3 Bronze

- 5.3.1 Write down the composition, properties and uses of phosphor bronze

- 5.3.2 Write down the composition, properties and uses of silicon bronze
- 5.3.3 Write down the composition, properties & uses of aluminum bronze
- 5.3.4 Write down the composition, properties and uses of beryllium copper
- 5.4 Aluminum alloys
 - 5.4.1 Write down the composition, properties and uses of Duralumin
 - 5.4.2 Write down the composition, properties and uses of Y alloy
 - 5.4.3 Write down the composition, properties and uses of Magnesium
- 5.5 Write down the composition, properties and uses of Magnesium alloys
- 5.6 Write down the composition, properties and uses of Nickel alloys

6. TESTING OF MATERIALS

- 6.1 Introduction
 - 6.2 Write down the classification of test
 - 6.3 Describe Nondestructive test
 - 6.4 Explain the following Destructive test
 - 6.4.1 Mechanical test
 - 6.4.2 Tensile test
 - 6.4.3 Impact test
 - 6.4.4 Hardness test
 - 6.4.5 Fatigue test
 - 6.4.6 Creep test

MTR-202

ENGINEERING MATERIALS

LIST OF PRACTICALS

- From given samples of engineering materials, identify the materials and put them in widely accepted categories based on typical properties associated to the category. State the major characteristics for each category (e.g., metals, ceramic, plastic & composite etc.) (3 Hours)
2. Make any model using composite material. (3 Hours.)
 3. To study the structural characteristics or constitution of a metal or an alloy in relation to its physical and mechanical properties. (6 Hours.)
- To conduct Rockwell or Vicker Hardness tests on samples made from metallic & plastic materials
(6 Hours.)

5. 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 (6Hours.)
6. To study the decomposition of Austenite as a function of cooling rates (6 Hours.)
7. To conduct Charpy V-notch impact test and determine the ductile-brittle transition temperature of steels. (3 Hours.)
8. To determine the Young's Modulus, %age Elongation, Yield Stress and UTS of givensamples of Steels, Aluminum and brass using Tensile testing machine. (3 Hours.)
9. 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. (3 Hours.)
- To examine the internal flaws in given samples of materials using various NDT methods. (3 Hours.)
- To determine the glass transition temperature of polymers on Differential Scanning Calorimeter. (6 Hours.)
12. To determine the rate of corrosion for mild steel sample by exposing it to ambient Environment. (6 Hours.)
13. To study the fracture modes and features for given samples of cast iron, steel, plastics and composites (3 Hours.)
- For construction of typical mechanized system, make appropriate selection of engineering materials for the following components:
 i) Linkage ii) Drive iii) Cam iv) Brake v) Shuttle valve
 Give your reasons for the selection. (6 Hours.)

MTR-213

Drives & Linkages

Total Contact Hours:	160	T	P	C
Theory (Hours):	64	2	3	3
Practical (Hours):	96			
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

Course Contents

KINEMATICS FUNDAMENTALS & MECHANISM

- 1.1. Define the concept of Degree of Freedom
- 1.2. Define links, joints and kinematics chain
 - 1.2.1. Lower Pairs/Full Joint
 - 1.2.2. Higher Pair/Half Joint
- 1.4 Differentiate between mechanism and machine
- 1.5 Determining the DOF
- 1.6 Differentiate between mechanism and structure
- 1.7 Linkage Transformation & Inversion
- 1.8 Four Bar Chain and The GRASHOF Condition
- 1.9 Intermittent Motion
 - 1.9.1 Definition of Intermittent Motion
 - 1.9.2 Geneva Mechanism
 - 1.9.3 Ratchet and Pawl
 - 1.9.4 Linear Geneva Mechanism
 - 1.9.5 Complaint Mechanisms

12Hours

JOINTS

- 2.1. Define Fasteners/Joints
- 2.2. Types of Joints
- 2.3. Riveted Joints
 - 2.3.1. Construction
 - 2.3.2. Method of Riveting
 - 2.3.3. Materials of Rivets
 - 2.3.4. Types of Rivet Joints
 - 2.3.4.1. Lap Joint

16 Hours

2.3.4.2. Butt Joint

2.3.4.3. Shape of rivet heads

2.4. Advantages and Disadvantages of Riveted joints

2.5. Welded Joints

2.5.1. Definition

2.5.2. Welding Processes

2.5.2.1. Definition of Fusion

2.5.2.2. Definition of Forge

2.5.3. Types of Welded joints

2.5.3.1. Lap Joint

2.5.3.2. Butt Joint

2.6. Advantages and Disadvantages of Welded joints

2.7. Screwed Joints

2.7.1. Definition

2.7.2. Single or Double Threaded Screw Joints

2.7.3. Right or Left Handed Screw Joints

2.7.4. Nomenclatures uses in Screw Threads

2.7.4.1. Major

2.7.4.2. Minor Diameter

2.7.4.3. Pitch Diameter

2.7.4.4. Pitch

2.7.4.5. Lead

2.7.4.6. Crest Trough

2.7.4.7. Root

2.7.4.8. Depth of Thread

2.7.4.9. Angle of Thread

2.7.5. Shape of Thread

2.7.5.1. Square

2.7.5.2. Acme

2.7.5.3. Buttress

2.8. Advantages and Disadvantages of Screw joints

2.9. Cotter and knuckle joints

2.9.1. Definition of Cotter Joints

2.9.2. Types of Cotter Joints

2.9.3. Definition of Knuckle Joints

2.9.4. Types of Knuckle Joints

2.10. Keys and coupling

2.10.1. Significance of Keys in joints

2.10.2. Types of Keys

2.10.2.1. Sunk keys

2.10.2.2. Saddle keys

2.10.2.3. Tangent keys

2.10.2.4. Round keys

2.10.2.5. Splines

2.11. Shaft Coupling

2.11.1. Purpose of Coupling

2.11.2. Types of Coupling

2.11.2.1. Rigid Coupling

2.11.2.2. Flexible Coupling

3. BELTS AND CHAIN DRIVES

3.1. Significance of Belt Drives

3.2. Types of Belts

8 Hours

3.2.1. Flat

3.2.2. V-Belt

- 3.2.3. Circular or Ropes
- 3.3. Types/Configurations of Flat Belt Drive
- 3.4. Velocity Ratio of a Flat Belt
- 3.5. Power Transmitted by a Flat belt
- 3.6. Condition for the Transmission of Maximum Power
- 3.7. Construction of V-Belt
- 3.8. Types of V-Belts
- 3.9. Advantages and Disadvantages of V-belt Drive
- 3.10. Types of Rope Drives
- 3.11. Construction of Rope Drives
- 3.12. Construction of Chain Drives
- 3.13. Advantages and Disadvantages of Chain Drive
- 3.14. Velocity Ratio of Chain Drives
- 3.15. Classification of Chains
 - 3.15.1. Hoisting and Hauling Chains
 - 3.15.2. Conveyor Chains
 - 3.15.3. Power Transmitting Chains
- 3.16. Power Transmitted by Chains

4. SPRINGS

- 4.1. Definition
- 4.2. Applications of Springs
- 4.3. Types of Springs
 - 4.3.1. Helical
 - 4.3.2. Conical
 - 4.3.3. Torsional
 - 4.3.4. Laminated or Leaf Springs
 - 4.3.5. Special Purpose Springs

6 Hours

4.4. Differentiate between Compression & Tensile Springs

4.5. Define Spring Index

4.5.1. Series & Parallel Configurations

4.6. Define Spring Rate

4.7. Define Pitch of the Spring

5. CLUTCHES & BRAKES

5.1. Definition

5.2. Types of Clutches

5.2.1. Positive Clutches

5.2.2. Friction Clutches

5.3. Construction and Working of Disc or plate clutches

6 Hours

5.4. Construction and Working of Cone clutches

5.5. Construction and Working of Centrifugal clutches

5.6. Types of Brakes

5.6.1. Hydraulic brakes

5.6.2. Electric brakes

5.6.3. Mechanical brakes

6. GEARS

6.1. Definition

6.2. Advantages and Disadvantages of Gear Drives

6.3. Terms used in Gears

6.4. Law of Gearing for constant velocity

8 Hours

6.5. Construction and applications of Spur Gears

6.6. Construction and applications of Helical Gears

6.7. Construction and applications of Bevel Gears

6.8. Construction and applications of Worm Gear

6.9. Velocity ratio of Simple Gear train

- 6.10. Velocity ratio of Compound Gear train
- 6.11. Velocity ratio of Reverted Gear train

CAM FOLLOWER MECHANISM

- 7.1. Cam-Follower as a function generator
- 7.2. Cam Terminologies
- 7.3. Types of Follower Motion
- 7.4. Types of Cam

- 7.4.1. Radial/Plate Cam

8 Hours

- 7.4.2. Axial/Cylindrical Cam

- 7.5. Types of Follower

- 7.5.1. Flat-faced

- 7.5.2. Mushroom(Curved)

- 7.5.3. Roller

RECOMMENDED BOOKS

Robert Norton, Machine Design: An Integrated Approach

R.S. Khurmij& K. Gupta, Machine Design

Henry T. Brown: Mechanical Movements: Mechanisms and Devices: Dover Science Books(2005)

N. Chironis : Mechanisms, Linkages and Mechanical Controls, (1965)

MTR-213 DRIVES & LINKAGES

INSTRUCTIONAL OBJECTIVES

KINEMATICS FUNDAMENTALS & MECHANISM

- 1.1. Define the concept of Degree of Freedom
- 1.2. Define links, joints and kinematics chain
- 1.3. Explain the 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. Describe the methods of determining DOF
- 1.6. Differentiate between mechanism and structure
- 1.7. Describe Linkage Transformation & Inversion
- 1.8. Explain Four Bar Chain and The GRASHOF Condition
- 1.9. Describe mechanisms for Intermittent Motion
 - 1.9.1. Explain Geneva Mechanism
 - 1.9.2. Explain Ratchet and Pawl
 - 1.9.3. Explain Linear Geneva Mechanism
- 1.10. Describe Complaint Mechanisms

JOINTS

- 2.1. Define Fasteners/Joints
- 2.2. Explain the Types of Joints
- 2.3. Describe Riveted Joints
 - 2.3.1. Construction
 - 2.3.2. Method of Riveting
 - 2.3.3. Materials of Rivets
 - 2.3.4. Types of Rivet Joints

2.3.4.1. Lap Joint

2.3.4.2. Butt Joint

2.3.4.3. Shape of rivet heads

2.4. Describe the Advantages and Disadvantages of Riveted joints

2.5. Explain Welded Joints

2.5.1. Definition

2.5.2. What are the Welding Processes?

2.5.2.1. Definition of Fusion

2.5.2.2. Definition of Forge

2.5.3. Explain the Types of Welded joints

2.5.3.1. Lap Joint

2.5.3.2. Butt Joint

2.6. Describe the Advantages and Disadvantages of Welded joints

2.7. Explain Screwed Joints

2.7.1. Definition

2.7.2. Single or Double Threaded Screw Joints

2.7.3. Right or Left Handed Screw Joints

2.7.4. Nomenclatures uses in Screw Threads

2.7.4.1. Major

2.7.4.2. Minor Diameter

2.7.4.3. Pitch Diameter

2.7.4.4. Pitch

2.7.4.5. Lead

2.7.4.6. Crest Trough

2.7.4.7. Root

2.7.4.8. Depth of Thread

2.7.4.9. Angle of Thread

2.7.5. Shape of Thread

2.7.5.1. Square

2.7.5.2. Acme

2.7.5.3. Buttress

2.8. Describe the Advantages and Disadvantages of Screw joints

2.9. Describe the design and types of Cotter and knuckle joints

2.9.1. Definition of Cotter Joints

2.9.2. Types of Cotter Joints

2.9.3. Definition of Knuckle Joints

2.9.4. Types of Knuckle Joints

2.10. Describe the design and significance of Keys and coupling

2.10.1. Significance of Keys in joints

2.10.2. Types of Keys

2.10.2.1. Sunk keys

2.10.2.2. Saddle keys

2.10.2.3. Tangent keys

2.10.2.4. Round keys

2.10.2.5. Splines

2.11. Explain the types of Shaft Coupling

2.11.1. Purpose of Coupling

2.11.2. Types of Coupling

2.11.2.1. Rigid Coupling

2.11.2.2. Flexible Coupling

3. BELTS AND CHAIN DRIVES

3.1. Explain the Significance of Belt Drives

3.2. Describe the Types of Belts

3.2.1. Flat

3.2.2. V-Belt

3.2.3. Circular or Ropes

3.3. Explain the Types/Configurations of Flat Belt Drive

3.4. Describe the calculations for Velocity Ratio of a Flat Belt

3.5. Explain the formula of Power Transmitted by a Flat belt

3.6. Determine the condition for the Transmission of Maximum Power

3.7. Describe the Construction of V-Belt

3.8. Explain the Types of V-Belts

3.9. Describe the Advantages and Disadvantages of V-belt Drive

3.10. Explain the Types of Rope Drives

3.11. Describe the Construction of Rope Drives

3.12. Describe the Construction of Chain Drives

3.13. Describe the Advantages and Disadvantages of Chain Drive

3.14. Describe the calculations for Velocity Ratio of Chain Drives

3.15. Describe the Classification of Chains

3.15.1. Hoisting and Hauling Chains

3.15.2. Conveyor Chains

3.15.3. Power Transmitting Chains

3.16. Explain the formula of Power Transmitted by Chains

4. SPRINGS

4.1. Define Springs

4.2. Describe the Applications of Springs

4.3. Explain the Types and applications of Springs

4.3.1. Helical

4.3.2. Conical

4.3.3. Torsional

4.3.4. Laminated or Leaf Springs

- 4.3.5. Special Purpose Springs
- 4.4. Differentiate between Compression & Tensile Springs
- 4.5. Define Spring Index
 - 4.5.1. Series & Parallel Configurations
- 4.6. Define Spring Rate
- 4.7. Define Pitch of the Spring
- 5. CLUTCHES & BRAKES**
 - 5.1. Define Clutches
 - 5.2. Explain the Types of Clutches
 - 5.2.1. Positive Clutches
 - 5.2.2. Friction Clutches
 - 5.3. Describe the Construction and Working of Disc or plate clutches
 - 5.4. Describe the Construction and Working of Cone clutches
 - 5.5. Describe the Construction and Working of Centrifugal clutches
 - 5.6. Explain the Types of Brakes
 - 5.6.1. Hydraulic brakes
 - 5.6.2. Electric brakes
 - 5.6.3. Mechanical brakes
- 6. GEARS**
 - 6.1. Define Gears and state its application
 - 6.2. Describe the Advantages and Disadvantages of Gear Drives
 - 6.3. Explain the Terms used in Gear Design
 - 6.4. Explain the Law of Gearing for constant velocity
 - 6.5. Describe the Construction and applications of Spur Gears
 - 6.6. Describe the Construction and applications of Helical Gears
 - 6.7. Describe the Construction and applications of Bevel Gears

- 6.8. Describe the Construction and applications of Worm Gear
- 6.9. Explain the calculation of Velocity ratio of Simple Gear train
- 6.10. Explain the calculation of Velocity ratio of Compound Gear train
- 6.11. Explain the calculation of Velocity ratio of Reverted Gear train

CAM FOLLOWER MECHANISM

- 7.1. Explain the Cam-Follower mechanism as a function generator
- 7.2. Describe Cam Terminologies
- 7.3. Explain the Types of Follower Motion
- 7.4. Describe the Types of Cam
 - 7.4.1. Radial/Plate Cam
 - 7.4.2. Axial/Cylindrical Cam
- 7.5. Explain the Types of Follower
 - 7.5.1. Flat-faced
 - 7.5.2. Mushroom(Curved)
 - 7.5.3. Roller

LIST OF PRACTICALS

To study the characteristics of four bar mechanism by applying Gruebler and Grashof conditions.

To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.

Study the transmission calculation of Worm Drive.

Study and compare the velocity ratios and direction of rotation of Simple, Compound and Reverted Gear Train.

Determine the follower displacement against angular rotation of a cam.

Draw the velocity and acceleration diagrams of cam follower mechanism.

Study of uniform motion cam with a roller follower.

Study the comparison of SHM and constant acceleration cams with a roller follower.

Verify the application of the expression for maximum torque in Clutch Plate

Measure the slip & creep on measurement apparatus in belt drive

Create the various types of linkage mechanism in CAD and simulate for the motion output.

MTR-222**SENSORS & ACTUATORS**

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

Aims

To Attain a Practical and Working Knowledge of Different Types of Sensors

To Attain a Practical and Working Knowledge of Different Types of Actuators Esp. Electrical Actuators

To Identify and Select Sensors & Actuators as Per the Given Parameters

COURSE CONTENTS**The Process of Measurement**

1.1. Define Measurement

1 Hours

1.2. Fundamental Methods of Measurement

1.3. The SI System

SENSORS AND TRANSDUCERS

2.1. Definition of sensors and transducers

2 Hours

2.2. Performance terminologies

2.3. Static and Dynamic Characteristics

DISPLACEMENT, POSITION AND PROXIMITY SENSORS

3.1. Potentiometer Sensor

3.2. Strain-gauge Element

3.3. Capacitive Element

6 Hours

3.4. Variable Inductance Transducers

3.5. Differential Transformer

3.6. Proximity Switches

3.7. Hall effect Sensors

VELOCITY AND MOTION SENSORS

4.1. Optical Encoder

4.2. Tacho-generator

5 Hours

4.3. Pyroelectric Sensors

4.4. Accelerometer

4.5. Vibro-meters

5. FORCE

5.1. Strain-gauge Load Cells

3 Hours

5.2. Piezoelectric Load Cells

5.3. Ballistic weighing

6. FLUID PRESSURE

6.1. Bourdon Tube Gauges

6.1.1. Flat Metal Diaphragms

3 Hours

6.1.2. Corrugated Diaphragms

6.1.3. Semiconductor Diaphragms

6.2. Additional Transducers

6.2.1. Strain Gauges and Flat diaphragms

6.2.2. Inductive Transducers

6.2.3. Capacitive Transducers

6.2.4. Piezoelectric Transducers (PVDF)

7. LIQUID FLOW

7.1. Flow Measurement Methods

7.1.1. Flowmeters

7.1.1.1. Orifice Plate

7.1.1.2. Venturi meters

7.1.1.3. Turbine Meter

4 Hours

7.1.1.4. Variable Area Meter

7.1.1.5. Ultrasonic Flowmeter

7.1.2. Velocity Probes

7.1.3. Doppler Shift Method for Velocity Measurement

7.1.4. Flow Visualization Techniques

8. TEMPERATURE

8.1. Bimetallic Strips

8.2. Resistance Temperature Detectors (RTDs)

4 Hours

8.3. Thermistors

8.4. Thermocouples

8.5. Pyrometers

9. ELECTRICAL ACTUATION SYSTEM

4 Hours

9.1. Relays

9.2. Solenoids

9.3. DC Motors

9.3.1. Control of Brush-type DC motors

9.3.2. Control of Brushless permanent magnet DC motors

9.4. AC Motors

9.4.1. Characteristics of Single-Phase Squirrel Cage Induction Motor

9.4.2. Characteristics of Three-Phase Induction Motor

9.5. Stepper Motor

9.5.1. Construction

9.5.2. Types

9.5.3. Control of Stepper Motor

RECOMMENDED BOOKS

W. Bolton, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson

Thomas G. Beckwith, John H. Lienhard V, Roy D. Marangoni, *Mechanical Measurement*, Pearson

Sensors and Actuators: Control System Instrumentation: Clarence W. de Silva (2007)

Sensors: An Introductory Course: Kourosh Kalantar-Zadeh (2013)

Industrial Automated Systems: Instrumentation and Motion Control: Terry L.M. Bartelt
(2010)
Actuators: Basics and Applications Hartmut Janocha (2010)
Introduction to Mechatronics: W. Bolton
Mechatronics & Microprocessor: Willey
Industrial Instrumentation & Control: Curtz. D Johnson.

INSTRUCTIONAL OBJECTIVES**The Process of Measurement**

1.1. Define Measurement

1.2. Fundamental Methods of Measurement

1.2.1. Direct Comparison

1.2.2. Indirect Comparison

1.3. The SI System

1.3.1. Fundamental Units (base units)

1.3.2. Derived Units

1.3.3. Define standards

1.3.4. Standards of base units

SENSORS AND TRANSDUCERS

2.1. Define Sensors and Transducers

2.2. Explain the terminologies used to define the Performance of transducers

2.2.1. Range

2.2.2. Error

2.2.3. Accuracy

2.2.4. Sensitivity

2.2.5. Hysteresis Error

2.2.6. Linearity and Non-Linearity

2.2.7. Repeatability

2.2.8. Dead Band

2.2.9. Resolution

2.3. Describe the Static and Dynamic Characteristics of the transducers

2.3.1. Response time

2.3.2. Time Constant

2.3.3. Rise time

2.3.4. Settling time

DISPLACEMENT, POSITION AND PROXIMITY SENSORS

3.1. Explain Sliding contact resistive transducers

3.1.1. State the governing equation and measurement process

3.1.2. Construction of Sliding contact resistive transducers

3.1.2.1. Resistive wire arrangement

3.1.2.2. Variable resistance element (conductive film)

3.1.3. Describe the characteristics Potentiometer

3.1.3.1. Resolution

3.1.3.2. Linearity

3.2. Explain the Strain-gauge Element transducer

3.2.1. Describe the Construction and configuration of Strain gauge element

3.2.2. Explain the sensitivity characteristic of Strain-gauge element

3.2.3. Explain the governing equation and measurement process

3.2.4. Describe the use of strain-gauge bridge circuit

3.3. Explain the Capacitive Element transducer

3.3.1. Explain the governing equation of capacitive element transducer

- 3.3.2. Describe the Construction and configuration of capacitive element
 - 3.3.2.1. The use of changing dielectric constant configuration
 - 3.3.2.2. The use of changing Area configuration
 - 3.3.2.3. The use of changing distance configuration
- 3.4. Explain the Variable Inductance Transducers
 - 3.4.1. Describe the classification of Variable Inductance Transducers
 - 3.4.1.1. Variable self-inductance
 - 3.4.1.2. Variable mutual inductance
 - 3.4.2. Explain the governing principle and equation
- 3.5. Describe the Differential Transformer
 - 3.5.1. Explain the construction of Linear-Variable Differential Transformer
 - 3.5.2. Explain the linearity characteristic of LVDT using performance curve
 - 3.5.3. Describe the phase-sensitive circuitry for LVDT
- 3.6. Explain the use of Proximity Switches
 - 3.6.1. Define proximity switches
 - 3.6.2. Explain different types of mechanical switches as Proximity switches (limiting device)
 - 3.6.3. Describe the construction and working of reed switch as Proximity switches (limiting device)
 - 3.6.4. Explain the use of photo detectors as Proximity switches (limiting device)
 - 3.6.4.1. Photo emissive Detectors
 - 3.6.4.2. Photodiodes
 - 3.6.4.3. Phototransistors
 - 3.6.4.4. Light Dependent Resistors (LDRs)
- 3.7. Explain the Hall effect Sensors

- 3.7.1. Explain the Working principle of Hall Effect Sensor
- 3.7.2. State the formula for hall-effect voltage
- 3.7.3. Explain the characteristics of Hall-Effect Sensor
- 3.7.4. Describe different arrangement of hall-effect sensor according to its use
 - 3.7.4.1. Position
 - 3.7.4.2. Displacement
 - 3.7.4.3. Proximity sensor

VELOCITY AND MOTION SENSORS

- 4.1. Explain the types of Optical shaft Encoder
 - 4.1.1. Explain the construction and working of Incremental encoder
 - 4.1.2. Explain the construction and working of Absolute encoders
 - 4.1.3. Characteristics of absolute and incremental encoder
- 4.2. Explain the construction and working of Tacho-generator
 - 4.2.1. Explain the loading effect on tacho-generator
- 4.3. Explain Pyro electric Sensors
 - 4.3.1. Describe pyro electric effect
 - 4.3.2. Explain pyro electric materials
 - 4.3.3. Explain the use of pyro electric sensor in household motion detectors
- 4.4. Explain Vibrometers and Accelerometers
 - 4.4.1. Explain the function of Accelerometer
 - 4.4.2. Explain the operation of The Seismic Instrument
 - 4.4.3. Explain the function of gyroscope

FORCE

- 5.1. Explain the working of Strain-gauge Load Cells for force measurement
 - 5.1.1. Configuration for tension and compression detection
 - 5.1.2. Temperature compensation procedure
- 5.2. Explain the working of Piezoelectric Load Cells for force measurement
 - 5.2.1. Define Piezoelectric effect
 - 5.2.2. Explain some characteristics of available Piezoelectric materials

FLUID PRESSURE

- 6.1. Describe the Bourdon Tube Gauges
 - 6.1.1. Explain the function of Flat Metal Diaphragms
 - 6.1.2. Explain the function of Corrugated Diaphragms
 - 6.1.3. Explain the function of Semiconductor Diaphragms
- 6.2. Describe some Additional Transducers
 - 6.2.1. Explain the configuration of Strain Gauges and Flat diaphragms for pressure measurement
 - 6.2.2. Explain the function of Inductive Transducers
 - 6.2.3. Explain the function of Capacitive Transducers

FLUID FLOW

- 7.1. Describe the flow measurement methods.
 - 7.1.1. Explain the basic function of different flowmeters
 - 7.1.1.1. Orifice Plate
 - 7.1.1.2. Venturi meters
 - 7.1.1.3. Turbine Meter
 - 7.1.1.4. Variable Area Meter

- 7.1.1.5. Ultrasonic Flowmeter
- 7.1.2. Explain the basic function of different velocity probes
- 7.1.3. Explain the Doppler shift method for fluid velocity measurement
- 7.1.4. Explain the basic function of different Flow Visualization Techniques

DESCRIBE THE TEMPERATURE MEASUREMENT TRANSDUCERS

- 8.1. Bimetallic Strips
- 8.2. Explain the function of Resistance Temperature Detectors (RTDs)
- 8.3. Explain the measurement of resistance change in RTDs
- 8.4. Explain the function of Thermistors
 - 8.4.1. Materials of thermistor
 - 8.4.2. Characteristic of thermistor
- 8.5. Explain the working principle of Thermocouples
 - 8.5.1. State Seebeck Effect
 - 8.5.2. Describe the Thermocouple materials and construction
 - 8.5.3. Explain the measurement of thermocouple emf
- 8.6. Explain Pyrometry

ELECTRICAL ACTUATION SYSTEM

- 9.1. Describe the function of Relays
 - 9.1.1. Explain different types of relay switches
- 9.2. Describe the function of Solenoids and explain some of its applications
- 9.3. Describe the working principle of DC Motors
 - 9.3.1. Explain the control of Brush-type DC motors
 - 9.3.2. Explain the control of Brushless permanent magnet DC motors

9.4. Explain the working principle of AC Motors

9.4.1. Describe the Characteristics of Single-Phase Squirrel Cage Induction Motor

9.4.2. Describe the Characteristics of Three-Phase Induction Motor

9.5. Explain the operation of DC Stepper Motor

9.5.1. Explain its Construction

9.5.2. Describe its Types

9.5.3. Explain the control of Stepper Motor

9.5.4. Describe the characteristics of Stepper motor

LIST OF PRACTICALS

Study characteristic and application of photo Conductive Detectors.

Study characteristic and application of Thermistor.

Study the Seebeck Effect in thermocouple and its temperature measuring procedure.

Study characteristic and construction of Various Switches.

Study characteristic, construction and application of Resistance Temperature Detector (RTD).

Understand the operating principle of Magnetic Device Sensor.

Study characteristic, construction and application of Strain Gauge.

Study characteristic, construction and application of LVDT.

Study the application of Photovoltaic Cells.

Understand the characteristic of infrared Transducer.

Study the application of Ultrasonic Transducers.

Study the operating principle and applications of Pressure Transducer.

Understand the Construction and working of optical fiber.

Study the operating principle of potentiometer using in detecting angular position.

Study the working and characteristics of accelerometer in your lab.

Measure the speed, direction and position of a DC motor using optical encoder.

Study the working principle of Hall Sensor.

Study the configuration of Hall sensor as Position, Speed and Proximity Sensor.

MTR-233**MOTORS & GENERATORS**

Total Contact Hours:	160	T	P	C
Theory (Hours):	64	2	3	3
Practical (Hours):	96			

Aims

To understand the working principle of a motor and generator

To learn about the types of motors & generators

To know about the different repair techniques for motors & generators

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

Torque

Moments of inertia

○ Electric Flux

○ Magnetic Flux

1.6 Law of Conservation of Energy

2 DC MOTORS

12 Hours

2.1 Operating Principles	
2.2 Permanent Magnet DC Motor	
2.3 DC Motor with field coils	
Series wound motor	
○ Shunt wound motor	
○ Compound motor	
2.4 Brushless Permanent Magnet DC Motor	
2.5 Control of DC Motors	
2.6 Advantages and Drawbacks of DC motors	
3 AC MOTORS	8 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	
4 STEPPER MOTORS	8 Hours
4.1 Operating Principles	
4.2 Stepper Motor Specifications	
4.3 Variable Reluctance Stepper	
4.4 Permanent Magnet Stepper	
4.5 Hybrid Stepper	
4.6 Stepper Motor Control	
5 SERVO MOTORS	8 Hours
5.1 Operating Principle	
5.2 Servo vs Stepper motor	
5.3 What is inside a Servo?	
5.4 Types of Servo Motors	
5.5 Applications of Servo Motors	
5.6 Servo Motor Control	
6 GENERATORS	8 Hours
6.1 How does a Generator work?	
6.2 Components of a Generator:	
6.2.1 Engine	
6.2.2 Alternator	
6.2.3 Fuel System	
6.2.4 Voltage Regulator	
6.2.5 Cooling and Exhaust Systems	
6.2.6 Lubrication System	
6.2.7 Battery Charger	
6.2.8 Control Panel	
6.2.9 Main Assembly / Frame	
6.3 Using generator to power industrial applications	
7 TYPES OF GENERATORS	6 Hours
7.1 Induction Motor	
7.2 Dynamo	
7.3 MHD Generator	

8 REPAIR OF MOTORS & GENERATORS

8 Hours

- 8.1 Common Faults in a motor
- 8.2 Common Faults in a generator
- 8.3 Repairing a motor
- 8.4 Improving efficiency of a motor
- 8.5 Repairing a generator
- 8.6 Improving efficiency of a generator

RECOMMENDED BOOKS

Electric Motors & Generators (Fundamental Series): Jack Rudman, Passbook, (2010)
Motors, Generators, Transformers and Energy: Pericles Emanuel (1985)
Electrical Machines by J. chapman

MTR-233

MOTORS & GENERATORS

INSTRUCTIONAL OBJECTIVES

INTRODUCE MOTORS & GENERATORS 1.1

- Define Motors & their working principle
- 1.2 Define Generators & their working principle
- 1.3 Enlist the types of Motors
- 1.4 Enlist the type of Generators
- 1.5 Understand the process of motor selection (Torque, Moments of inertia, electric and magnetic flux)
- 1.6 Describe the Law of conservation of Energy

KNOW ABOUT THE WORKING AND APPLICATIONS OF DC MOTORS

- 2.1 Understand the operating principle of DC motors
- 2.2 Describe the working of a Permanent Magnet DC motor
- 2.3 Describe the working of DC motor with field coils (Series wound motor, Shunt wound motor, Compound motor)
- 2.4 Describe the working of Permanent Magnet DC Motor
- 2.5 Understand the control of a DC Motor
- 2.6 Enlist the advantages and drawbacks of DC motors

KNOW ABOUT THE WORKING AND APPLICATIONS OF AC MOTORS

- 3.1 Describe the principle of operation of an AC motor

- 3.2 Detail the working of a Single Phase Squirrel Cage Induction Motor
- 3.3 Illustrate the working of a Three Phase Induction Motor
- 3.4 Describe the working of a Synchronous Motor
- 3.5 Enlist the advantages and drawbacks of AC motors

KNOW ABOUT THE WORKING AND APPLICATIONS OF STEPPER MOTORS

- 4.1 Understand the operating principle of a Stepper motor
- 4.2 Enlist the specifications of a stepper motor
- 4.3 Describe the working of a Variable Reluctance Stepper
- 4.4 Describe the working of a Permanent Magnet Stepper
- 4.5 Describe the working of a Hybrid Stepper
- 4.5 Understand the control of Stepper motors

KNOW ABOUT THE WORKING AND APPLICATIONS OF SERVO MOTORS

- 5.1 Define in detail the working principle of Servo Motors
- 5.2 Differentiate between the Servo and Stepper motors
- 5.3 Describe the construction of a Servo
- 5.4 Enlist the types of Servo Motors
- 5.5 Describe the applications of a Servo motor
- 5.6 Understand the control of a Servo motor

KNOW ABOUT THE WORKING OF GENERATORS 6.1

- Understanding the working of a Generator
- 6.2 Describe the components of a generator (engine, alternator, fuel system, voltage regulator, cooling & exhaust system, lubrication system, battery charger, control panel, main assemble/frame)
- 6.3 Understand the industrial applications of a generator

UNDERSTAND THE TYPES OF GENERATORS AND THEIR APPLICATIONS

- 7.1 Understand the Induction motor generators
- 7.2 Understand the working of a dynamo
- 7.3 Understand the working of a MHD generator

KNOW ABOUT THE TECHNIQUES INVOLVED IN THE REPAIR OF MOTORS & GENERATORS

- 8.1 Describe the common faults in a motor
- 8.2 Describe the common faults of a generator
- 8.3 Understand repairing a motor and generator
- 8.4 Understand improving efficiency of a motor and generator

LIST OF PRACTICAL

- Identification of the working principle, components of a DC motor and demonstrate it's running in terms of fundamental physical laws and phenomenon. (6 Hours)
- Identification of the working principle, components of an AC motor and demonstrate it's running in terms of fundamental physical laws and phenomenon. (6 Hours)
- Identification of the working principle, components of a generator and demonstrate it's running in terms of fundamental physical laws and phenomenon. (6 Hours)
4. Construct a small scale dynamometer. (3Hours)
- Demonstrate the measurement of different types of DC motor mechanical output power using a small scale dynamometer. (6Hours)
- Demonstrate the measurement of different types of AC motor mechanical output power using a small scale dynamometer (6 Hours)
- Determine the relationship between different types of DC motor rotational speed and voltage. (6Hours)
- Determine the relationship between different types of AC motor rotational speed and voltage (6 Hours)
- Determine the relationship between different types of DC motor output torque and input current (6Hours)
- Determine the relationship between different types of AC motor output torque and input current (6 Hours)
11. Practice installation of a DC Motor (6Hours)

- | | | |
|-----|---|----------|
| 12. | Practice installation of an AC Motor | (6Hours) |
| | Installation of a stepper and servo motor, study its applications and compare advantages and drawbacks of each. | (6Hours) |
| 14. | Practice installation of a Generator. | (6Hours) |
| 15. | Testing of motors & generators | (3Hours) |
| 16. | Practice windings of motors & generators coils | (6Hours) |
| 17. | Repair of Motors & Generators: Common problems & solutions | (6Hours) |

MTR-253

INSTRUMENTATION & MEASUREMENT

Total Contact Hours:	160	T	P	C
Theory (Hours):	64	2	3	3
Practical Hours:	96			

Aims

- To develop knowledge and understanding of a range of instruments used in the industry
- To acquire the practical skills for the usage of these instruments
- To understand the working principle, types and construction of different analog and digital instruments and their accessories
- To manipulate skills of proper selection use, handling, maintain and repairing of various electrical and electronics instruments

COURSE CONTENTS

1. Measurement, Instrumentation & Calibration 5Hours

- 1.1 Introduction
- 1.2 Measurement
- 1.3 Instrument
- 1.4 Instrumentation
- 1.5 Error in measurement
- 1.6 Calibration and standards
- 1.7 Standards of measurement
- 1.8 EMF Standard

2. Analog Electromechanical Instruments 5Hours

- 2.1 Classification of instrument
- 2.2 Selection of instrument
- 2.3 Function of instrument
- 2.4 Comparison of analog and digital instrument
- 2.5 Electrical instrument
 - 2.5.1 Analog Ammeter, voltmeter

3. Frequency and rotational speed Meter 6Hours

- 3.1 Introduction
- 3.2 Types of frequency meters
- 3.3 Mechanical resonance type (vibrating reed type) frequency meter
- 3.4 Electrical resonance type frequency meter
- 3.5 Rotational speed measurements

- 3.5.1. Introduction
- 3.5.2. Stroboscopic method for measurement of speed

4. Instrument Transformer 6Hours

- 4.1 Introduction
- 4.2 Term relating to instrument transformer
- 4.3 Current Transformer
- 4.4 Potential Transformer
- 4.5 Testing of Instrument Transformer

5. Electronic Instrument 6Hours

- 5.1 Introduction
- 5.2 Essential of Electronic Instrument
- 5.3 Advantages of Electronic Instrument
- 5.4 Electronic Voltmeter

6. Cathode Ray Oscilloscope (CRO) 10 Hours

- 6.1 Introduction
- 6.2 Enlist applications of CRO
- 6.3 Draw a block Diagram of an Oscilloscope
- 6.4 Describe cathode Ray Tube (CRT)
- 6.5 Describe electrostatic and magnetic deflection
- 6.6 Describe vertical Amplifier
- 6.7 Describe time Base Sweep or Ramp Generator.
- 6.8 Enlist types of sweep

- 6.9 Define horizontal Amplifier
- 6.10 Define Delay Line
- 6.11 Explain basic Control of CRO.
- 6.12 Explain Dual Trace Oscilloscope
- 6.13 Explain Dual Beam Oscilloscope
- 6.14 Define Storage Oscilloscope
- 6.15 Define Sampling Oscilloscope
- 6.16 Define Digital Readout Oscilloscope
- 6.17 Define Digital Storage Oscilloscope
- 6.18 Define High Frequency Oscilloscope
- 6.19 Explain the accessories of Cathode Ray Oscilloscope
- 6.20 Define CRO Measurements.

7. Data Acquisition System 6 Hours

- 7.1 What is data acquisition system?
- 7.2 Explain objectives and Configuration of Data Acquisition System
- 7.3 Explain data Acquisition Systems
- 7.4 Application of DAQ system
- 7.5 Explain the procedure of data Conversion

8. Process Control Instrumentation 10 Hours

- 8.1 Introduction
- 8.2 Explain the aspect of Pharmaceutical Industries
- 8.3 Paper and Textile Industries
- 8.4 Explain the aspect of Food-Processing Industry
- 8.5 Explain the aspect of Aerospace Industry
- 8.6 Explain the aspect of Nuclear Power Industry
- 8.7 Explain the aspect of Bioprocess Industry

9. Sophistication in Instrumentation 10 Hours

- 9.1 Introduction
- 9.2 Explain the thermometry and Thermography
- 9.3 Explain the aspects of nano Instrumentations
- 9.4 Explain the condition Monitoring
- 9.5 Explain the biomedical Instrumentations
- 9.6 Explain the Robotic Instrumentation

RECOMMENDED BOOKS

Measurement and Instrumentation: Theory and Application: Alan S Morris and Reza Langari, 2011

Instrumentation for Engineering Measurements: James W. Dally, William F. Riley and Kenneth G. McConnell, 1993

Measurement and Instrumentation in Engineering: Principles and Basic Laboratory Experiments: Francis S. Tse and Ivan E. Morse, 1989

INSTRUCTIONAL OBJECTIVES**1. Measurement, instrumentation and calibration**

- 1.1 Introduction
- 1.2 Describe measurement system.
- 1.3 Explain the importance of instrument
- 1.4 Describe importance of instrumentation
- 1.5 Writes down the error in Measurement
 - 1.5.1 Define gross Error
 - 1.5.2 Define Systematic Error
 - 1.5.3 Define random Error
- 1.6 Explain calibration & Standard of measurement
 - 1.6.1 Explain process of Calibration
 - 1.6.2 Write down the Classification of calibration
 - 1.6.3 Explain standard of calibration
- 1.7 Define standards of measurement with classification.
- 1.8 EMF Standard
 - 1.8.1 Explain primary standard of emf i.e. Saturated Weston cell
 - 1.8.2 Explain secondary standard of emf i.e. Unsaturated Weston cell
 - 1.8.3 Explain zinc diode reference standard

2. Analog electromechanical instruments

- 2.1 Write down the following classification of instrument.
 - 2.1.1. Absolute and secondary instrument
 - 2.1.2 Analog and digital instrument
 - 2.1.3 Mechanical, electronic and electrical instrument.
 - 2.1.4 Manual and automatic instrument.
- 2.2 Write down the factor for selection of Instruments
- 2.3 Write down the following function of Instrument
 - 2.3.1 Indicating function
 - 2.3.2 Recording function
 - 2.3.3 Controlling function
- 2.4 write down the comparison of analog & digital instrument

- 2.5 Electrical Instruments
 - 2.5.1 Write down the classification of electrical instrument.
 - 2.5.2 Define the following electrical principle of operation.
 - 2.5.2.1 Magnetic effect
 - 2.5.2.2 Thermal effect
 - 2.5.2.3 Chemical effect
 - 2.5.2.4 Electromagnetic induction effect
 - 2.5.3 Define the following essential Features of indicating instruments
 - 2.5.3.1 Deflecting Devices
 - 2.5.3.2 Controlling Devices
 - 2.5.3.3 Damping Devices
- 2.6 Analog ammeter, Voltmeter & Ohmmeter
 - 2.5.1.1 Write down the types of instrument used as Ammeter and voltmeter.
 - 2.5.1.2 Write down the error in ammeter and voltmeter

3. Frequency and rotational speed Meter

- 3.6 What is frequency meter?
- 3.7 Enlist types of frequency meters
- 3.8 Describe the construction and working of mechanical resonance type (vibrating reed type) frequency meter
- 3.9 Describe the construction and working of electrical resonance type frequency meter
- 3.10 Rotational speed measurements
 - 3.5.1. Explain rotation speed measurement.
 - 3.5.2. Describe stroboscopic method for measurement of speed

4. Instrument Transformer

- 4.1 Explain instrument transformer.
- 4.2 Define the following term relating to instrument transformer.
 - 4.2.1 Burden of instrument transformer
 - 4.2.2 Transformation ratio
 - 4.2.3 Nominal transformation ratio
 - 4.2.4 Turns ratio
- 4.3 Describe current Transformer
- 4.4 Describe potential Transformer
- 4.5 Define the following testing of Instrument Transformed
 - 4.5.1 Absolute method
 - 4.5.2 Comparison method

5. Electronic Instrument

- 5.1 Importance of electronic instrument.
- 5.2 write down the following essential of Electronic Instrument
 - 5.2.1 Transducer
 - 5.2.2 Signal modifier
 - 5.2.3 Indicating devices
- 5.3 Enlist advantages of Electronic Instrument
- 5.4 Electronic Voltmeter
 - 5.4.1 What is electronic voltmeter?
 - 5.4.2 Advantages of electronic voltmeter
- 5.5 Types of electronic voltmeter

CATHODE RAY OSCILLOSCOPE (CRO)

- 6.21 Introduction
- 6.22 Enlist applications of CRO
- 6.23 Draw a block Diagram of an Oscilloscope
- 6.24 Describe cathode Ray Tube (CRT)
- 6.25 Describe electrostatic and magnetic deflection
- 6.26 Describe vertical Amplifier
- 6.27 Describe time Base Sweep or Ramp Generator.
- 6.28 Enlist types of sweep
- 6.29 Define horizontal Amplifier
- 6.30 Define Delay Line
- 6.31 Explain basic Control of CRO.
- 6.32 Explain Dual Trace Oscilloscope
- 6.33 Explain Dual Beam Oscilloscope
- 6.34 Define Storage Oscilloscope
- 6.35 Define Sampling Oscilloscope
- 6.36 Define Digital Readout Oscilloscope
- 6.37 Define Digital Storage Oscilloscope
- 6.38 Define High Frequency Oscilloscope
- 6.39 Explain the following accessories of Cathode Ray Oscilloscope
 - 6.39.1 Probes
 - 6.39.2 Electronic Switch
 - 6.39.3 Calibration
 - 6.39.4 Cameras
- 6.40 Define the following CRO Measurements
 - 6.40.1 Voltage measurement

- 6.40.2 Current measurement
- 6.40.3 Time period measurement
- 6.40.4 Lissajous figures/pattern
- 6.40.5 Phase-angle measurement
- 6.40.6 Frequency measurement
- 6.40.7 Dielectric loss measurement

Data Acquisition System

- 7.1 What is data acquisition system?
- 7.2 Explain objectives and Configuration of Data Acquisition System
- 7.3 Explain the following data Acquisition Systems
 - 7.3.1 Analog and automated data acquisition systems
 - 7.3.2 Single channel data acquisition system
 - 7.3.3 Multi-channel data acquisition system
- 7.4 Enlist Application of DAQ system
- 7.5 Explain the following procedure of data Conversion
 - 7.5.1 Analog-to-digital conversion (ADC)
 - 7.5.2 Digital-to-analog (D/A) conversion

8. Process Control Instrumentation

- 8.1 Introduction
 - 8.2 Explain the following aspect of Pharmaceutical Industries
 - 8.2.1 Importance
 - 8.2.2 Measurement of Water Content
 - 8.3 Paper and Textile Industries
 - 8.3.1 Importance
 - 8.3.2 Measurement of Relative Humidity
 - 8.4 Explain the following aspect of Food-Processing Industry
 - 8.4.1 Importance
 - 8.4.2 Measurement of Flow
 - 8.5 Explain the following aspect of Aerospace Industry
 - 8.5.1 Importance
 - 8.5.2 Selection of Sensor
 - 8.6 Explain the following aspect of Nuclear Power Industry
 - 8.6.1 Importance
 - 8.6.2 Safety and security instrumentation
 - 8.6.3 Waste Disposal System
 - 8.7 Explain the following aspect of Bioprocess Industry
 - 8.7.1 Importance
 - 8.7.2 Fermentation Process

9. Sophistication in Instrumentation

9.1 Introduction

9.2 Explain the following thermometry and Thermography

9.2.1 Radiation Thermometers

9.2.2 Infrared Thermograph

9.2.3 Thermal Flowmeter

9.2.4 Thermal Mass-flow Meters

9.3 Explain the following aspects of nano Instrumentations

9.3.1 Introduction

9.3.2 Nano stylus Instruments

9.3.3 Optical Instrument

9.4 Explain the following condition Monitoring

9.4.1 Introduction

9.4.2 IR Camera

9.4.3 Acoustic Emission Technique

9.4.4 Ultrasonic Scanning Technique

9.5 Explain the following biomedical Instrumentations

9.5.1 Introduction

9.5.2 Sensing Physical Variables

9.5.3 Radioactive Technique

9.5.4 X-ray and Radiotherapy

9.5.5 Endoscopy

9.6 Explain the following Robotic Instrumentation

9.6.1 Introduction

9.6.2 Ranging Techniques

List of Practical(s)

Calibrate and make the following measurements with a ruler, measuring tape and Vernier caliper. Remove zero error if present and discuss which method of measurement gives a more accurate answer. Also discuss which instrument has a better utility that caters to different sorts of measurements. Write your observations. (9 Hours) - Thickness of a block -Depth of a bowl - Internal diameter of a hole

Calibrate and make the following measurements with a Vernier caliper and a micrometer screw gauge. Remove zero error if present and discuss which method of measurement gives a more accurate answer. Discuss which instrument has a better utility. (6 Hours.) - Diameter of a rod - Diameter of a ball

Measure the length of different sized objects with a ruler and measuring tape and convert into units of different Unit Systems. Also show how the error in measurement was removed.

Measure the weight of different objects on different weighing scales depending on the capacity of the weighing scale and convert the readings into units of different Unit Systems. Also show how the error in measurement was removed. (6 Hours)

Measure the current flowing in a simple circuit using a galvanometer. Determine the value of the resistances. Set the power supply at 12 V. Record the reading and uncertainty in your answer. Determine the internal resistance of the galvanometer. (6 Hours)

Assemble the following basic electrical circuits and measure the voltage, current and resistance using an ammeter, voltmeter and ohmmeter. Substitute all the measuring instruments for a multi-meter and take readings. (12 Hours)

- Electric bulb circuit
- Electric bulbs in series circuit
- Buzzer circuit
- Electric bulbs in parallel circuit

Determine the temperature of the following using a thermometer. Discuss the limitations of a thermometer. Suggest other methods of temperature sensing that cater to a wide variety of measurements. Make a circuit to display the temperature. (9 Hours) Boiling Water Closed Room Computer Circuit Board

Observe and record the following in an Instrument Transformer (Current Transformer) (6 Hours)

Rise and Droop time	Volts per Amps
Single windings versus multiple windings	Common mode noise

- Assemble a wheat-stone bridge and take readings of the output. Measure voltage and current in the circuit (6 Hours)
- Assemble a Kevin and a Maxwell bridge and take readings at the output. Measure voltage and current in the circuit (12 Hours)
- Generate different frequencies (FM, AM, AF, RF) by the signal generator and view on the . (6Hours)
- Observe a small strand of hair under a simple optical microscope and electron microscope. Change the magnification and resolution. Observe the difference and record. Compare results of both the instruments. (6 Hours)
13. Calibrate different instruments in lab (electrical and mechanical) (3Hours)
- Use a measuring cylinder and a burette to measure a colored and transparent liquid quantity. Differentiate between the two methods of measurement stating the pros and cons of each. Also elaborate on the utility of both methods. (6 Hours)

MTR-263**ELECTRONIC DEVICES & CIRCUITS**

Total Contact Hours:	160	T	P	C
Theory (Hours):	64	2	3	3
Practical (Hours):	96			

Aims

Identify various electronic components and explain the principle of operation

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

COURSE CONTENTS**1. DIODES AND APPLICATIONS**

4 Hours

1.1 Biasing the PN junction.

1.1.1 Depletion region, Junction barrier potential

1.1.2 Forward and reverse bias.

1.2 Rectifier Diode

1.2.1 Half wave and full wave (Bridge) rectifier.

1.2.2 Ripple factor, surge current.

1.2.3 Rectifier filter: L, PI and T filters.

1.3 Diode Multiplier.

1.3.1 Voltage multiplier circuit. (Doubler, Tripler, Quadrupler)

1.4 Diode Data Sheet

1.5 Common faults in rectifier.

1.6 Diode as a switch

2. BIPOLAR JUNCTION AND FIELD EFFECT TRANSISTORS

20 Hours

2.1 Transistor types and BJT construction.

2.2 Basic Transistor operation, Forward, Reverse Bias. Transistor current.

2.3 Transistor Parameters and Ratings

2.4 Transistor as a voltage amplifier.

2.5 Transistor amplifier, configuration, comparison and uses.

2.6 Transistor, modes of operation.

2.7 Transistor as a switch.

2.8 Transistor and IC packages and terminal Identification.

- 2.9 General purpose transistors (TO-18, TO-39, TO-46, TO-52, TO-72, TO-92, TO-23 AB)
- 2.10 Power Transistor (TO-3, TO-218, T-220, T-225)
- 2.11 RF Transistor.
- BJT Biasing Techniques:
- 2.12 The DC operating point.
- 2.13 The fixed base bias.
- 2.14 The emitter bias.
- 2.15 Voltage divider bias.
- 2.16 The collector bias.
- 2.17 Field Effect Transistor and its Biasing:
- 2.18 Junction Field Effect Transistor (JFET)
- 2.19 JFET Characteristics and parameter.
- 2.20 JFET Biasing.
- 2.21 Metal oxide Semiconductor FET (MOSFET) types.
- 2.22 MOSFET Biasing.

3. SPECIAL DIODES

10 Hours

- 3.1 Zener Diodes.
- 3.2 Zener Diode as voltage Regulator, percentage of regulation.
- 3.3 Zener limiting.
- 3.4 Varactor Diodes.
- 3.5 Varactor in Tuning Circuits.
- 3.6 Optical Diodes
- 3.7 Light Emitting Diode(LED)
- 3.8 Liquid Crystal Diode(LCD)
- 3.9 Photo Diode.
- 3.10 Other Diodes.
- 3.11 Schottky diode, construction, Characteristics, uses.
- 3.12 Tunnel Diode, Negative resistance region.
- 3.13 Tunnel Diode Oscillator.
- 3.14 PIN Diode
- 3.15 Step Recovery Diode
- 3.16 LASER Diode
- 3.17 IMPATT Diode
- 3.18 Gunn Diode.

4. THYRISTOR, SPECIAL DIODES & TRANSISTORS

10 Hours

- 4.1 The shockley diode,
- 4.2 Silicon Controlled Rectifier (SCR)
- 4.3 SCR Applications.
- 4.4 Silicon Controlled Switch (SCS)
- 4.5 Diac and Triac
- 4.6 Unijunction Transistor (UJT)

- 4.7 Photo diode & Photo transistor
- 4.8 Light Activated SCR (LASCR)
- 4.9 Opto-coupler.

5. PHASE CONTROLLED RECTIFIERS (1-PHASE & 3-PHASE) 1 Hours

- 5.1 Basic controlled rectifier circuits
- 5.2 Forced commutated controlled rectifier circuit
- 5.3 Naturally commutated convertors (half & full wave)

6. INVERTERS 6 Hours

- 6.1 1-Phase full-wave circuit
- 6.2 3-phase full-wave bridge circuit as a line commutated inverter
- 6.3 Four quadrant control

7. CONTROL OF DC & AC MOTORS 4 Hours

- 7.1 DC motor speed control system
- 7.2 3-phase full-wave controlled rectifier circuit to control DC motors
- 7.3 1-phase full-wave controlled rectifier circuit to control DC motor
- 7.4 Introduction of speed control of induction motors
- 7.5 Voltage, variation, frequency variation
- 7.6 Plus width modulation technique of frequency control
- 7.7 Variable frequency, variable voltage control system (AC to AC converter)
- 7.8 SCRCyclo-converter
- 7.9 Open-loop & closed-loop induction motor speed control

RECOMMENDED BOOKS

Electronic Fundamentals: Floyd
Power Electronics :B.W. Williams
Digital electronics:Malvino
Electronics in Industry : Chute

INSTRUCTIONAL OBJECTIVES**UNDERSTAND THE PRINCIPLES, CHARACTERISTICS AND APPLICATION OF VARIOUS TYPES OF SEMICONDUCTOR DIODES**

- 1.1.1 Explain semiconductor doping.
- 1.1.2 List donor and acceptor materials for silicon and germanium.
- 1.1.3 Define majority carriers and minority charge carriers.
- 1.1.4 Explain the effect of temperature & light on the resistance of
 - Intrinsic semiconductor and
 - Extrinsic semiconductor
- 1.2 PN Junction Theory:
 - 1.2.1 Draw a PN Junction
 - 1.2.2 Define the terms depletion layer capacitance & diffusion capacitance.
 - 1.2.3 Sketch the voltage-current characteristics curve for a PN junction.
 - 1.2.4 Determine R_F , R_R and I_S from the diode characteristics curve.
 - 1.2.5 List the typical values of barrier potentials for silicon and germanium diode.
- 1.3 Understand PN Diode Applications
 - 1.3.1 List the uses of PN diode.
 - 1.3.2 Explain half and full wave rectifier using circuit diagram.
 - 1.3.3 Define Ripple factor, surge current.
 - 1.3.4 Explain function of rectifier (L, PI, T filters)
 - 1.3.5 Explain its uses as voltage multiplier (doubler).
 - 1.3.6 Explain the working of a voltage doubler circuit.
 - 1.3.7 List the applications of voltage multiplier circuit.
 - 1.3.8 Explain the operation of a diode as a switch.

UNDERSTAND BIPOLAR JUNCTION AND FIELD EFFECT TRANSISTORS, ITS BIASING AND BASIC BJT CIRCUITS.

- 2.1.1 Draw and label physical structure and symbols for NPN and PNP transistors.
- 2.1.2 Show the four Operation mode of BJT and application of each mode (cut off active, active and inverse)
- 2.1.3 Compute the values of I_E , and Beta (dc) for given value of I_B and I_C .
- 2.1.4 Explain the working of basic BJT voltage amplifier w.r.t. bias of junctions, Flow of charge carriers and transistor currents.

- 2.1.5 Define transistor cut off and breakdown voltages.
- 2.1.6 List four maximum ratings specified by manufacturers' parameters of transistor.
- 2.1.7 Drive the expression for I_C versus I_B for CE configuration in the active resistor.
- 2.1.8 Sketch the input and output static characteristics curves for common base (CB) Amplifier.
- 2.1.9 Repeat 2.1.8 for CE amplifier.
- 2.1.10 Repeat 2.1.8 for CC amplifier.
- 2.1.11 List the types of transistor structures.
- 2.1.12 Draw and label the Structure of epitaxial transistor.
- 2.1.13 Enlist the advantages of I.C. over conventional circuit.
- 2.1.14 List the three broad categories of BJTs with package types used for each.
- 2.1.15 Identify the high frequency limitations of BJT.

3 UNDERSTAND BJT BIASING TECHNIQUES

- 3.1 Explain the purpose of dc bias in a transistor circuit.
- 3.2 Show how bias effects the operation of BJT
 - 3.2.1 Draw and label load line on the characteristic curves for CE Configuration
- 3.3 using empirical formulas for h parameter
- 3.4 Locate the Q-point for linear operation of the amplifier

UNDERSTAND BASIC BJT CIRCUITS

- 4.1 Compute A_i , R_i , A_v , R_o and A_p for CE, CB and CC configuration
- 4.2 Using empirical formula.
- 4.3 Compare the three BJT configurations.
- 4.4 Draw a Darlington pair (emitter follower) circuit.
- 4.5 Explain the working of darlington pair.
- 4.6 List the applications of darlington pair

UNDERSTAND FIELD EFFECT TRANSISTORS

- 5.1 Explain the principle of the n-channel JFET using illustrations.
- 5.2 Sketch the construction of n-channel JFET & its symbol.
- 5.3 Sketch & label a family of drain characteristics of a n-channel JFET.
- 5.4 Define the terms I_{DSS} and V_p .
- 5.5 Explain the effect of change in V_{GS} the JFET characteristics.
- 5.6 Explain above from 2.4.1 thru. 2.4.3 for p-channel JFET.
- 5.7 Define the major data-sheet parameter of a JFET.

- 5.8 Explain the principle of n-channel enhancement MOSFET.
- 5.9 Sketch & label the family of drain characteristics of n-channel enhancement

MOSFET.

- 6.1 Repeat 2.4.9 for n-channel depletion-enhancement MOSFET.
- 6.2 Sketch symbols for p & n-channel JFET, n-channel enhancement MOSFET, p- and n- channel depletion- enhancement MOSFET.
- 6.3 List three advantages of n-channel over p-channel MOSFET.
- 6.4 Sketch the cross- section of V-MOSFET.
- 6.5 Explain the working of V-MOSFET.
- 6.6 Compare the V-MOSFET with other FETs.
- 6.7 List the applications of MOSFET.
- 6.8 Sketch the cross section of complementary MOSFET (CMOS).
- 6.9 List the applications of CMOS.

UNDERSTAND FET BIASING

- 7.1. Explain the term “FET biasing”
- 7.2 Draw DC load line and locate bias point on the family of drain
Characteristic curves of JFET.
- 7.3 Draw a self-bias arrangement p-channel & n-channel JFET.
- 7.4 Set the Q-point for a self-biased JFET
- 7.5 Explain the Q-point stability of a JFET.
- 7.6 Show zero bias of D-MOSFET.

UNDERSTAND BASIC FET CIRCUITS

- 8.1 List the three of configuration of FET amplifier.
- 8.2 Sketch & label the circuit for CS-JFET amplifier.
- 8.3 Write down expressions for A_v and Z_i and Z_o for CS, CD, CG, JFET amplifier
- 8.4 Draw MOSFET amplifier configuration.
- 8.5 Define (i) transconductance, g_m (ii) drain resistance, r_d
and (iii) Amplification factor of an FET.

UNDERSTAND THE CHARACTERISTICS AND APPLICATION OF DIODE USED FOR A SPECIAL PURPOSE ZENER DIODE

- 9.1 Explain the construction of Zener and draw its symbol
 - 9.1.1 Draw the V-I characteristic of a Zener diode.
 - 9.1.2 Identify the characteristic features of Zener diode.
 - 9.1.3 Explain the working of Zener diode as voltage regulator.
 - 9.1.4 Define the terms line regulation, and load regulation for Zener diode.
 - 9.1.5 Compare formulae to find the range of series resistor (R_S) and load resistor (R_L) for a Zener regulator for given variations in line voltage and current.
 - 9.1.6 List the other applications of Zener diode.
- 9.2 Understand the Characteristics of Varactor Diode
 - 9.2.1 Identify the key parameters of varactor diode.
 - 9.2.2 Enlist the applications of varactor diode.
 - 9.2.3 Draw the circuit of electronic tuner of a receiver using varactor diode.
- 9.3 Understand the Characteristics of Optical Diodes (LED LCD and Photodiode)
 - 9.3.1 Define the term optical devices.
 - 9.3.2 List the name of opto electronic devices.
 - 9.3.3 Explain the electroluminescence process in LED.
 - 9.3.4 List the materials with colour of emission used for LED
 - 9.3.5 Explain the effect of bias on the operation of normal and colour emissive LEDs.
 - 9.3.6 List the applications of LEDs.
 - 9.3.7 Describe the term Liquid crystal.
 - 9.3.8 Explain the working principle of both types of LCD.
 - 9.3.9 Compare LCD with a LED.
 - 9.3.10 List the applications of LCDs.
 - 9.3.11 Explain the operation of a photo diode.
 - 9.3.12 Name the materials used for photodiode with their colour Sensitivity characteristics
 - 9.3.13 List the applications of photodiodes.
 - 9.3.14 Draw a circuit of photoelectric relay using a photodiode.

UNDERSTAND SPECIAL DIODES (SCHOTTKY, TUNNEL, PIN, LASER, IMPATT, GUNN)

- 10.1 List main type of special diodes.
- 10.2 Explain the basic internal structure and working of a Schottky diode.

- 10.3 List the main application areas of Schottky diode
- 10.4 Explain the principle of tunnel diode using energy level diagram.
- 10.5 List the names of material used for making tunnel diode.
- 10.6 Sketch the construction along with symbol for a tunnel diode.
- 10.7 Compare the V-I characteristics of a tunnel diode with that of an ordinary.
- 10.8 List the applications of tunnel diode.
- 10.9 Sketch the basic parallel tunnel diode amplifier.
- 10.10 Sketch the tunnel diode oscillator circuit.
- 10.11 Explain briefly the working of circuit in 3.1.9 & 3.1.10
- 10.12 Show & label the three regions of a PIN diode structure
- 10.13 Explain the effect of bias on the resistance of PIN diode
- 10.14 List the names of the materials used for making PIN diode
- 10.15 Enlist the applications of PIN diode
- 10.16 Define the term LASER.
- 10.17 Sketch the structure of double hetero junction semiconductor laser diode.
- 10.18 List the names of the materials with field of application for laser diode.
- 10.19 List the application of lasers.
- 10.20 Describe the working of laser diode and photo diode pick up system of Compact Disk (CD) players
- 10.21 Explain Gunn effect in bulk semiconductors.
- 10.22 List the names of material exhibiting Gunn Effect.
- 10.23 Sketch a Gunn diode construction.
- 10.24 List the application of Gunn diode.
- 10.25 Give the name for acronym IMPATT.
- 10.26 Explain briefly the principle of IMPATT diode.
- 10.27 Sketch the structure of IMPATT diode
- 10.28 Explain the two behavioral effect of IMPATT diode to produce 180 phase Difference between the RF applied voltage and resulting current pulse
- 10.29 List the merits and demerits of IMPATT diode.
- 10.30 Enlist applications of IMPATT diode.

UNDERSTAND THYRISTORSUJT WITH THEIR APPLICATIONS

- 11.1 Explain the term thyristor
- 11.2 Name the important thyristor family devices
- 11.3 Sketch the construction of shockley diode
- 11.4 Draw and label the forward v-i characteristics for a shockley diode
- 11.5 List the methods to turn off and turn on shockley diode
- 11.6 Explain the working of a shockley diode relaxation oscillator.
- 11.7 Compare an SCR with a shockley diode.
- 11.8 Draw and label the schematic symbol for an SCR

- 11.9 Explain the turn-on process of SCR using transistor equivalent.
- 11.10 Sketch the V-I characteristics for SCR.
- 11.11 Interpret the SCR data sheet parameters.
- 11.12 Explain the phase-control of an SCR
- 11.13 Draw basic circuits for SCR used in the areas of
 - 11.13.1 Power control
 - 11.13.2 Switching and
 - 11.13.3 Protection
- 11.14 Explain briefly the circuits drawn under 4.1.13.
- 11.15 Compare a DIAC with a Shockley diode in terms of
 - 11.15.1 Basic structure
 - 11.15.2 Symbol
 - 11.15.3 Operation
- 11.16 Compare a TRIAC with an SCR in terms of
 - 11.16.1 Basic structure
 - 11.16.2 Symbol operation
- 11.17 Sketch & label the transistor equivalent circuit for a TRIAC.
- 11.18 Explain the phase shift control of TRIAC with a DIAC as a switching device as used in light for UJT.

UNDERSTAND UNIJUNCTION TRANSISTOR CHARACTERISTICS

- 12.1 Sketch the structure of a unijunction transistor (UJT).
- 12.2 Sketch the equivalent circuit and symbol for UJT.
- 12.3 Explain the working of UJT circuit of 4.2.2.
- 12.4 Draw the V-I characteristic curve for UJT.
- 12.5 Draw a circuit for UJT relaxation oscillator.
- 12.6 List the three factors controlling the period of oscillation of a relaxation oscillator
- 12.7 Sketch a UJT time delay circuit.

13. UNDERSTAND PROPERTIES OF PHOTO-SENSITIVE BJT&LASCR

- 13.1 Compare a photo-transistor with a conventional BJT.
- 13.2 List the factors controlling collector current of a photo transistor.
- 13.3 Draw the circuit for forward and reverse acting light operated relay using phototransistor .
- 13.4 Sketch the circuit of a photo darlington pair
- 13.5 List the requirements to turn-on and turn-off pf a light activated SCR (LASCR).
- 13.6 List the types of input devices normally used in an opto-coupler
- 13.7 List five types of output devices used in opto-coupler.

13.8 List the applications of opto-coupler.

**UNDERSTAND THE OPERATION OF PHASE CONTROLLED
RECTIFIERS & CONVERTERS, WITH
HELP OF CIRCUIT & WAVE DIAGRAM**

- 14.1 State various methods of phase control of SCRs
- 14.2 Explain with the help of circuit & wave diagrams, operation of controlled rectifier
- 14.3 Explain the forced commutation control method SCR
- 14.4 Explain the operation of half & full wave naturally commutated converters

**UNDERSTAND SINGLE & THREE PHASE FULL-WAVE
CONVERTER/INVERTER**

- 15.1 Draw circuit for 1-phase & 3-phase full-wave inverter circuit
- 15.2 Explain the working of inverter circuit (1-phase & 3-phase)
- 15.3 Explain the line commutated (single & three phase) inverter with full-wave output
- 15.4 Know the combined operation of rectifier & inverter as four quadrant control of a converter

**UNDERSTAND THE USE OF POWER ELECTRONICS FOR CONTROL
OF A.C. / D.C. MOTORS – UNDERSTAND THE USE OF DIODES
& SCRS CONNECTED FOR 1-PHASE & 3-PHASE, FOR SPEED
CONTROL OF D.C. MOTORS**

- 16.1 State the methods of speed control of dc motors
- 16.2 Explain the speed control of dc motors employing 3-phase full-wave controlled rectifier circuits
 - 16.3 Describe the speed control of DC motors employing 1-phase fully controlled circuit, with the help of circuit & waveform
 - 16.4 Draw circuit for a 3-phase fully phase controlled, 4-quadrant speed control of DC motors
 - 16.5 State methods of AC Motors Control
 - 16.6 Draw circuit & waveform for 3-phase AC variable output voltage employing semi-conductor devices
 - 16.7 Draw circuit & waveform for 3-phase AC variable frequency circuits employing semi-conductor devices
 - 16.8 Explain the methods employing SCRs & diodes for 3-phase variable voltage, variable frequency (AC to AC conversion) as applied to induction motor speed control, using circuits, & waveform

- 16.9 Describe with the help of block diagrams and waveforms, the pulse width modulation technique (PWM) of frequency variation, employing 1-phase & 3-phase input supply
- 16.10 Explain PWM & variable-voltage method for speed control of 3-phase induction motors
- 16.11 Draw block diagram and waveform for cyclo-converters giving 1-phase and 1-phase variable frequency output
- 16.12 State the use of SCR Cyclo-converters for speed control of AC motors
- 16.13 Draw and explain the open-loop speed control of electric motors
- 16.14 Draw and explain the closed-loop speed control of motors

LIST OF PRACTICALS

1. Draw the forward & reverse characteristics of a P.N. junction diode. (3 Hours.)
Assemble a full wave diode rectifier circuit with a PI filter & calculate the ripple factor of output wave. (3 Hours.)
Demonstrate diode as a switch with LED as a load.Troubleshoot a faulty diode rectifier circuit. (3 Hours.)
Plot the input & output characteristics of a transistor in common base configuration and common emitter configuration. (3 Hours.)
Plot the input and output characteristics of transistor in common collector configuration.
6. Plot the transfer characteristics curve of transistor in CE configuration. (3 Hours.)
7. Assemble a transistor voltage amplifier and find its voltage gain. (3 Hours.)
8. Plot the characteristics curves for a common source FET amplifier. (3 Hours.)
9. Demonstrate MOSFET as a switch and study the performance (3 Hours.)
10. Plot the characteristics curves for SCR&UJT. (3 Hours.)
11. Assemble a light dimmer using a DIAC& a TRIAC. (3 Hours.)
12. Demonstrate the working of an opto-coupler using (6 Hours.)
a) Photo diode & LED b) Phototransistor & LED
Demonstrate the working of an operational amplifier, use of op-Amp as an inverting & non-inverting amplifier and a voltage follower.Draw the frequency response of an Op-Amp. 3 Hours.)
14. Study the characteristics and series-parallel working of power diodes (3 Hours.)
15. Demonstrate SCR phase control.Study the 4-quadrant control of SCR's (3 Hours.)
Observe the characteristics & working of forced commutated controlled-rectifier circuits and naturally commutated full-wave convertors (3 Hours.)
Construct and study working of 1-phase full-wave inverter circuit and 3-phase full-wave inverter (3 Hours.)
18. Study 3-phase full-wave control circuit for DC motors (3 Hours.)
19. Study working of AC to AC converters as AC motor speed control (3 Hours.)
20. Study PMW technique of frequency control (3 Hours.)
21. Study open & closed loop induction motor speed control (3 Hours.)

MTR -272**DIGITAL LOGIC DESIGN**

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

Aims

To understand the fundamentals of digital electronics

To understand the applications of digital electronic devices in the industry

COURSE CONTENTS**1. INTRODUCTION** Hours

- 1.1 Digital & analogy quantities
- 1.2 Number systems, BIT, BYTE, NIBBLE
- 1.3 Elements of digital electronics

2. LOGIC GATES Hours

- 2.1 AND Gate
- 2.2 OR Gate
- 2.3 NOT Gate
- 2.4 NAND Gate
- 2.5 NOR Gate
- 2.6 XOR Gates

3. BOOLEAN ALGEBRA Hours

- 3.1 Laws of Boolean algebra
- 3.2 De Morgans Laws
- 3.3 Boolean Function Generation from truth tables

4. ARITHMETIC LOGIC CIRCUITS Hours

- 4.1 Half adders
- 4.2 Full adders
- 4.3 Adder-subtractor
- 4.4 Comparators

COMBINATIONAL LOGIC AND DATA PROCESSING CIRCUITS 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 Read-only memories
- 5.8 Diode ROM
- 5.9 Commercially available ROM

6. FLIP-FLOPS

4 Hours

- 6.1 RS Flip-Flop
- 6.2 Clocked RS Flip-Flop
- 6.3 D Flip-Flop
- 6.4 Edge-triggered D Flip-Flop
- 6.5 JK Flip-Flop

7. CLOCKS & TIMERS

Hours

- 7.1 TTL clock
- 7.2 555—astable, monostable
- 7.3 Applications

8. SHIFT REGISTERS

Hours

- 8.1 Introduction, shift-Right & shift-Left
- 8.2 Serial in-serial out
- 8.3 Serial-in parallel-out
- 8.4 Parallel-on serial-out

COUNTERS

Hours

- 9.1 Introduction, types
- 9.2 Ripple counter
- 9.3 Synchronous counter
- 9.4 Presentable counter
- 9.5 Digital clock

MEMORIES

Hours

- 10.1 Introduction, volatile, non-volatile
- 10.2 Memory Addressing
- 10.3 ROM, PROM, EPROM, capacity
- 10.4 RAM, Static & dynamic, capacity

11. APPLICATION OF DIGITAL ELECTRONICS

2 Hours

- 11.1 Digital clock
- 11.2 Frequency & time period counter
- 11.3 Moving Message Display

RECOMMENDED BOOKS

1. Industrial Electronics: James A. Rehg and Glenn J. Sartori (2005)
 2. Digital Electronics: A Practical Approach William Kleitz (8th Edition) (2007)
- Power Electronics :B.W. Williams

INSTRUCTIONAL OBJECTIVES**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

UNDERSTAND THE WORKING OF VARIOUS LOGIC GATES

- 2.1 Describe the working of AND Gate
- 2.2 Describe the working of OR Gate
- 2.3 Describe the working of NOT Gate
- 2.4 Describe the working of NAND Gate
- 2.5 Describe the working of NOR Gate
- 2.6 Describe the working of XOR Gates
- 2.7 Understand the configurations formed by combining gates

INTRODUCTION TO BOOLEAN ALGEBRA & ITS LAWS

- 3.1 Study the laws of boolean algebra
- 3.2 Study the De Morgans Laws
- 3.3 Understand the boolean function generation from truth tables

DETAILED DESCRIPTION OF ARITHMETIC LOGIC CIRCUITS

- 4.1 Describe the working of Half adders
- 4.2 Describe the working of Full adders
- 4.3 Describe the working of Adder-subtractor
- 4.4 Describe the working of comparators

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

- 5.1 Define the terms multiplexer, demultiplexers, decoder, encoders, BDC converters
- 5.2 Explain multiplexers, using logic circuits & block-diagrams (multiplexers using IC's such as 74150)
- 5.3 Explain demultiplexers, 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

DETAILED DESCRIPTION OF FLIP-FLOPS 6.1

- Describe the working of RS Flip-Flop
- 6.2 Describe the working of Clocked RS Flip-Flop
- 6.3 Describe the working of D Flip-Flop
- 6.4 Describe the working of Edge-triggered D Flip-Flop
- 6.5 Describe the working of JK Flip-Flop

UNDERSTAND THE WORKING OF CLOCKS & TIMERS

- 7.1 Study the function of a TTL clock
- 7.2 Study the Timer 555 – astable, monostable
- 7.3 Identify the applications of clock and timers

KNOW ABOUT SHIFT REGISTERS

- 8.1 Study the basic concepts of shift-right & shift-left registers
- 8.2 Understanding the serial in-serial out configuration
- 8.3 Understand the serial-in parallel-out configuration
- 8.4 Understand the parallel-on serial-out configuration

UNDERSTAND THE WORKING OF COUNTERS

- 9.1 Study the basics and the types of counters
- 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 Understand the working of digital clock

KNOWS VARIOUS TYPES OF MEMORIES

- 10.1 Define various types of memories: ROM, PRM, EPROM, RAM
- 10.2 State memory of common memory devices in KB, MB
- 10.3 Know the system of memory addressing

APPLY THE CONCEPTS OF DIGITAL ELECTRONICS FOR PROJECT(S)

- 11.1 Explain the use of digital electronic circuits as elements of a chosen system
- 11.2 Describe the use of digital electronic circuits for the following:-
 - 11.2.1 Moving display
 - 11.2.2 Frequency counters
 - 11.2.3 Digital clock

LIST OF PRACTICALS

Identify and verify truth tables for AND, OR, NOT Gates ICs

Identify and verify truth tables for NOR, NAND, XOR Gates ICs

Construct and verify truth tables of half adder, full adder

Connect and study an adder & subtractor circuits

To perform and study the function of Decoder & demultiplexer through related IC

To perform and study the function of Encoder & Multiplexer through related IC

Identify and verify the functions of RS Flip-Flop

Identify and verify the functions of Clocked RS Flip-Flop

Identify and verify the functions of D Flip-Flop

Identify and verify the functions of JK Flip-Flop

Connect a 555 IC as

A-stable multivibrator

Monostable multivibrator

Bistable multivibrator

Connect and observe the working of shift registers (SISO, SIP, PISO, PIPO)

Identify, connect and observe working of ripple and synchronous counters

Select components, assemble and observe working of a digital clock

Study the working of memory devices

Assemble and observe working of frequency counter (Project – 2)

Assemble and observe working of moving message display (Project – 3)

YEAR - 3

اسلامیات / مطالعہ پاکستان

GEN 3II

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کل وقت: 20 گھنٹے

نصاب (سال سوئم)

حصہ اول اسلامیات

حصہ دوم مطالعہ پاکستان

موضوعات:

قرآن مجید

-1

سورة الفاتحہ۔ ایتہ الکرسی۔ سورة البقرة کی آخری آیات از امن الرسول سے تا آخر اور سورة اخلاق مع ترجمہ و تشریح

دس منتخب احادیث مع ترجمہ و تشریح

-2

☆ بنی الاسلام علی خمس شہادت انا الہ الاکملہ الصلوٰتہ وایتا الزکوٰۃ وحج

البيت وصوم رمضان

☆ الدین النصیحتہ

☆ المنشاء مویتمن

☆ للمومن علی المومن سنت خصال یعود ماذا مرض و تشہدہ اذامات ویجیبہ اذا

دعا

☆ لیسلم علیہ اذا لقیہ ولیثمتہ اذا عطس وفصیحلہ اذا غاب او شہد

☆ لا تنخن من خائک

☆ لا یدخل الجنة قاطع

☆ ان اللہ حرم علیکم عقوق المہات واضاعتہ المال

☆ لیسر او لا تعسر او لا تنفرا

☆ ذاق طعم الايمان من مرضی باللہ وبالاسلام دینا بمجمدنیا

☆ افضل الذکر لا الہ الا اللہ

-3 حقوق و فرائض

☆ حصول تعلیم بطور فرص۔ والدین اور اولاد کے حقوق و فرائض۔ ہمسایہ کے حقوق

-4 اسلام کی اخلاقی اقدار

☆ صبر و استقلال۔ غفور و درگزر۔ ایفاء عہد۔ اخوت۔ ایثار و قربانی

سال سوئم
حصہ اول اسلامیات

تدریس مقاصد

قرآن حکیم

عمومی مقصد: منتخب سورتوں اور آیات کی روشنی میں اسلام کے بنیادی مقاصد اور عبادات جان سکے
خصوصی مقاصد: طالب علم اس قاتل ہو جائے گا کہ
سورۃ الفاتحہ: آیتہ الکرسی۔ سورۃ بقرۃ کی آخری آیات از امن 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
- ☆ عبادت 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
- ☆ تعلیم 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 مقصد:

☆ احادیث کا ترجمہ بیان کر سکے

- ☆ احادیث کی تشریح کر سکے
- ☆ معاشرتی اور انفرادی زندگی میں احادیث سے راہنمائی حاصل کر سکے
- حقوق و فرائض**
- عمومی مقصد: اسلامی معاشرے کا ایک اچھا فرد بن سکے
- خصوصی مقاصد:
- ☆ والدین کے حقوق و فرائض بیان کر سکے
- ☆ ہمسایوں کے حقوق بیان کر سکے
- ☆ اسلام میں حقوق و فرائض کی اگاہی کی صورت میں اپنے اندر خدمت خلق کا جذبہ پیدا کر سکے
- اسلامی اقدار
- عمومی مقصد: 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 اخلاق کی اہمیت بیان کر سکے
- ☆ قرآن و سنت کی روشنی میں صبر و استقلال کی اہمیت بیان کر سکے
- ☆ اسلام میں عفو و درگزر کی اہمیت بیان کر سکے
- ☆ ایفاء عہد کی اہمیت بیان کر سکے
- ☆ اخوت کے معنی و مفہم کو بیان کر سکے
- ☆ اخوت اسلامی کی اہمیت بیان کر سکے
- ☆ اسلام کی اعلیٰ اقدار کو اپنا کر مثالی معاشرہ پیدا کر سکے

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GEN 311

نصاب (سہل سوئم)
مطالعہ پاکستان
حصہ دوم

موضوعات

- ☆ قیام پاکستان
- ☆ بانڈری کمیشن
- ☆ ریڈ کلف ایوارڈ
- ☆ تقسیم بنگال و کلکتہ
- ☆ تقسیم پنجاب
- ☆ مسئلہ مہاجرین
- ☆ ریاست کا الحاق
- ☆ ریاست جموں و کشمیر
- ☆ نہری پانی کا تنازعہ
- ☆ قرار داد مقاصد
- ☆ علماء کے بانیس نکات
- ☆ 1956-1962 اور 1973 کے دساتیر کی اسلامی دفعات
- ☆ پاکستان کا محل وقوع اور اس کی جغرافیائی اہمیت
- ☆ قدرتی وسائل (تیل-گیس-کونلہ)

مطالعہ پاکستان (حصہ دوم)
قیام پاکستان

تدریس مقاصد

عمومی مقاصد: قیام پاکستان کے بعد درپیش مسائل سے آگاہی حاصل کرے اور بیان کرے
خصوصی مقصد:

- ☆ باؤنڈری کمیشن تشکیل اور اس کے فرائض بیان کر سکے
- ☆ ریڈ کلف 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
- ☆ قیام پاکستان کے بعد نفاذ اسلام کی کوششوں کو بیان کر سکے
- ☆ پاکستان کے محل وقوع اور اس کی جغرافیائی اہمیت بیان کر سکے
- ☆ پاکستان میں قدرتی وسائل (تیل - گیس - کوئلہ) کے بارے میں بیان کر سکے

(غیر مسلم طلباء کے لئے)

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کل وقت: 20

Gen 3II

- ☆ نصاب اخلاقیات
- ☆ سال سوئم
- ☆ موضوعات
- ☆ احساس ذمہ داری
- ☆ مثبت ذہن
- ☆ عدل و انصاف
- ☆ قومی خدمت کا جذبہ
- ☆ ذکر و نظر کی پاکیزگی
- ☆ احترام آدمیت
- ☆ شائستگی
- ☆ غفو و درگزر
- ☆ بردباری
- ☆ خود انحصاری
- ☆ اثر و نفوذ
- ☆ جامعیت
- ☆ اپنی ذات کی معرفت (بذریعہ ہم عمر طلباء۔ اساتذہ۔ اہم شخصیات ادارہ)

(غیر مسلم طلباء کے لئے)

نصاب اخلاقیات

سال سوئم

تدریس مقاصد

- ☆ عمومی مقصد: 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 گا 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 ادوارہ 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 برکت سے استفادہ کر سکے

MGM-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS

Total Contact Hours

Theory	32	T P C
Practical	0	1 0 1

AIMS: The study of this subject will enable the student to develop the management skills, acquaint them with the functions & practices of Management and Human Relations and develop psychological approach to assist in solving the work-related problems, efficiently.

COURSE CONTENTS

- | | |
|--|----------------|
| 1. INDUSTRIAL PSYCHOLOGY. | 2 Hours |
| 1.1 History and definition. | |
| 1.2 Nature and scope. | |
| 2. LEADERSHIP | 1 Hour |
| 2.1 Definition and types. | |
| 2.3 Qualities of a good leader. | |
| 3. MOTIVATION | 2 Hours |
| 3.1 Definition. | |
| 3.2 Types (Financial and non-financial motives). | |
| 3.3 Conflict of motives. | |
| 4. MORALE | 1 Hour |
| 4.1 Importance. | |
| 4.2 Development. | |
| 4.3 Measurement. | |

5. HUMAN ENGINEERING.	1 Hour
5.1 Importance of human factor in industry.	
5.2 Man-machine system.	
5.3 Strategy for making allocation decisions.	
6. INDUSTRIAL FATIGUE AND BOREDOM.	2 Hours
6.1 Definition and distinction.	
6.2 Psychological causes.	
6.3 Objective causes.	
6.4 Prevention	
7. INDUSTRIAL ACCIDENTS	2 Hours
7.1 Psychological causes.	
7.2 Objective causes.	
7.3 Prevention	
8. INDUSTRIAL PREJUDICE	2 Hours
8.1 Causes	
8.2 Remedies	
9. PUBLIC RELATIONS.	2 Hours
9.1 Importance	
9.2 Functions	
10. GUIDANCE AND COUNSELLING	2 Hours
10.1 Importance	
10.2 Choice of job.	
10.3 During service	
11. JOB EVALUATION	2 Hours
11.1 Importance	
11.2 Methods	
11.3 Job satisfaction	
11.4 Work simplification.	
12. INDUSTRIAL MANAGEMENT	2 Hours
12.1 Introduction	
12.2 Functions of management.	
12.3 Subdivisions of management	
12.4 Objectives of industrial management.	

- 13. PERSONNEL SELECTION. 2 Hours**
- 13.1 Recruitment of employees.
 - 13.2 Training.
 - 13.3 Effects of training on production and product cost.
- 14. WORKING CONDITIONS. 2 Hours**
- 14.1 Importance and consideration.
 - 14.2 Effects on efficiency and per unit cost.
- 15. TIME AND MOTION STUDY. 3 Hours**
- 15.1 Concept and importance.
 - 15.2 Sequence of motion study.
 - 15.3 Principles of motion study.
 - 15.4 Steps to time study.
 - 15.5 Determination of operations time.
- 16. QUALITY CONTROL. 2 Hours**
- 16.1 Concept and advantages
 - 16.2 Methods.
- 17. ROLE OF FOREMAN IN MANAGEMENT. 2 Hours**
- 17.1 Foreman's abilities.
 - 17.2 Duties and functions.

RECOMMENDED BOOKS

- 1 C.S. Meyers, Industrial Psychology, Oxford University Press, London.
Smith Wakley, Psychology of Industrial Behaviors, Mc-Graw Hill, New York.
Ghulam Hussain, Nizam-at-e-Sanaat Aur Insani Rawabat, Ilmi Kitab
Khana, Urdu Bazar, Lahore.
Andrew R. Megill, The Process of Management; William M New Man.
Richard N Omen, Management of Industrial Enterprises.

MGM-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS

INSTRUCTIONAL OBJECTIVES

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

KNOW INDUSTRIAL PSYCHOLOGY.

- 1.1 Describe brief history if industrial psychology.
- 1.2 Describe in detail definition of industrial psychology.
- 1.3 State nature and scope of industrial psychology.

KNOW LEADERSHIP.

- 2.1 Define leadership.
- 2.2 Describe types of leadership.
- 2.3 State qualities of a good leader

UNDERSTAND MOTIVATION.

- 3.1 Define motivation.
- 3.2 Describe financial and non-financial motives.
- 3.3 Explain conflict of motives.

KNOW MORALE.

- 4.1 State importance of morale.
- 4.2 Describe development of morale.
- 4.3 State the method of measurement of morale.

UNDERSTAND HUMAN ENGINEERING.

- 5.1 Explain importance of human engineering in the industry.
- 5.2 Explain man-machine system.
- 5.3 Explain strategy for making allocation decisions.

UNDERSTAND INDUSTRIAL FATIGUE AND BOREDOM.

- 6.1 Define fatigue and boredom.
- 6.2 Describe psychological causes of fatigue and boredom.
- 6.3 Describe objective causes of fatigue and boredom.
- 6.4 Explain measures to prevent fatigue and boredom.

UNDERSTAND INDUSTRIAL ACCIDENTS.

- 7.1 Explain psychological causes of industrial accidents.
- 7.2 Explain objective causes of industrial accidents.
- 7.3 Explain measures to prevent industrial accidents.

UNDERSTAND INDUSTRIAL PREJUDICE.

- 8.1 Define prejudice
- 8.2 Explain causes of industrial prejudice.
- 8.3 Explain remedies of industrial prejudice.

UNDERSTAND THE SIGNIFICANCE OF PUBLIC RELATIONS.

- 9.1 Explain importance of public relations.
- 9.2 Explain functions of public relations.

UNDERSTAND THE NEED FOR GUIDANCE AND COUNSELLING.

- 10.1 State importance of guidance and counselling.
- 10.2 Explain the role of guidance and counselling in choosing the job.
- 10.3 Describe help of guidance and counselling during service.

UNDERSTAND JOB EVALUATION.

- 11.1 Explain importance of job evaluation.
- 11.2 Explain methods of job evaluation.
- 11.3 Explain job satisfaction.
- 11.4 Explain work simplification.

UNDERSTAND INDUSTRIAL MANAGEMENT.

- 12.1 Define management.
- 12.2 State functions of management.
- 12.3 Enlist subdivision of management.
- 12.4 Explain objectives of industrial management.

UNDERSTAND TRAINING AND ITS EFFECTS.

- 13.1 Describe the recruitment procedure of employees in an industrial concern.
- 13.2 Explain training.
- 13.3 Identify the kinds of training.
- 13.4 Explain the effects of training on production and product cost.

UNDERSTAND THE EFFECT OF WORKING CONDITION ON EFFICIENCY.

- 15.1 Explain importance of working condition.
- 15.2 Describe air-conditioning, ventilation, lighting and noise.
- 15.3 State the effects of good working conditions on efficiency and per unit cost.

UNDERSTAND TIME AND MOTION STUDY.

- 15.1 Explain the concept.
- 15.2 Describe the importance of work study.
- 15.3 Explain the sequence of motion study.
- 15.4 State the principles of motion study.
- 15.5 Describe the steps for carrying out time study.
- 15.6 Explain the method of determination of operations time.

UNDERSTAND THE METHODS OF QUALITY CONTROL.

- 16.1 Define quality control
- 16.2 State the advantages of quality control.
- 16.2 Explain methods of quality control.

UNDERSTAND THE ROLE OF FOREMAN IN AN INDUSTRIAL UNDERTAKING.

- 17.1 Explain ability of the foreman.
- 17.2 Enlist duties of foreman.
- 17.3 Describe functions of foreman as middle management.

Total Contact (Hours)	160	T	P	C
Theory (Hours):	64	2	3	3
Practical (Hours):	96			

Aims

To provide an overview of the structure of a micro-processor and micro controller

To introduce the most commonly used microcontrollers in programming

To understand how programs are written in assembly language

COURSE CONTENTS**1. INTRODUCTION****6 Hours**

1.1 Definition : Microprocessors

1.1.1 Definition: ROM

1.1.2 PROM

1.1.3 EPROM

1.1.4 EEPROM

1.1.5 RAM

1.1.6 Flash

1.1.7 Input/output

1.2 Microcontrollers

1.3 Difference between micro-processor and micro controllers

1.4 Components of a micro-processing system

1.4.1 Central Processing Unit

1.4.2 Input Output Interfaces

1.4.3 Memory

2. MICRO PROCESSING SYSTEM**16Hours**

2.1 Buses

2.1.1 Data Bus

2.1.2 Address Bus

2.1.3 Control Bus

2.2 Architecture of a microprocessor

2.2.1 Arithmetic and Logic Unit (ALU)

- 2.2.2 Registers
 - 2.2.2.1 Accumulator Register
 - 2.2.2.2 Status Register
 - 2.2.2.3 Program Counter Register
 - 2.2.2.4 Memory Address Register
 - 2.2.2.5 Instruction Register
 - 2.2.2.6 General Purpose Register
 - 2.2.2.7 Stack Pointer Register
- 2.2.3 Control Units
- 2.2.4 Clock generator
- 2.3 Memory
- 2.4 Peripheral Devices
- 2.5 Making connections
- 2.6 Polling/Interrupts
- 2.7 Parallel I/O
- 2.8 Serial Communication

3 MICROCONTROLLERS

8Hours

- 3.1 General Construction and components of a microcontroller
- 3.2 Selection of microcontroller
- 3.3 8-bit microcontroller
- 3.4 16-bit microcontroller
- 3.5 32 bit microcontroller
- 3.6 Architecture of RISC and CISC

4 AN INTRODUCTION TO WRITING INSTRUCTIONS

8 Hours

- 4.1 Definition of an instruction set
- 4.2 Mnemonics
- 4.3 Basic instruction types
 - 4.3.1 Addressing modes
 - 4.3.2 Inherent addressing
 - 4.3.3 Immediate addressing
 - 4.3.4 Direct addressing
 - 4.3.5 Register indirect addressing
 - 4.3.6 Indexed addressing
 - 4.3.7 Relative addressing

5 COMMONLY USED MICROCONTROLLERS

12Hours

- 5.1 Motorola (68HC05 and 68HC11)
 - 5.1.1 Ports
 - 5.1.2 Modes
 - 5.1.3 Oscillator Pins
 - 5.1.4 Interrupt Controller
 - 5.1.5 Timer
 - 5.1.6 COP
 - 5.1.7 PWM
- 5.2 Atmel (8051)
 - 5.2.1 Ports
 - 5.2.2 ALE
 - 5.2.3 PSEN
 - 5.2.4 EA
 - 5.2.5 XTAL1, XTAL2
 - 5.2.6 RESET
 - 5.2.7 Serial I/O
 - 5.2.8 Timing
 - 5.2.9 Interrupts
- 5.3 PIC (16Cxxx)
 - 5.3.1 I/O Ports
 - 5.3.2 Analogue Inputs
 - 5.3.3 Timers
 - 5.3.4 Serial I/O
 - 5.3.5 Parallel Slave Port
 - 5.3.6 Crystal Input
 - 5.3.7 Master Clear

6 ASSEMBLY PROGRAMMING

14 Hours

- 6.1 Writing pseudo codes
- 6.2 Syntax and commands
- 6.3 Algorithms
- 6.4 Routines and Subroutines
- 6.5 Examples of assembly language programs

RECOMMENDED BOOKS

Microprocessors and Microcontrollers: N. Kumar, M Saravanan and S Jeevananthan, 2011

Microprocessors & Microcontrollers: Deepali A Godse and Atul P Godse, 2008

MTR-303

MICROPROCESSORS & MICRO-CONTROLLERS

INSTRUCTIONAL OBJECTIVES

INTRODUCE MICROCONTROLLERS AND MICROPROCESSORS

- 1.1 Define microprocessors and microcontrollers
- 1.2 Differentiate between micro-processor and micro controllers
- 1.3 Study the components of a micro-processing system (Central Processing Unit, Input Output Interfaces and Memory)

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 memory of a micro processing system for storage; understand its various types and functions of each type (ROM, PROM, EPROM, EEPROM, RAM, and Flash)
- 2.4 Describe the input and output ports for external connectivity (peripheral devices, making connections, polling/interrupts, parallel and serial I/O)

KNOW ABOUT THE BASICS OF MICROCONTROLLERS

- 3.1 Study the general construction and identify the components of a microcontroller
- 3.2 Understand the criteria for the selection of microcontrollers
- 3.3 Describe a 8-bit microcontroller
- 3.4 Describe a 16-bit microcontroller
- 3.5 Describe a 32 bit microcontroller
- 3.6 Discuss the architecture of RISC and CISC and their usage

UNDERSTAND HOW TO WRITE INSTRUCTIONS

- 4.1 Define an instruction set
- 4.2 Understand the concept of Mnemonics
- 4.3 Identify the basic instruction types
 - 4.3.1 Understand the different addressing modes
 - 4.3.2 Describe inherent addressing

- 4.3.3 Describe immediate addressing
- 4.3.4 Describe direct addressing
- 4.3.5 Describe register indirect addressing
- 4.3.6 Describe indexed addressing
- 4.3.7 Describe relative addressing

INTRODUCE SOME COMMONLY USED MICROCONTROLLERS

- 5.1 Study Motorola (68HC05 and 68HC11) microcontroller: components and operation
- 5.2 Study Atmel (8051) microcontroller: components and operation
- 5.3 Study PIC (16Cxxx) microcontroller: components and operation

DESCRIBE IN DETAIL THE ASSEMBLY PROGRAMMING

- 6.1 Outline the process of writing pseudo codes
- 6.2 Understand the syntax and commands of assembly language
- 6.3 Understand writing assembly algorithms
- 6.4 Understand the concept of routines and subroutines
- 6.5 Study examples of assembly language programs

LIST OF PRACTICAL

1. Study and identify the components of a micro-processing system (6 Hours.)
2. Study and identify the pins of a microcontroller (9Hours.)
3. Introduction to assembly programming software: (12 Hours.)
Write a program in assembly language to subtract a hexadecimal number in memory address 0050 from a hexadecimal number in memory location in 0060 and store the result in location 0070. (6 Hours.)
5. Multiply two 8-bit numbers, located at addresses 0020 and 0021 and store the product an 8-bit number in location 0020 (6 Hours.)
6. Move a block of 32 numbers starting at address \$2000 to a new start address \$3000 (6 Hours.)
7. Write a subroutine that can be used to produce a time delay and which can set to any value. (6 Hours.)
8. Write a routine that can be used so that if the input from a sensor to address 2000 is high the program jumps to one routine starting at 3000 and if low the program continues (6 Hours.)
9. Write a program for switching of lights (6 Hours.)
10. Write a program for producing delay in to subsequent activities (6 Hours.)
Run a program to operate two to three different outputs on the peripherals of microcontrollers (6 Hours.)
12. Interface a 7segment display and LCD with micro controller (6 Hours.)
13. Demonstrate safety measures for a micro processing system (6 Hours.)
14. Class project: Write a program and assemble a circuit using microcontroller, sensor and actuator. (9 Hours.)

MTR-312**HYDRAULICS & PNEUMATICS**

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

Aims

To familiarize the students to basic concepts & working of hydraulics and pneumatics

To comprehend the working of various systems operated by hydraulics and pneumatics

To understand the industrial applications of hydraulics and pneumatics

COURSE CONTENTS**1. INTRODUCTION****4 Hours**

1.1 HydraulicsPneumatics

1.2 Difference between Hydraulics and Pneumatics systems

1.3 Applications of hydraulics & pneumatics system

1.4 Hydraulic and pneumatic power supply

2. FLUIDICS**2 Hours**

2.1 Basic fluid properties

2.2 Hydrostatics

2.3 Buoyancy

2.4 Stability

2.5 Pressure distribution in a fluid with rigid body motion

2.6 Fluid dynamics

2.7 Conservation of mass and momentum

3. DIRECTIONAL CONTROL VALVES (DCVS)**5 Hours**

3.1 Function of DCVs

3.2 Types of common DCVs (spool, shuttle and poppet)

3.3 Valve symbols

3.4 Pilot operated valves

3.5 Directional valves

4. PRESSURE CONTROL VALVES (PCVS)

5 Hours

- 4.1 Function of PCVs
- 4.2 Types of common DCVs (pressure regulating, pressure limiting and pressure sequence valve)
- 4.3 Valve symbols
- 4.4 Operation of pressure regulating valves
- 4.5 Operation of pressure limiting valves
- 4.6 Operation of pressure sequence valves

5. CYLINDERS

7 Hours

- 5.1 Symbol and construction of a hydraulic/pneumatic cylinder
- 5.2 Types of cylinders (single acting and double acting)
- 5.3 Selection of cylinders
- 5.4 Cylinder sequencing
- 5.5 Cascade Control

6. PROCESS CONTROL VALVES

3 Hours

- 6.1 Function of a Process control valve
- 6.2 Diaphragm actuator
- 6.3 Valve bodies and plugs and their types
- 6.4 Control valve sizing
- 6.5 Examples of fluid control systems

7. ROTARY VALVES

4 Hours

- 7.1 Function of a rotary valve
- 7.2 Semi rotary actuator
- 7.3 Vane motor
- 7.4 Examples of systems employing rotary valves

BOOKS RECOMMENDED

Introduction to Hydraulics and Pneumatics: Ilango Soundarak, 2011

Introduction to Fluid Power: James L Johnson, 2001

Hydraulics and Pneumatics: Andrew Parr (Second Edition), 1999

INSTRUCTIONAL OBJECTIVES**INTRODUCE HYDRAULICS & PNEUMATICS**

- 1.1 Define hydraulics and pneumatics
- 1.2 Differentiate between hydraulics and pneumatics systems
- 1.3 Outline the applications of hydraulics & pneumatics system
- 1.4 Describe the power sources for hydraulic and pneumatic systems

INTRODUCE LAWS OF FLUIDICS

- 2.1 Understand basic fluid properties
- 2.2 Describe the concepts of hydrostatics, buoyancy, stability
- 2.3 Study the pressure distribution in a fluid with rigid body motion
- 2.4 Study the basic concepts of fluid dynamics
- 2.5 Study the conservation of mass and momentum

3. UNDERSTAND THE WORKING AND APPLICATIONS OF DCVS

- 3.1 Describe the function of DCVs
- 3.2 Outline the common types of DCVs (spool, shuttle and poppet)
- 3.3 Study the various valve symbols along with symbols for DCVs
- 3.4 Describe the pilot operated valves
- 3.5 Describe the operation of directional valves

UNDERSTAND THE WORKING AND APPLICATIONS OF PRESSURE CONTROL VALVES (PCVS)

- 4.1 Understand the function of PCVs
- 4.2 Describe the common types of DCVs and their functions (pressure regulating, pressure limiting and pressure sequence valve)
- 4.3 Study the valve symbols of PCVs
- 4.4 Describe the operation of pressure regulating valves
- 4.5 Describe the operation of pressure limiting valves
- 4.6 Describe the operation of pressure sequence valves

DESCRIBE THE WORKING OF CYLINDERS

- 5.1 Understand the symbol and construction of a hydraulic/pneumatic cylinder
- 5.2 Identify the types of cylinders (single acting and double acting)
- 5.3 Study the method for selection of cylinders
- 5.4 Understand the concept of cylinder sequencing
- 5.5 Understand the concept of cascade control

DESCRIBE THE WORKING AND APPLICATIONS OF PROCESS CONTROL VALVES

- 6.1 Understand the function of a Process control valve
- 6.2 Describe a diaphragm actuator
- 6.3 Study the valve bodies and plugs and their types
- 6.4 Study the sizing of a control valve
- 6.5 Study the examples of various fluid control systems

DESCRIBE THE APPLICATIONS AND WORKING OF ROTARY VALVES

- 7.1 Understand the function of a rotary valve
- 7.2 Study a semi rotary actuator
- 7.3 Study a vane motor
- 7.4 Study the systems employing rotary valves

LIST OF PRACTICALS

1. Identify and study various DCVs (6 Hours.)
 2. Identify and study various PCVs (6 Hours.)
 3. Demonstrate the working of a spool; shuttle and poppet valve (6Hours.)
 Demonstrate the working of a pressure limiting, pressure regulating and Pressure sequencing valve. (6Hours.)
 5. Demonstrate the working of single and double acting cylinders (6Hours.)
 6. Demonstrate process control through valves of different alignments (9Hours.)
 7. Visit to an industry employing pneumatic and hydraulic systems (9Hours.)
- Design and assemble an “AND” logic circuit. Connect components to match the schematic diagram. Operate and explain circuit to instructor. (6Hours.)
- Design and assemble an “OR” logic circuit. Design and draw schematic diagram. Connect components to match schematic diagram. Operate and explain circuit to instructor. (6Hours.)
- Design and assemble a “LIMITED MEMORY” circuit which shall extend a cylinder for an adjustable period of time, then automatically retract the cylinder. With the help of your schematic diagram, connect components, accordingly. Operate and explain circuit to instructor. (9Hours.)
- With the “FULL MEMORY” circuit designed by you, demonstrate the working of a double acting cylinder using two positions, 4-way valve. The valve is air-piloted in both directions and operates a double acting cylinder. Using a schematic diagram based on your own design, connect components to match the diagram. Operate and explain circuit to instructor. (9Hours.)
- Design and assemble a “ONE SHOT CYCLE” circuit that shall operate only the cylinder for one timed cycle. Design and draw schematic diagram. Connect components to match schematic diagram. Operate and explain circuit to instructor. *[No matter how long the valve is held shifted, only one cycle of the cylinder will result. The pulse valve controls the time delay before the retraction of the cylinder. The one shot cycle is a limited memory time function.]* (6Hours.)
- Design and assemble an “AUTOMATIC CAM CYCLING” circuit- that shall automatically cycles the continuous reciprocation of a cylinder. Design and draw schematic diagram and connect components in accordance with the schematic diagram. Operate and explain circuit to instructor. *[Limit valves located at the full extension and retraction of the cylinder are mechanically (cam) operated. Flow control valves that control the flow of the exhaust air leaving the cylinder (bleeding out) govern the speed of the operation. The cycle is started and stopped the shifting of toggle valve.]* (6Hours.)

Design and assemble a “DOOR OPENER – DELAY SHUT” circuit. Design a schematic circuit which allows two valves to start a cycle that extends a cylinder for an adjustable time period and then retracts it. The adjustable time delay is controlled by a “limited memory” circuit. A third valve (toggle valve) must have the ability to extend the cylinder and keep the cylinder extended until the operator wants it retracted. Design and draw schematic diagram. Connect components to match schematic diagram. Operate and explain circuit to instructor.

(6 Hours.)

MTR-323 Programmable Logic Controller

Total Contact Hours

Theory	64		T	P	C
Practical	96	2	3	3	

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

- Explain the operation of Limit, Proximity and Photo Switches.
- Explain the operation of various sensors and relays in simple circuits.
- Configure circuits in the Relay Ladder Convention.
- 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.
- Use Arithmetic, Logical and Move Instructions when programming the PLC
- Explain Output Override and I/O Update instructions in the PLC.
- Explain how the different Functions of a PLC are used.
- Configure and properly install a PLC System.
- Troubleshoot a PLC system
- Use of HMI with PLCs.

COURSE CONTENTS

1. OPERATION OF SENSORS

4 Hours

- 1.1. Tactile and non-tactile sensing
- 1.2. Types of limit switches
- 1.3. Concept of Normally Open/Closed
- 1.4. Different types of actuators
- 1.5. Operation and application of limit switches, Faults that can occur with limit switches
- 1.6. Review of capacitance and inductance
- 1.7. Different types of proximity switches
- 1.8. Operation and application of proximity switches, Faults that can occur with proximity switches
- 1.9. Review of photo-emitters and photo-sensors, Different types of photo switches
- 1.10. Different scanning techniques used with photo switches, Applications of photo switches, Faults that can occur with photo switches

2. OPERATION OF SENSORS AND RELAYS IN SIMPLE CIRCUITS 6 Hours

- 2.1. Different types of relays
- 2.2. Review of the concept of magnetic fields
- 2.3. Review of the concept of motor force

- 2.4. Concept of timed on/off
- 2.5. Applications of relays
- 2.6. Review of series circuits
- 2.7. Operation of sensors and relays in simple circuits
- 2.8. Faults that can occur in simple circuits

INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS (PLCs): 4 Hours

- 3.1. Programmable logic controllers
- 3.2. Parts of a PLC
- 3.3. Principles of Operation
- 3.4. Modifying the operation
- 3.5. PLCs versus computers
- 3.6. PLC sizes and applications

4. PLC HARDWARE COMPONENTS 6 Hours

- 4.1. The I/O section
- 4.2. Digital I/O section
- 4.3. Analog I/O section
- 4.4. I/O specifications
- 4.5. The CPU
- 4.6. The processor-memory module
- 4.7. Memory design
- 4.8. Memory types
- 4.9. Programming Devices

5. BASICS OF PLC PROGRAMMING 6 Hours

- 5.1. Processor memory organization
- 5.2. Program scan
- 5.3. PLC programming languages
- 5.4. Relay-type instructions
- 5.5. Instruction addressing
- 5.6. Branch instructions
- 5.7. Internal relay instructions
- 5.8. Entering the ladder diagram
- 5.9. Modes of operation

6. DEVELOPING PLC WIRING DIAGRAMS AND LADDER PROGRAMS

4 Hours

- 6.1. Electromagnetic control relays
- 6.2. Motor starters

- 6.3. Manually operated switches
- 6.4. Mechanically operated and proximity switches
- 6.5. Output control devices
- 6.6. Latching relays
- 6.7. Converting relay ladder diagrams into PLC ladder programs

7. PROGRAMMING TIMERS

6 Hours

- 7.1 Mechanical timing relays
- 7.2 Timer instructions
- 7.3 ON-DELAY timer instruction
- 7.4 OFF-DELAY timer instruction
- 7.5 Retentive timer
- 7.6 Cascading timers

8. PROGRAMMING COUNTERS

6 Hours

- 8.1. Counter instructions
- 8.2. Up-counters
- 8.3. Down-counters
- 8.4. Cascading counters
- 8.5. Incremental Encoder-counter applications

9. PROGRAM CONTROL INSTRUCTIONS

4 Hours

- 9.1. Master control and zone control instructions
- 9.2. JUMP instructions and subroutines
- 9.3. IMMEDIATE INPUT and IMMEDIATE OUTPUT instructions
- 9.4. Forcing external I/O address
- 9.5. Safety circuitry

10. DATA MANIPULATION INSTRUCTIONS

4 Hours

- 10.1. Data manipulation
- 10.2. Data transfer operations
- 10.3. Data compare instructions
- 10.4. Data manipulation programs
- 10.5. Numerical data I/O interfaces
- 10.6. Set point control

11. MATH INSTRUCTIONS

4 Hours

- 11.1. Math instructions
- 11.2. Addition instructions
- 11.3. Subtraction instructions
- 11.4. Multiplication instructions

- 11.5. Division instructions

12. SEQUENCER INSTRUCTIONS

4 Hours

- 12.1. Mechanical sequencers
- 12.2. Sequencer instructions
- 12.3. Sequencer program

13. PLC INSTALLATION PRACTICES, EDITING, AND TROUBLESHOOTING

8 Hours

- 13.1. PLC enclosures
- 13.2. Electrical noise
- 13.3. Leaky inputs and outputs
- 13.4. Grounding
- 13.5. Voltage variations and surges
- 13.6. Program editing
- 13.7. Programming and monitoring
- 13.8. Preventive maintenance
- 13.9. Troubleshooting

14. INTRODUCTION TO HUMAN MACHINE INTERFACE

6 Hours

- 14.1 Overview
- 14.2 Design of an HMI
- 14.3 Information Context
- 14.4 Implementation of an HMI
- 14.5 Usability of Programming Languages
- 14.6 Evaluation of an HMI

RECOMMENDED BOOKS:

Bryan and Bryan, Programmable Controllers Theory and Implementation, 2nd Ed.

Introduction to Programmable Logic Controllers By Gary Dunning

Programmable Logic Controllers By W. Bolton

Introduction to PLCs: A beginner's guide to Programmable Logic Controllers: Elvin Pérez Adrover (2012)

Fundamentals of Programmable Logic Controllers and Ladder Logic (Volume 1):
Orlando Charria (2012)

MTR-323 Programmable Logic Controller

INSTRUCTIONAL OBJECTIVES

1. OPERATION OF SENSORS

- 1.1. Explain tactile and non-tactile sensing
- 1.2. List the different types of limit switches
- 1.3. Explain the concept of Normally Open/Closed
- 1.4. List the different types of actuators
- 1.5. Explain the operation of limit switches
- 1.6. List applications of limit switches
- 1.7. Explain the faults that can occur with limit switches
- 1.8. Review capacitance and inductance
- 1.9. List the different types of proximity switches
- 1.10. Explain the operation of proximity switches
- 1.11. List the applications of proximity switches
- 1.12. Explain the faults that can occur with proximity switches
- 1.13. Review photo-emitters and photo-sensors
- 1.14. List the different types of photo switches
- 1.15. Explain the different scanning techniques used with photo switches
- 1.16. List the applications of photo switches
- 1.17. Explain the faults that can occur with photo switches

2. OPERATION OF SENSORS AND RELAYS IN SIMPLE CIRCUITS

- 2.1. List the different types of relays
- 2.2. Review the concept of magnetic fields
- 2.3. Review the concept of motor force
- 2.4. Explain the concept of timed on/off
- 2.5. List applications of relays
- 2.6. Review series circuits
- 2.7. Analyze the operation of sensors and relays in simple circuits
- 2.8. Explain the distributed control
- 2.9. Explain the faults that can occur in simple circuits

INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS (PLCs)

- 3.1. Introduce the Programmable logic controllers
- 3.2. List basic parts of a PLC
- 3.3. Explain principles of operation of PLC
- 3.4. Explain how to modify the operation through a PLC
- 3.5. Compare PLCs and computers
- 3.6. Explain variation in PLC size and relate the size with the required applications

4. PLC HARDWARE COMPONENTS

- 4.1. Explain the function of I/O section
- 4.2. Explain the function of digital I/O section
- 4.3. Explain the function of analog I/O section
- 4.4. List I/O specifications of PLCs
- 4.5. Explain the function of CPU
- 4.6. Explain the function of the processor-memory module
- 4.7. Explain the requirements for sizing the memory
- 4.8. Explain various memory types
- 4.9. List programming devices used for PLC programming
- 4.10. List various devices used for recording, storing and loading programs

5. BASICS OF PLC PROGRAMMING

- 5.1. Explain processor memory organization
- 5.2. Explain the process and need of scanning
- 5.3. Explain the two types of PLC programming languages
- 5.4. Explain Relay-type instructions
- 5.5. Define address number and explain Instruction addressing
- 5.6. Explain when to use branch instructions
- 5.7. Explain when to use Internal relay instructions
- 5.8. Explain how to enter the ladder diagram
- 5.9. Explain common operating modes of PLCs

6. DEVELOPING PLC WIRING DIAGRAMS AND LADDER PROGRAMS

- 6.1. Identify the function of electromagnetic control relays
- 6.2. Explain the function of a motor starter
- 6.3. Describe manually operated switches
- 6.4. Describe mechanically operated and proximity switches
- 6.5. Discuss output control devices
- 6.6. Explain the function of latching relays
- 6.7. Explain how to convert relay ladder diagrams into PLC ladder programs

7. PROGRAMMING TIMERS

- 7.1. Describe the function of mechanical timing relays
- 7.2. Teach and explain timer instructions used in PLCs
- 7.3. Explain the use of ON-DELAY timer instruction
- 7.4. Explain the use of OFF-DELAY timer instruction
- 7.5. Describe the function and use of a retentive timer
- 7.6. Explain methods of cascading timers

8. PROGRAMMING COUNTERS

- 8.1. Teach and explain various counter instructions
- 8.2. Describe the function of up-counters
- 8.3. Describe the function of down-counters
- 8.4. Explain methods of cascading counters
- 8.5. Discuss incremental encoder-counter applications

9. PROGRAM CONTROL INSTRUCTIONS

- 9.1. Discuss and explain master control and zone control instructions
- 9.2. Describe JUMP instructions and its use to move between subroutines
- 9.3. Explain the use of IMMEDIATE INPUT and IMMEDIATE OUTPUT instructions
- 9.4. Explain the use of forcing function of a PLC for external I/O
- 9.5. Describe various safety circuits provided in PLCs

10. DATA MANIPULATION INSTRUCTIONS

- 10.1. Define data manipulation instructions
- 10.2. List and explain various data transfer operations
- 10.3. Discuss the use of various data compare instructions
- 10.4. Explain how to write data manipulation programs
- 10.5. Describe numerical data I/O interfaces and their use
- 10.6. Explain various set point control schemes

11. MATH INSTRUCTIONS

- 11.1. Explain use of math instructions
- 11.2. Describe use of addition instructions
- 11.3. Describe use of subtraction instructions
- 11.4. Discuss and explain use of multiplication instructions
- 11.5. Discuss and explain use of division instructions

12. SEQUENCER INSTRUCTIONS

- 12.1. Describe various forms of mechanical sequencers
- 12.2. Explain how to use sequencer instructions
- 12.3. Explain how to develop a sequencer program

13. PLC INSTALLATION PRACTICES, EDITING, AND TROUBLESHOOTING

- 13.1. Explain features of a PLC enclosure
- 13.2. Describe the effect of electrical noise on the performance of PLCs
- 13.3. Discuss the effects of leaky inputs and outputs
- 13.4. Explain the importance of proper grounding
- 13.5. Describe methods to control voltage variations and protect against surges
- 13.6. Explain procedures for program editing
- 13.7. Discuss modes of programming and monitoring of PLCs
- 13.8. Explain and list preventive maintenance procedures
- 13.9. Explain procedures for troubleshooting PLCs

INTRODUCTION TO HUMAN MACHINE INTERFACE

- 14.1 Overview of the concept of HMI systems
- 14.2 Discuss the typical steps involved in the designing of an HMI
- 14.3 Understand the end user requirements
- 14.4 Discuss the implementation process of an HMI
- 14.5 Describe the various programming languages used for an HMI
- 14.6 Discuss how to evaluate an HMI system

MTR-323 Programmable Logic Controller

LIST OF PRACTICALS

Determine the technical specifications of various sensors from the product manuals.
Connect various sensors in appropriate configurations to demonstrate their operation.
Configure simple circuits as directed by the instructor for the operation of sensors.
Configure circuits given in the relay ladder convention by the instructor from the sensors and devices in the lab.
Given a circuit convert it to the relay ladder equivalent then into the accepted format for a PLC
Identify the various components of the PLC in the lab
Identify the Data, Address, Control and Power lines of the motherboard
Identify the addresses of various inputs assigned by the instructor
Identify the addresses of various outputs assigned by the instructor
Identify all of the keys in the programming software
Program the PLC to perform a simple stop/start routine.
Connect the necessary components to execute the program.
Program the PLC to perform a task as outlined by the instructor using Timer and Counter instructions.
Connect the necessary components to execute the program.
Program the PLC to perform a task as outlined by the instructor using Arithmetic, Logical and Move instructions.
Connect the necessary components to execute the program.
Program various routines as assigned by the instructor, which will reinforce the Output Override and I/O Update instructions.
Given all the components necessary to configure a PLC system, install a PLC system.
Program the PLC to perform a task as outlined by the instructor using Block Transfer instructions.
Connect the necessary components to execute the program.
Program the PLC to perform a task as outlined by the instructor using I/O Bus devices.
Connect the necessary components to execute the program.
Program a PLC for Traffic Light Control.
Program a PLC for Reverse Forward Control of a Motor.
Program a PLC for Conveyor Belt Motor Control.
Program a PLC for 100 Cars parking.
Program a PLC for motor Star Delta Control.
Configuration of HMI with PLC.

MTR -333 COMPUTER INTEGRATED MANUFACTURING (CIM)

Total Contact Hours:	160	T	P	C
Theory (Hours):	64	2	3	3
Practical (Hours):	96			

Aims

- To bring together all the knowledge acquired in the course syllabus and understand the unification of all the elements of a mechatronic & automated production system
- To understand the designing of a mechatronic/automated manufacturing system
- To introduce efficient manufacturing systems principles to enhance productivity

COURSE CONTENTS

1. INTRODUCTION TO AUTOMATION 6Hours

- 1.1. Definition of Automation
- 1.2. Basic Elements of an Automated System
 - 1.2.1. Power required for different manufacturing processes
 - 1.2.2. Program of instructions
 - 1.2.3. Control systems.
- 1.3. Advantages of Automation
- 1.4. Levels of Automation

2. INTRODUCTION TO MANUFACTURING SYSTEM 8 Hours

- 2.1. Definition of Manufacturing System
- 2.2. Components of Manufacturing System

- 2.3. Classification according to Number of stations
- 2.4. Classification According to Levels of Automation
- 2.5. Classification according to capacity

3. INTRODUCTION OF CIM AND CAD/CAM

10 Hours

- 3.1. Definition of CIM
- 3.2. Nature and role of the elements of CIM system
- 3.3. Product Design and CAD
 - 3.3.1. Phases of design process
- 3.4. Application of Computers in Design
 - 3.4.1. Geometric Modeling
 - 3.4.2. Engineering Analysis.
 - 3.4.3. Design Evaluation and Review
 - 3.4.4. Automated Drafting
- 3.5. Application of Computer-Aided Manufacturing
 - 3.5.1. Planning in Manufacturing
 - 3.5.2. Control in Manufacturing

4. PROCESS PLANNING AND CAPP

10 Hours

- 4.1. Scope of Process Planning
- 4.2. Benefits of CAPP
- 4.3. Group Technology
 - 4.3.1. Part Families

4.3.2. Part Classification and Coding System

4.4. Benefits of Group Technology

4.5. Methods of implementing CAPP

4.5.1. Retrieval CAPP System

4.5.2. Generative CAPP System

4.6. Concurrent Engineering

5. FLEXIBLE MANUFACTURING SYSTEM

10 Hours

5.1. FMS

5.2. Components of FMS

5.2.1. Manufacturing Control system (workstations and other logistics)

5.2.2. Material Handling and Storage System

5.2.3. Computer Control System

5.2.4. Human Resources

5.3. Types of FMS

5.3.1. Flexible Manufacturing Cells

5.3.2. Flexible Transfer Lines

5.3.3. Flexible Machining System

6. COMPUTER AIDED QUALITY CONTROL

10Hours

6.1. Define Quality

6.2. Total Quality Control (TQC) and CIM

6.3. Objective of QC

6.4. Inspection Technologies

6.4.1. Applications & Benefits of Coordinate measuring machines CMMs

6.4.2. Applications of Stylus type surface texture measuring machines

6.4.3. Applications/advantages of Laser Interferometer Measuring system

6.4.4. Applications of Vision System

6.4.5. Flexible Inspection System (FIS)

7. PRODUCTION PLANNING AND CONTROL

10 Hours

7.1. Activities of Production Planning

7.1.1. Master Production Schedule

7.1.2. Structure of Material Requirement Planning (MRP)

7.1.3. MRP Benefits

7.1.4. Steps of Capacity Planning

7.2. Production Control

7.2.1. Phases of Shop Floor Control

7.2.1.1. Phases of Shop Floor Control

7.2.1.2. Types of shop floor data collection

7.2.1.3. Advantages Of Automatic Data Collection System

7.2.2. Inventory Control

7.2.3. Manufacturing Resource Planning (MRP II)

7.3. Enterprise Resource Planning

7.4. Applications of Just-In-Time Production System

RECOMMENDED BOOKS

Automation, Production Systems, and computer-Integrated Manufacturing: M.P.Groover
CIM Systems: An Introduction to Computer Integrated Manufacturing: Mitchell (1991)

Ranky, P.G. Computer Integrated Manufacturing: An Introduction with Case Studies,
Prentice Hall, (1985)

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO AUTOMATION

1.1. Definition of Automation

1.2. Describe the Basic Elements of an Automated System

1.2.1. Power required for different manufacturing processes

1.2.2. Program of instructions

1.2.3. Control systems.

1.2.3.1. Types of control system

1.2.3.2. Basic components of open/closed loop system

1.3. Explain the Advantages of Automation

1.3.1. Maintenance and Repair Diagnostics

1.3.2. Safety Monitoring

1.3.3. Error Detection and recovery

1.4. Explain the Levels of Automation

1.4.1. Device Level

1.4.2. Machine Level

1.4.3. Cell or system Level

1.4.4. Plant Level

1.4.5. Enterprise Level

2. INTRODUCTION TO MANUFACTURING SYSTEM

2.1. Definition of Manufacturing System

2.2. Describe Components of Manufacturing System

2.2.1. Production Machines

2.2.2. Material Handling System

2.2.3. Computer Control System

2.2.4. Human Resource

2.3. Explain the Classification according to Number of stations

2.3.1. Single Station

2.3.2. Multiple Station (Fixed Route/Variable Route)

2.3.3. Classification According to Levels of Automation

2.3.4. Classification according to capacity

2.3.4.1. Low Quantity Production

2.3.4.2. Medium Quantity Production

2.3.5. High Quantity Production

3. INTRODUCTION OF CIM AND CAD/CAM

3.1. Definition of CIM

3.2. Describe the Nature and role of the elements of CIM system

- 3.2.1. Marketing
- 3.2.2. Product Design
- 3.2.3. Planning
- 3.2.4. Purchase
- 3.2.5. Manufacturing Engineering
- 3.2.6. Factory Automation Hardware
- 3.2.7. Warehousing
- 3.2.8. Logistics and Supply Chain Management
- 3.2.9. Finance
- 3.2.10. Information Management

3.3. Describe the Product Design and CAD

3.3.1. What are the Phases of design process?

- 3.3.1.1. Recognition of need
- 3.3.1.2. Problem definition
- 3.3.1.3. Synthesis
- 3.3.1.4. Analysis and optimization
- 3.3.1.5. Evaluation
- 3.3.1.6. Presentation

3.4. Explain the Application of Computers in Design

- 3.4.1. Geometric Modeling
- 3.4.2. Engineering Analysis.
- 3.4.3. Design Evaluation and Review
- 3.4.4. Automated Drafting

3.5. Explain the Application of Computer-Aided Manufacturing

3.5.1. Planning in Manufacturing

3.5.2. Control in Manufacturing

4. PROCESS PLANNING AND CAPP

4.1. Explain the Scope of Process Planning

4.2. Explain the Benefits of CAPP

4.3. Describe what is Group Technology?

4.3.1. Part Families

4.3.2. Part Classification and Coding System

4.3.2.1. Systems based on design attributes

4.3.2.2. Systems based on part manufacturing attributes

4.4. Explain the Benefits of Group Technology

4.5. Explain what are the Methods of implementing CAPP?

4.5.1. Retrieval CAPP System

4.5.2. Generative CAPP System

4.5.3. Concurrent Engineering

5. FLEXIBLE MANUFACTURING SYSTEM

5.1. Define FMS

5.2. Describe the Components of FMS

5.2.1. Manufacturing Control system (workstations and other logistics)

5.2.1.1. Loading and Unloading Stations

5.2.1.2. Machining Stations

5.2.1.3. Assembly Stations

5.2.2. Explain Material Handling and Storage System

5.2.2.1. What are the Methods of transporting materials?

5.2.2.1.1. Industrial Trucks

5.2.2.1.2. Automated Guided Vehicles
and Guidance Technologies

5.2.2.1.3. Monorails and Rails Guided Systems

5.2.2.1.4. Conveyors Systems

5.2.2.1.5. Cranes and Hoists

5.2.2.2. Explain the types of Storages Systems

5.2.2.2.1. AS/RS

5.2.2.2.2. Carousel Storage System

5.2.3. Explain Computer Control System

5.2.4. Describe Human Resources as a component of FMS

5.3. Explain the Types of FMS

5.3.1. Flexible Manufacturing Cells

5.3.2. Flexible Transfer Lines

5.3.3. Flexible Machining System

6. COMPUTER AIDED QUALITY CONTROL

6.1. Define Quality

6.2. Explain Total Quality Control (TQC) and CIM

6.3. Describe the Objective of QC

6.4. What are the up-to-date Inspection Technologies

6.4.1. Applications and Benefits of Coordinate measuring machines CMMs

6.4.2. Applications of Stylus type surface texture measuring machines

6.4.3. Applications and advantages of Laser Interferometer Measuring System

6.4.4. Applications of Vision System

6.4.5. Flexible Inspection System (FIS)

7. PRODUCTION PLANNING AND CONTROL

7.1. Describe Activities of Production Planning

7.1.1. Master Production Schedule

7.1.2. Structure of Material Requirement Planning (MRP)

7.1.3. MRP Benefits

7.1.4. Steps of Capacity Planning

7.2. Explain Production Control

7.2.1. Phases of Shop Floor Control

7.2.1.1. Phases of Shop Floor Control

7.2.1.2. Types of shop floor data collection

7.2.1.2.1. On-line data collection systems

7.2.1.2.2. Off-line data collection systems

7.2.1.3. Describe the Advantages Of Automatic Data Collection System

7.2.1.3.1. Bar Code Technology

7.2.1.3.2. Optical Character Recognition

7.2.1.3.3. Magnetic Ink Character Recognition

7.2.1.3.4. Voice Recognition

7.2.1.3.5. Smart Cards

7.2.2. Inventory Control

7.2.3. Manufacturing Resource Planning (MRP II)

7.3. Explain Enterprise Resource Planning

7.3.1. Applications of Just-In-Time Production System

LIST OF PRACTICALS

- Study a manufacturing system, understand the design process and explain it (6 Hours)
2. Observe a CIM system; identify its parts and explain its operation (6Hours)
- Study a medium-sized manufacturing unit and apply the concepts of Management Information System to assist in enhancing its productivity. (12Hours)
- Take an example of a manufacturing unit and apply the concepts of computer aided production planning with a view to increase its output. (12Hours)
- Apply the concepts of computer aided quality management system to a manufacturing unit and show its benefits (12 Hours)
6. Carry out a study to make a manufacturing unit more flexible. (12Hours)
- Explain the production costs involved in a Mechatronic System (case study) and justify the cost. (12 Hours)
8. Mini Project: Design a CIM cell of any manufacturing unit (12Hours)
9. Determine the position of points using incremental and absolute methods (12 Hours)

Total Contact Hours:	160	T	P	C
Theory(Hours):	64	2	3	3
Practical (Hours):	96			

Aims

- To understand the basic concepts of robotics
- To understand the application of robots in industry
- To identify the operating principles and configurations of industrial robots

COURSE CONTENTS**1. INTRODUCTION 6 Hours**

- 1.1 Definition: Robot
- 1.2 Introduction to robotics
- 1.3 History of Robots
- 1.4 Three Laws of Robotics
- 1.5 Advantages of Robots

2. ARCHITECTURE OF ROBOTIC SYSTEMS 7 Hours

- 2.1 Mechanical Structure
 - Kinematics model
 - Dynamics model
- 2.2 Actuators: Electrical, Hydraulic, Pneumatic, Artificial Muscle
- 2.3 Computation and controllers
- 2.4 Sensors
- 2.5 Communications
- 2.6 User interface
- 2.7 Power conversion unit

3. INDUSTRIAL ROBOT CLASSIFICATION 2 Hours

- 3.1 Degrees of Freedom & Types of Joint
- 3.2 Robot workspace
- 3.3 Mechanical Configurations
 - 3.3.1 Cartesian
 - 3.3.2 Gantry

- 3.3.3 Cylindrical
- 3.3.4 Spherical
- 3.3.5 Jointed
- 3.3.6 SCARA
- 3.4

Advantages and Disadvantages

4. MOTION CONTROL

4Hours

- 4.1 Axis Limit
- 4.2 Point to Point
- 4.3 Contouring
- 4.4 Line Tracking

5. ROBOT TOOLING

8 Hours

- 5.1 Grippers
- 5.2 Appliances
- 5.3 Part-Compliant Tooling

6. SENSING CAPABILITY

10 Hours

- 6.1 Gripper Pressure Sensor
- 6.2 Electro-Optic Force Sensor
- 6.3 Optical presence Sensing
- 6.4 Robot Vision
- 6.5 Tactile sensing
- 6.6 Voice Communication

7 TEACHING ROBOTS TO DO WORK

10 Hours

- 7.1 The robot's world and the real world
- 7.2 Programming Methods
 - Teach-Pendant Programming
 - Keyboard Programming
 - VAL
 - AML/2
 - ARMBASIC

8 PERFORMANCE SPECIFICATIONS

5Hours

- 8.1 Payload
- 8.2 Repeatability
- 8.3 Speed
- 8.4 Stability Analysis

9. INDUSTRIAL APPLICATIONS OF ROBOTS

12Hours

9.1 Application of Robots in Industry

9.1.1 Welding

9.1.2 Assembly

9.1.3 Material handling

9.1.3 Loading and unloading

9.1.14 CIM Hostile and remote environments

9.2 Robot Utilization and Justification

9.2.1 Labour Resistance

9.2.2 Economic Justification

RECOMMENDED BOOKS

Robots and Manufacturing Automation:, .C.RayAsfahl, John Wiley & Sons Inc., USA

Analytical Robotics and Mechatronics: Wolfram Stadler, McGraw-Hill, Intl. Edition.

Introduction to Robotics, Analysis, Systems, Applications: S. B. Niku (Prentice Hall)
(2001)

Industrial Robotics Technology:M.P. Groover

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)

INSTRUCTIONAL OBJECTIVES**ROBOT ANATOMY AND RELATED ATTRIBUTES**

1.1. Define Robotics

1.2. Describe the concept of Joints and Links

1.2.1. Define Degree of Freedom

1.2.2. Explain the types of Robotic Joints

1.2.2.1. Linear Joint

1.2.2.2. Orthogonal Joint

1.2.2.3. Rotational Joint

1.2.2.4. Twisting Joint

1.2.2.5. Revolving Joint

1.3. Describe the Common Robot Configurations

1.3.1. Define Work Volume

1.3.2. Define Degree of Freedom (DOF)

1.3.3. Describe Construction, DOF, Work Envelop and Applications of Polar Configuration

1.3.4. Describe Construction, DOF, Work Envelop and Applications of Cylindrical Configuration

1.3.5. Describe Construction, DOF, Work Envelop and Applications of Cartesian Configuration

1.3.6. Describe Construction, DOF, Work Envelop and Applications of Articulated/Joint-Arm Configuration

1.3.7. Describe Construction, DOF, Work Envelop and Applications of SCARA (Selective Compliance Assembly Robot Arm)

1.3.8. Describe different Wrist Configuration and the concept of degree of freedom

1.4. Describe the types of Joint Drive Systems

1.4.1. Describe Electric Drives

1.4.1.1. Explain the types

1.4.1.2. Describe their characteristics and selection

1.4.2. Describe the Hydraulic and Pneumatic Drives

1.4.2.1. Explain their working principle

1.4.2.2. Explain their components

1.4.2.3. Explain their characteristics

ROBOT CONTROL SYSTEM

2.1. Describe the Classification of Robot Controllers

2.1.1. Characteristics and Applications of Limited sequence control

2.1.2. Characteristics and Applications of Playback with point-to-point control

2.1.3. Characteristics and Applications of Playback with continuous path control

2.1.4. Characteristics and Applications of Intelligent control

END EFFECTORS

3.1. Describe Grippers used in industrial robot applications

3.2. Explain some Tools used in industrial robot application

SENSORS IN ROBOTICS

- 4.1. Brief describe Tactile sensors
 - 4.1.1. Force Measurement
 - 4.1.2. Pressure Measurement
- 4.2. Brief describe Proximity sensors
 - 4.2.1. Explain the use of Micro switches in Robotics
 - 4.2.2. Explain the use of Photosensitive Sensor in Robotics
- 4.3. Describe Machine vision system
 - 4.3.1. Image Acquisition
 - 4.3.1.1. Explain the concept of Illumination
 - 4.3.1.2. Explain the concept of Digitization
 - 4.3.1.2.1. Sampling
 - 4.3.1.2.2. Quantization
 - 4.3.2. Vision Sensors
 - 4.3.2.1. Cameras and Camera selection
 - 4.3.2.1.1. Characteristics of CCD Camera
 - 4.3.2.1.2. Characteristics of CMOS Camera
 - 4.3.2.2. IR Distance Sensors
 - 4.3.2.2.1. Explain basic principle of operation
 - 4.3.2.2.2. Characteristics
 - 4.3.2.3. Ultrasonic and Laser Sensor
 - 4.3.2.3.1. Explain basic principle of operation
 - 4.3.2.3.2. Characteristics and Sonar Effect
 - 4.3.3. Basic Feature Detection Techniques
 - 4.3.3.1. Thresholding

4.3.3.2. Edge Finding Technique

4.3.3.2.1. Gradient-based procedure

4.3.3.2.2. Zero-crossing based procedure

4.3.4. Motion Planning

4.3.4.1. Explain the concept of Navigation, Localization and Mapping

4.3.4.2. Define the concept of Bug algorithm

4.3.4.3. Define the concept of Configuration Space

4.3.4.4. Define the concept of Potential Field Algorithm

INDUSTRIAL ROBOT APPLICATIONS

5.1. Describe the advantages of using Robots in Industries

5.2. Describe the use of robots in Material Handling Applications

5.2.1. Material transfer applications

5.2.2. Machine Loading/Unloading Applications

5.3. Describe the use of robots in Processing Operations

5.3.1. Spot Welding

5.3.2. Continuous Arc Welding

5.3.3. Spray Coating

5.3.4. Other Processing Applications like Drilling, Grinding, Laser Cutting

5.4. Describe the use of robots in Assembly and Inspection

ROBOT PROGRAMMING

6.1. Define Robot Program

6.2. Briefly explain Lead-through Programming

6.2.1. Advantages and disadvantages

6.3. Briefly explain Robot Programming Languages

6.3.1. Advantages and disadvantages

6.4. Simulation and Off-Line Programming

6.4.1. Advantages and disadvantages

ENGINEERING ANALYSIS OF INDUSTRIAL ROBOTS

7.1. Introduction to Manipulator Kinematics

7.1.1. Define Frame

7.1.2. Define Forward Kinematics of Manipulators

7.1.3. Define Reverse Kinematics of Manipulator

7.1.4. Define Trajectory Generation

7.1.5. Describe the Spatial Description of Position, Orientation and Frame

7.1.5.1. Description of Position

7.1.5.2. Description of Orientation

7.1.5.3. Description of Frame

7.1.5.4. Basic Calculation for Position, Orientation and Frame description

7.1.6. Describe Mappings

7.1.6.1. Mappings involving translated frames

7.1.6.2. Mappings involving rotated frames

7.1.6.3. Mappings involving general frames

7.1.6.4. Basic Calculation of Frame translation and rotation

7.1.7. Describe Operators

7.1.7.1. Translation operator

7.1.7.2. Rotation operator

7.1.7.3. Transformation operator

7.1.8. Describe Transformation Arithmetic

7.1.8.1. Basic Calculation of Transformation Matrix

7.2. Understand the concept of Accuracy and Repeatability

7.2.1. Define Control resolution

7.2.2. Define Accuracy

7.2.3. Define Repeatability

FUTURE TREND IN ROBOTICS

8.1. Describe the use of Robots in Rehabilitation

8.2. Explain the concept of Behavior Based Robotics

8.3. Describe Biological Inspired Robots

LIST OF PRACTICALS:

Identify basic components of Robot in your lab

Basic practice using jog mode of pendant

Operation practice after Joint Position Teaching

Understanding and practice of velocity and time

Practice absolute coordinate and relative coordinate

Practice the movement of gripper

Practice to control the program storage and retrieval

Assembling a Robot using any Robot Development Kit and Explore its Work Envelope

Programming a Robot using any Robot Development Kit and Execution of the Assigned Task

MTR-352**EMERGING MECHATRONICS & AUTOMATION TECHNOLOGIES**

Total Contact Hours:	64	T	P	C
Theory (Hours):	64	2	0	2
Practical (Hours):	Nil			

Aims

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

COURSE CONTENTS

- 1. MICRO ELECTRO-MECHANICAL SYSTEMS** 9 Hours
 - Definition: MEMs
 - Advantages of MEMs
 - Fabrication of MEMs
 - Economy of MEMs manufacturing
- 2. ARTIFICIAL INTELLIGENCE** 9 Hours
 - Definition and overview
 - Features of a Intelligent system and different tests/approaches
 - Agents and abstraction
 - Searching and states
- 3. IMAGE PROCESSING** 9 Hours
 - Overview
 - Introduction to images, points, pixels and functions
 - Histogram analysis and mapping
 - Filtering
- 4. HAPTIC INTERFACES** 9 Hours
 - Introduction to haptic
 - Existing application of haptic
 - Methods for sensing the position of and actuating haptic interfaces
 - Salient features of haptic device design
 - Different types of haptic interfaces

5. NANOTECHNOLOGY	10 Hours
<input type="checkbox"/> The basics <input type="checkbox"/> History <input type="checkbox"/> Nano-scale electronics <input type="checkbox"/> Magnetism on nano-scale <input type="checkbox"/> Nano-scale materials and photonics	
6. 3-D PRINTING	9 Hours
<input type="checkbox"/> Introduction <input type="checkbox"/> Concept of 2-D and 3-D <input type="checkbox"/> Tools used for 3-D designing / Printing <input type="checkbox"/> Application Software(s) for 3-D designing / Printing	
7. MEDICINE	9 Hours
Mechatronic applications in medicine: MRIs Neurosurgery Urological surgery and orthopedics High intensity focused ultrasound Blood sampling	

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)

INSTRUCTIONAL OBJECTIVES**MICRO ELECTRO-MECHANICAL SYSTEMS**

- 1.1 Define MEMs
- 1.2 Identify the advantages of MEMs
- 1.3 Study the fabrication process of MEMs
- 1.4 Study the economy of MEMs manufacturing

EXPLAINING ARTIFICIAL INTELLIGENCE

- 2.1 Definition and overview of artificial intelligence
- 2.2 Identify the features of an intelligent system and different approaches for tests
- 2.3 Understand the concepts of agents and abstraction
- 2.4 Understand the concept of searching and states

INTRODUCE IMAGE PROCESSING

- 3.1 Study the basics of image processing
- 3.2 Study the concepts of images, points, pixels and functions
- 3.3 Understand histogram analysis and mapping
- 3.4 Understand filtering

INTRODUCE HAPTIC INTERFACES

- 4.1 Study the basics of haptic
- 4.2 Identify the existing application of haptic
- 4.3 Understand the methods for sensing the position of and actuating haptic interfaces
- 4.4 Identify the salient features of haptic device design
- 4.5 Describe the different types of haptic interfaces

INTRODUCE NANOTECHNOLOGY

- 5.1 Study the basics of nanotechnology
- 5.2 Study the history of nanotechnology
- 5.3 Understand the concept of nano-scale electronics
- 5.4 Understand the concept of magnetism on nano-scale
- 5.5 Understand the concepts of nano-scale materials and photonics

INTRODUCE 3-D PRINTING

- 6.1 Study the basics of 3-D printing
- 6.2 Understand the concept of 2-D and 3-D
- 6.3 Identify the tools used for 3-D designing
- 6.4 Understand the software used for 3-D designing

INTRODUCE MEDICAL APPLICATIONS OF MECHATRONICS &AUTOMATION

7.1 Study the mechatronic applications in medicine (MRIs, neurosurgery, urological surgery and orthopedics, high intensity focused ultrasound, blood sampling, etc)

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

Aims

- To familiarize students with the manufacturing flow and different manufacturing processes
- To introduce the concept of lean manufacturing
- To introduce the GMP guidelines

COURSE CONTENTS**1. INTRODUCTION****2 Hours**

- 1.1 What is manufacturing?
- 1.2 Introduction to Manufacturing Tools
- 1.3 Manufacturing Technology Factors
 - Software
 - Tooling
 - Material Production
 - Material Forming/Removal
 - Material Handling
 - Additive Processes
- 1.2 Major manufacturing processes:
 - Woodworking
 - Molding
 - Casting ○
 - Forming ○
 - Machining ○
 - Joining
 - Crushing& Milling ○
 - Rapid manufacturing

2. WOOD WORKING **3 Hours**

- 2.1 Processes Involved in wood working (Cutting, Seasoning)
- 2.2 Woodworking tools & machines
- 2.3 Industrial uses of wood working

3. MOLDING **1 Hours**

- 3.1 Definition of Molding & industrial applications
- 3.2 Manufacturing tools/accessories/machinery
- 3.3 Types of Molding

4. CASTING **3 Hours**

- 4.1 Definition of Casting
- 4.2 Casting Methods & Techniques
- 4.3 Applications in Different Manufacturing Industries

5. FORMING **4Hours**

- 5.1 Definition
- 5.2 Manufacturing tools/ machinery
- 5.3 Metal Working /Forming Processes: An Introduction
- 5.4 Industrial Applications

6. MACHINING **3 Hours**

- 6.1 Introduction to Machining Process
- 6.2 Machining tools/ machinery
- 6.3 Industrial uses

7. JOINING **4 Hours**

- 7.1 Definition: Material Joining
- 7.2 Manufacturing tools/ machinery
- 7.3 Description of various joining processes (Welding, Soldering, Adhesive Bonding, Mechanical Joining etc.) and their utility

8. RAPID MANUFACTURING

3 Hours

- 8.1 Concept and general process
- 8.2 Manufacturing tools/ machinery involved in RM
- 8.3 Typical Applications of RMP

9. CNC/NC MACHINES

4 Hours

- 9.1 Working Principle
- 9.2 CNC machine tools and their functions
- 9.3 Processes in CNC Machines
- 9.4 Programming (relative and absolute) and writing codes

10. LEAN MANUFACTURING / GOOD MANUFACTURING PRACTICES (GMP)

3 Hours

- 10.1 Definition & Principles of Lean Manufacturing
- 10.2 Types of Wastages
- 10.3 Description of Six Sigma & Kaizen Quality Systems
- 10.4 Benefits of Lean Manufacturing
- 10.5 Examples of Lean Manufacturing
- 10.6 Facilities (Environment, Equipment, Machinery, Tools etc.)
- 10.7 Production (Raw Material, Processing, Quality Control, Labelling)
- 10.8 Human Resource (Personnel, Records, Complaints etc.)

RECOMMENDED BOOKS

Manufacturing Processes: Materials, Productivity, and Lean Strategies: J. Barry Duvall and David R. Hillis (2011)

Manufacturing Best Practices: Bobby Hull, Wiley and SAS Business Series (2010)

CNC Programming Handbook: Peter Smid, Third Edition (2007)

CNC Machine Manual

INSTRUCTIONAL OBJECTIVES**INTRODUCION TO MANUFACTURING TECHNOLOGY AND PRACTICE**

- 1.1 Define manufacturing
- 1.2 Describe the different manufacturing processes (Casting, Machining, Joining, Metal Forming /Working, Woodworking etc.)
- 1.3 Understand the products of manufacturing technology (software, tooling, material forming/removal, material handling and other additive processes)
- 1.4 Understanding the major manufacturing processes/stages (Woodworking Molding, Casting, Forming, Machining, Joining, Rapid manufacturing, Crushing)

KNOW ABOUT THE PROCESS OF WOODWORKING

- 2.1 Define woodworking& its industrial applications
- 2.2 Know about the commonly used tools&machinesused in woodworking.
- 2.3 Understand the processes of woodworking
- 2.4 Describe different steps involved in woodworking

KNOW ABOUT THE PROCESS OF MOLDING

- 3.1 Define the process of molding
- 3.2 Identify various manufacturing tools/accessories/machinery involved in molding process
- 3.3 Understand the process of molding and its types
- 3.4 Identify the industrial applications where molding is used

KNOW ABOUT THE PROCESS OF CASTING

- 4.1 Define casting
- 4.2 Enlist various manufacturing tools/machinery involved in casting process
- 4.3 Describe the steps involved in the process of casting
- 4.4 Enlist and briefly describe different types of casting
- 4.5 Describe the industrial applications of the casting process

KNOW ABOUT THE PROCESS OF FORMING

- 5.1 Briefly describe the process of forming
- 5.2 Enlist the equipment and machinery involved in the process of forming
- 5.3 Categorize the forming process into its types and describe each
- 5.4 Identify the industrial applications where forming process is used

KNOW ABOUT THE PROCESS OF MACHINING

- 6.1 Define machining process and describe the working and applications of various machining tools
- 6.2 Identify the industrial applications where machining is used
- 6.3 Differentiate between machining and casting; state the advantages and disadvantages of each

KNOW ABOUT THE PROCESS OF JOINING

- 7.1 Describe the joining process
- 7.2 Enlist and describe the tools and machinery used for joining
- 7.3 Describe different types of joints
- 7.4 Identify the industrial applications where joining is used

INTRODUCE THE CONCEPT OF RAPID MANUFACTURING

- 8.1 Discuss the concept of rapid manufacturing and describe the process
- 8.2 Identify various manufacturing tools/machinery involved in rapid manufacturing process
- 8.3 Describe the industrial applications where rapid manufacturing is used

UNDERSTAND THE WORKING PRINCIPLE OF CNC/NC MACHINES

- 9.1 Define the functions of numerical control and computerized numerical control machine
- 9.2 Describe the working principle of NC & CNC machines
- 9.3 Identify the tools that can be used and their functions in processes performed by a NC and CNC machines
- 9.4 Describe all the processes that can be performed in a NC and CNC machines
- 9.5 Understand and practice relative and absolute programming in NC & CNC machines and writing the codes

INTRODUCE THE CONCEPT OF LEAN MANUFACTURING & GOOD MANUFACTURING PRACTICES (GMP)

- 10.1 Define lean manufacturing
- 10.2 Describe the principles of lean manufacturing
- 10.3 Understand the types of wastages involved during manufacturing
- 10.4 Understand the concept of six sigma and kaizen activities
- 10.5 Enlist the benefits of lean manufacturing
- 10.6 Study the examples of lean manufacturing in industries

- 10.7 Define GMP and describe its main features
- 10.8 Study the impact of manufacturing related facilities / work environment on GMP
- 10.9 Describe the selection criteria to ensure quality of raw materials and its impact on Processing and quality of end products
- 10.10 Describe the correlation between selection & continual trainings of personnel and GMP
- 10.11 Describe GMP practices such as laboratory control, proper record keeping, labeling and Managing complaintsetc,)

LIST OF PRACTICALS

Industrial visits to familiarize with different manufacturing processes. Students must prepare a separate report for each visit, based on their observations, for assessment purpose.

- i) Foundry (9 Hours)
- ii) Assembling Unit (9 Hours)
- iii) Machining Unit (9 Hours)

Group Project and Reporting: Students' groups shall visit 4-5 different industries in nearby areas and observe to what extent the concept of Lean manufacturing is being applied by the industry. If not, why?

Discuss the relevant issues with the technical and managerial staff . Based on your observation and discussion, write a comprehensive report for assessment by the course in-charge. (9 Hours)

3. Programming on a CNC/NC Machine: (12 Hours.)

Demonstrate a working knowledge of the history and applications of CNC machine tools. Describe the basic operation of the typical CNC machine tool. Practice the general operation and safety requirements/procedures for CNC operations.

Given an engineering drawing of a simple part with linear features such as slots and linear edges, steps and drill holes, the student will be able to generate a CNC program that will successfully machine the part.

- Use the G00 (rapid traverse) command

- Use the G01 (linear interpolation) command

- Use the G81 command (drill cycle)

- Use the M functions

- Use the F command (feed rate)

- Use the S command (spindle speed)

- Program tool changes

- Assign an X and Y coordinates while programming a part.

- Choose the correct tooling.

- Calculate the speed for all tools to be used in machining.

- Determine an appropriate method for clamping the part before programming the part's geometry in the CNC language.

Given a correct program, the student will be able to set-up and operate the CNC mill resulting in a correctly machined part.

- ☐ Perform the start-up procedures described in the CNC Operators manual.

- Generate correct program file using the CNC-Predator Editor PROGRAM.

- ☐ Describe and use the functions of the CNC control panel.

- Preset the X=0, Y=0 points according to the procedure outlined in the Operators manual.

- Safely execute a dry run of all programs prior to actual machining.

- ☐ Operate the CNC during normal machining operations.

Edit an incorrect program

Locate the corners of a vise or fixture to the nearest .001 of an inch using the manual controls of the CNC.

Given an engineering drawing of a complex part, the student will be able to correctly program the part using the advanced capabilities of the CNC mill. (9 Hours)

- 4.1 Program contours using the G02 and G03 (circular interpolation) commands.
- 4.2 Correctly program bores or large diameter holes
- 4.3 Program special drilling cycles (peck and deep hole).
- 4.5 Program bolt circle using the polar coordinate commands.
- 4.6 Program arcs and radii using the polar coordinate commands.
- 4.7 Recognize situations where the dwell function (G04) is needed and apply the dwell function correctly.
- 4.8 Use the MDI keyboard to input tool length offset data.

Given an engineering drawing of a turning job, the student will be able to correctly program the CNC lathe to do simple OD operations. (6 Hours)

- 5.1 Correctly input the home and index positions for the turret of the CNC lathe.
- 5.2 Choose the tool best suited for the operations that are programmed.
- 5.3 Choose the correct cutting speed and feed rate to ensure adequate tool life.
- 5.4 Correctly program OD turning operations, tapering, grooving and cut off operations.

The student will be able to correctly and safely operate the CNC lathe producing geometrically correct turned parts. (12 Hours.)

- Correctly power up the CNC lathe according to the Lathe Operators Manual.
- Call into present NC memory any current program using the control panel.
- Demonstrate the functions of the NC control panel to the instructor prior to solo use of the CNC lathe.
- Correctly adjust the jaws of the power chuck to accept various blank diameters.
- Correctly load tools into the turret.
- Correctly replace carbide inserts on turning tools.
- Prove new programs prior to machining using the dry run function.
- Operate the CNC lathe in the automatic mode under actual machining conditions.
- Adjust the offset functions to bring out of tolerance parts into tolerance.
- Edit NC programs using the edit function of the Fanuc control.

Given an engineering drawing of a complex part, the student will be able to successfully program the part on a CNC lathe. (9 Hours.)

Program threads, OD contours and radii, correctly.
Correctly program drilling operations.
Correctly program ID turning operations.

Construct a plastic part from a 3 D printer using rapid manufacturing technique. Write a description of the procedure. (6 Hours)

Introduction to basic simulation software (e.g. FLEXSIM) used in a manufacturing industry. (6 Hours)

Pht –341 Entrepreneurship

Total Contact Hours	= 32 Hrs	T	P	C
Theory	= 32 Hrs	1	0	1

Course Objective

- 1- Understanding the concept and elements of small business enterprise.
- 2- Apply the techniques for generating business ideas as well as for identifying and assessing business opportunities.
- 3- Understand the procedures required for establishing an enterprise.
- 4- Understand the procedures for assessing market and for selecting location for a small business.
- 5- Understand the importance of financial record keeping in a small business.
- 6- Develop business plan and evaluate it in real market situation.
- 7- Apply the concepts of Chemical / Pharmaceutical Engineering on planning, designing and layout of related technical projects.

Course Contents

1- Entrepreneurship and Management

4 Hr

- 1.1 The concept of entrepreneurship
- 1.2 Entrepreneurial style Vs Managerial style
- 1.3 Terminology used in entrepreneurship
- 1.4 Classification of business; difference between social and commercial business
- 1.5 Reasons for Entrepreneurship; importance in society, self employment, benefits & limitation, Importance of relations/links
- 1.6 Entrepreneurial motivation; setting goals and risk assessment.
- 1.7 Small enterprises; elements, ideas, motivation, resources, business plan etc.

2- Entrepreneurship and innovation

3 Hr

- 2.1 Creativity and innovation; creativity potential, techniques for developing creative abilities
- 2.2 Business ideas; resources of business ideas, collective thinking and creative thinking,
- 2.3 Risk involved in innovation
- 2.4 Identifying and assessing business opportunities

3- Entrepreneurs

5 Hr

- 3.1 Entrepreneurial characteristics
- 3.2 Assessment of entrepreneurial potential; assessment of individuals
- 3.3 Entrepreneurial Leadership: abilities for a successful businessman
- 3.4 Self discipline; check list for attaining self discipline
- 3.5 Decision making skills; steps for decision making, rating of decision making skills
- 3.6 Principles of negotiation; resolving business issues through negotiation

4- Establishment of An Enterprise

8 Hr

- 4.1 Market; Five 'W' of market, competitors, assessment of market size & demand
- 4.2 Business location; importance, selection of site
- 4.3 Legal forms of business; Proprietorship, Partnership, limited company, Cooperative, advantages &disadvantages
- 4.4 Costing of product; direct and indirect cost
- 4.5 Break even analysis: fixed and variable costs, calculating break even indicates & applications
- 4.6 Finance & sources of financing; equity financing & loan financing, initial capital & working capital estimation

5- Management of an Enterprise

8 Hr

- 5.1 Hiring and managing people; hiring procedures, term & condition of services and Job description etc.

- 5.2 Managing sales & supplies; characteristics of successful sales personals, importance of advertisement, life cycle of product, selection of supplies, work order, delivery & payment etc.
- 5.3 Management of capital; operating cycle concept, management of cash & stock etc.
- 5.4 Accounting and book keeping: cash book, balance sheet etc.
- 5.5 Income tax; income tax returns, computation of business income
- 5.6 Sales tax; basic scheme of sale tax, assessment of return etc

6- Business Plan

4 Hr

- 6.1 Purpose of business plan
- 6.2 Components of business plan; outline, process of writing business plan
- 6.3 Analysis of business plan: feasibility; breakeven point, evaluating problem in starting business
- 6.4 Standard business plan

MTR-392**Project**

Total Contact (Hours):	192	T	P	C
Theory (Hours):	Nil	0	6	2
Practical (Hours):	192			

Aims

Enable students to implement the knowledge & skills gathered through various theoretical and laboratory courses

Introduce students to conduct independent literature survey for contemporary problems and issues related to implementation of the allotted project.

Encourage the students to acquire a comprehensive understanding about design, operation, simulation, data collection and analysis on the important areas of the project.

Course Contents

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

Suggested Fields

Renewable Energy
Environment
Construction
Transport
Robotics
Industrial Automation & Machinery
Telecommunication
Electric Power
Medicine & Health
Nanotechnology
Chemical & Petro-Chemical
Oil & Gas
Surface Coating
Bio-Technology
Others

MINIMUM QUALIFICATIONS OF TEACHER

For Technical Subjects

B.Sc. /BE degree in Engineering (Mechanical / Electronics/ Mechatronics)
with minimum of 2 years Industrial/ Teaching experience in the related field

MSc./Ph.D degree in disciplines related to
Mechanical/Electronics/Mechatronics & Control/Automation
Systems Engineering

DAE in Automation/ Mechatronics/Mechanical'/Electronics with 6-
yearsIndustrial/ Teaching experience in the related field

For Subjects pertaining to Humanities / Related Studies /Management

MA degree in English with 2 years of teaching experience

M.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 or Chemistry with 2-years of teaching experience

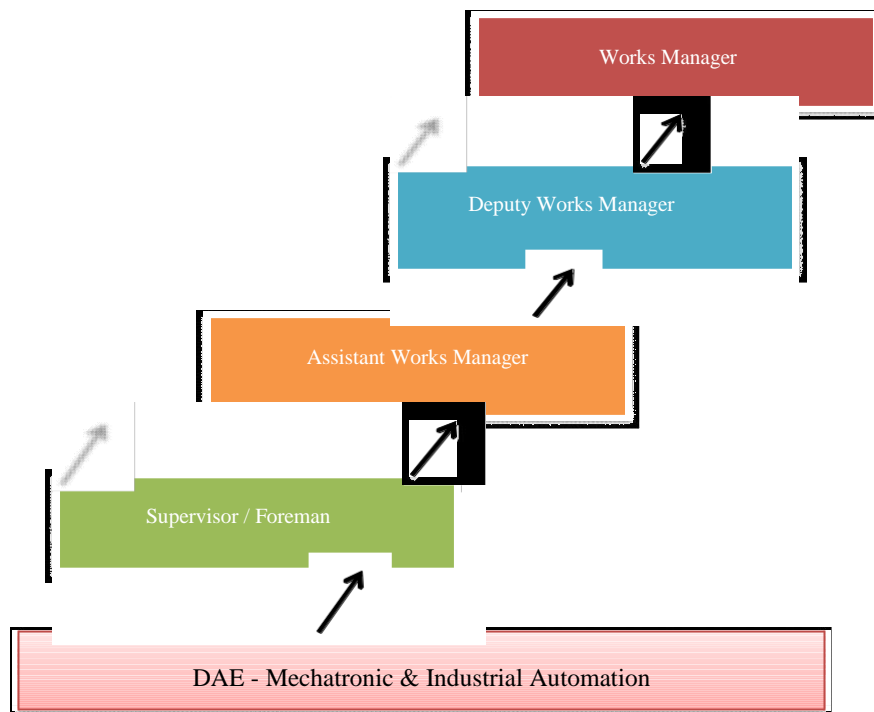
MBA degree with 2-years of teaching experience

PROGRESSION ROUTE FOR EMPLOYMENT / CAREER

The students holding DAE qualifications in Mechatronics can seek employment in firms/companies/industry dealing in any of the following fields / 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
Autonomous vehicles	Computer Graphics Special effects for Movie Industry

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



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 products.

Suggestions for Future Revision of Curriculum

During the whole process of curriculum development for this 3-year DAE Mechatronics & Industrial Automation Technology course, the key stakeholders were contacted to seek their views and meet their expectations during the challenging task of curriculum alignment. This exercise required the combination and balancing of the relevant topics from the previous curricula for Mechatronics Technology and Automation Technology. In fact, the interaction with stakeholders helped in understanding the changing paradigms of the relevant and allied industries and its impact on the curriculum revision / development.

During the process, many lessons were learnt which provided basis for the recommendations and suggestions as stated below:

The curriculum in use for both the courses is very extensive and demanding for the learners who come from a diverse educational and social background. They also lack in practical and analytical skills and generally their participation level in such activities is lower than desirable. The curriculum therefore has to be interesting and engaging in order to motivate the learners. This can be achieved, initially, by rigorous training in the usage of computer-based technology and essential applications and followed by teaching and training them through simulated images and extended usage of Information and Communication Technologies.

For future revision of curriculum, curriculum mapping be introduced which enables teachers to assure that they allocate sufficient time to cover each topic and objective. Curriculum maps provide the framework for building teaching units. Some topics and objectives are seasonal and must be taught during the appropriate time of the year. Other topics and objectives are developmental and must be built in sequentially throughout the year.

With the development of National Qualifications Framework (NQF), the interests of employers, employees, learners and qualification holders are safeguarded. NQF also facilitates lifelong learning and guides enterprises and employment agencies match skill demand with supply, and let the individuals make appropriate choices of training and career.

The main elements of framework shall be appropriate, transferable, broad and competency-based standards developed by employers etc. These shall be endorsed by the key stakeholders including civil society that reflect the skills required in the economy, public institutions, vocational and academic qualifications supported by a credible, fair and transparent system of assessment of skills learned and competencies gained, irrespective of

how and where they have been learned (e.g. through formal and informal education and training, work experience and on-the-job learning).

It is essential to closely link the process of curriculum development with industrial needs, research and developmental activities. For this a viable training network has to be established in order to channel support and co-operation for curriculum development and its periodic revision. A range of suitable mechanisms and incentives for stakeholders are needed to establish a sustainable curriculum development/revision process.

For effective motivation of students, the curriculum – both theory and experimental work – shall be delivered as an integrated whole. Since applied sciences including mathematics form the foundation to many disciplines, therefore experience in the laboratory or workshop is vital and should be illustrated through appropriate demonstration and practices from real life applications.

The methods and materials used in the training should be carefully adapted to the students' needs. To promote this aspect, it is suggested that teachers/trainers should make maximum use of numerical and graphical representation keeping the written material to a minimum, especially under the situation where the language of instruction differs from the native language.

In the present scenario of globalization, there is an increase in the mobility of labour which makes it obligatory to acquire foreign language skills – the need shall be addressed while developing or revising curriculum. Further, the training materials developed in one country if adapted elsewhere – it should be carefully made with due regard to local needs

The career development/counselling culture should be promoted throughout education and training systems as well as during employment services as a means to promote continuous learning. This culture will be of particular importance for ensuring the employability and facilitating the transition from education and training to work or further training.

The machines and equipment, used in workshops in educational institutions should be geared up to the needs of the workplace and should simulate it as closely as possible. Students should be capable of operating and maintaining such equipment, as accurately as possible.

Linkages between academia and industry or employers shall be encouraged or strengthened via bilateral visits and mutual interactions for enhancing the relevancy of curriculum via development of skill standards.

