PUNJAB BOARD OF TECHNICAL EDUCATION

21-A, Kashmir Block Allama Iqbal Town, Lahore
www.pbte.edu.pk- Tel # 042-99260193-94 (Ext. 139,140,115)
R&D Section Tel # 042-99260273

No: PBTE/R&D/2019/1364-1460 Dated:-20-06-19

NOTIFICATION

In pursuance of the letter No: TEVTA/Acad/CUR/6-524/GAP(DAE-Mech.) dated 27-03-2019, it is notified that the old course of DAE in Mechanical Technology (3 years) has been repealed and replaced with revised course of **"DAE in Mechanical Technology (3 years)"** for its implementation in TEVTA and Non TEVTA (affiliated) Institutions / Colleges.

It is imperative to note that there is no change in the course contents of Metallurgy (Mech-262) in the revised curriculum of DAE in Mechanical Technology; hence, pursuant upon the letter No: TEVTA/Acad/Cur/6-524/Vol-IX/DAE Mech. dated 28-05-2019, all concerned are informed that **the old code i.e. Mech-242 for the subject of Metallurgy will be retained as existed previously instead of Mech-262.**

Punjab Board of Technical Education, Lahore will conduct the examinations of the said technology for the academic session 2019-20 w.e.f. 1st annual examination 2020 and onwards accordingly. However the candidates who were registered in the old course i.e. DAE in Mechanical Technology (3 years) will avail the prescribed chances. Soft copy of the curriculum of the said technology may be downloaded from the website of PBTE i.e. http://www.pbte.edu.pk/Ptextbooks.aspx

SECRETARY

Copy to:

1- The General Manager Academics, TEVTA, Lahore.
2- The General Manager Operations, TEVTA, Lahore.
3- PA to Chairman, PBTE, Lahore.
4- PA to Secretary, PBTE, Lahore.
5- PA to Controller of Examinations, PBTE, Lahore.
6- The Principals concerned.
7- Senior Research Officer, PBTE, Lahore.
8- Deputy Controller of Examinations (Conduct), PBTE, Lahore.
9- Deputy Controller of Examinations (Secrecy), PBTE, Lahore.
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20- Assistant Secretary (Record & Verification), PBTE, Lahore.
21- Web Administrator, PBTE Lahore to upload on Board Website.

GOVERNMENT OF THE PUNJAB

TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY

Curriculum For

DAE

Mechanical Technology

(36AMECH2019R3)

(Revised, 2019)

CURRICULUM SECTION

ACADEMICS DEPARTMENT

96-H, GULBERG-II, LAHORE

Ph # 042-99263055-9, 99263064

gm.acad@tevta.gop.pk, manager.cur@tevta.gop.pk

APPROVED
Date: 25/3-2019
Sign:

APPROVED
Date: 25-3-19
Sign:

D.A.E Mechanical Tech.
Revised Scheme of Studies (2019)

1st Year

Code		Subject	T	P	C
Gen	111	Islamiat and Pak Studies	1	0	1
ENG	112	English	2	0	2
Math	113	Applied Mathematics	3	0	3
Phy	122	Applied Physics	1	3	2
Ch	112	Applied Chemistry	1	3	2
Mech.	127	Workshop Practice – I	2	15	7
		(A) General Metal Work 0 3			
		(B) Wood Work 0 3			
		(C) Welding and Forging 0 3			
		(D) Foundry 0 3			
		(E) Basic Machine Shop-I 0 3			
		Theory 2 0			
Comp	152	Computer Application	1	3	2
Mech.	151	Occupational Health Safety & Environment	1	0	1
Mech.	173	Engineering Drawing and Graphics	1	6	3
		TOTAL	13	30	23

2nd Year

Code		Subject	T	P	C
Gen	211	Islamiat and Pak Studies	1	0	1
Phy	212	Applied Mechanics	1	3	2
Math	212	Applied Mathematics-II	2	0	2
MGM	201	Communication Skills & Report Writing	1	0	1
MGM	221	Business Management and Industrial Economics	1	0	1
Elect.	212	Applied Electricity and Electronics	1	3	2
Mech.	233	Computer Aided Design (CAD)	1	6	3
Mech.	246	Workshop Practice-II	2	12	6
		(A) Basic Machine Shop-II 0 6			
		(B) Foundry and Pattern Making 0 3			
		(C) Adv. Welding 0 3			
		Theory 2 0			
Mech.	262	Metallurgy	2	0	2
Mech.	272	Metrology	1	3	2
		TOTAL	13	27	22

3rd Year

Code		Subject	T	P	C
Gen	311	Islamiat and Pak Studies	1	0	1
IMH	301	Industrial Management and Human Relations	1	0	1
Mech.	302	Fluid Mechanics and Hydraulic Machines	1	3	2
Mech.	313	Applied Thermodynamics	2	3	3
Mech.	321	Industrial Planning and Production Methods	1	0	1
Mech.	333	Machine Design & Analysis	2	3	3
Mech.	363	Tool& Mould Design	2	3	3
Mech.	332	Materials Testing and Heat Treatment	1	3	2
Mech.	354	Workshop Practice – III	2	6	4
Mech.	352	CAD/CAM	1	3	2
Mech.	372	CNC Machines	1	3	2
		TOTAL	15	27	24

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Date: 25 - 3 - 19
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REVISED CURRICULUM

OF

DIPLOMA OF ASSOCIATE ENGINEER

IN

MECHANICAL TECHNOLOGY

(FIRST YEAR)

2019

APPROVED
Date: 25/3/19
Sign:

Revised Scheme of Studies D.A.E. 1st -Year Mechanical

Code		Subject	T	P	C
Gen	111	Islamiat and Pak Studies	1	0	1
ENG	112	English	2	0	2
Math	113	Applied Mathematics	3	0	3
Phy	122	Applied Physics	1	3	2
Ch	112	Applied Chemistry	1	3	2
Mech.	127	Workshop Practice – I (A) Metal Work 0 3 (B) Wood Work 0 3 (C) Welding and Forging 0 3 (D) Foundry 0 3 (E) Basic Machine Shop-I 0 3 Theory 2 0	2	15	7
Comp	152	Computer Application	1	3	2
Mech.	151	Occupational Health Safety & Environment	1	0	1
Mech.	173	Engineering Drawing and Graphics	1	6	3
TOTAL			13	30	23

APPROVED
Date: 25 – 3 – 19
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Gen-111

ISLAMYAT AND PAK-STUDY

APPROVED
Date: 25/3/19
Sign:

اسلامیات/مطالعہ پاکستان

حصہ اول	اسلامیات	Gen III	ٹی	پی	سی
			1	0	1

حصہ دوم مطالعہ پاکستان

موضوعات حصہ اول اسلامیات سال اول

کتاب و سنت کل وقت:20 گھنٹے

قرآن مجید

1- تعارف قرآن مجید 2- نزول قرآن 3- مکی و مدنی سورتوں کی خصوصیات 4- وحی کی اقسام 3

5- پندرہ منتخب آیات معہ ترجمہ

1- لن تنالوا البر حتی تنفقوا مما تحبون

2- واعتصموا بحبل الله جمیعا ولا تفرقوا

3- ولا یجرمنکم شنان قوم علی ان لا تعدلوا

4- ان الله یامرکم ان تودوا الامانات الی اهلها

5- ان الله یامر بالعدل والاحسان

6- ان الصلوة تنهی عن الفحشاء والمنکر

7- لقد کان لکم فی رسول الله اسوة حسنة

8- ان اکرمکم عند الله اتقاکم

12- یمحق الله الربوٰ ویربی الصدقات

13- واصبر علی ما اصابک

14- وقولوا قولا سدیدا

15- ان الدین عند الله الاسلام

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(ب) سنت

1- سنت کی اہمیت

1- انما الاعمال بالنیات

2- انما بعث لاتمم مکارم الاخلاق

3- لایومن احدکم حتی یحب الا خیہ ما یحب لنفسہ

4- المسلم من سلم المسلمون من لسانہ ویدہ

5- قل امنت باللہ ثم استقم

6- خیرکم خیرکم لا ھلہ

7- سباب المسلم فسوق وقتالہ کفر

8- المومن اخوالمومن

9- کل المسلم علی المسلم حرام ذمہ ومالہ وعرضہ

10- آیۃ المنافق ثلاثۃ اذا حدث کذب واذا اوتمن خان واذا وعد اخلف

2- دین اسلام (5)

2.1 اسلام کے بنیادی عقائد کی وضاحت اور انسان کی انفرادی واجتماعی زندگی پر ان کے اثرات

1- توحید

2- رسالت

3- آخرت

4- ملائکہ

مندرجہ بالا عبادات کی اہمیت وفضیلت، سنتیں اور ا

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4- دین اسلام

عمومی مقصد۔ دین اسلام کے بنیادی عقائد 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 عقائد کی اہمیت بیان کر سکے۔
- ☆ اسلام کے بنیادی عقائد کے 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 کے اثرات بیان کر سکے
- ☆ اسلامی عقائد و عبادات کے مطابق اپنی زندگی ڈھال کر ایک اچھا مسلمان بن سکے۔

نصاب اخلاقیات　　سال اول (غیر مسلم طلباء کیلئے)

حصہ اول اخلاقیات　　Gen III

ٹی	پی	سی
1	0	1

کل وقت: 20 گھنٹے

حصہ دوم مطالعہ پاکستان

موضوعات

اخلاقیات کی تعریف اور اہمیت

اخلاقیات کا معیار (قانون۔ عقل۔ الہامی کتب)

مندرجہ ذیل اخلاق کی وضاحت

- دیانت داری
- وفاداری
- نظم وضبط
- راست گوئی
- صبر واستقلال
- حوصلہ مندی
- وقت کی پابندی
- صفائی
- اعتماد

APPROVED
Date: 28/3/19
Sign:

نصاب اخلاقیات سال اول

تدریسی مقاصد

عمومی مقصد۔ اعلیٰ اخلاق کی وجہ سے ملکی ترقی میں قابل قدر اضافہ کر سکے۔

خصوصی مقاصد۔ طالب علم اس قابل ہوگا 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 وضبط 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 اعتماد سے حسن کارکردگی کو بیان کر
- مصلحت کے فوائد بیان کر سکے

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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 بیان کر سکے۔
- جسمانی غلامی کے قومی سطح پر نقصانات بیان کر سکے۔

- نظریہ کی تعریف بیان کر سکے اور اس کی وضاحت کر
- نظریہ پاکستان کی تعریف کر سکے اور اس کا مفہوم بیان کر سکے۔
- علامہ اقبال اور قائداعظم 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۔

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Date: 25/3/19
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نصاب سال اول Gen III

حصہ دوم مطالعہ پاکستان کل وقت: 12 گھنٹے

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 علامہ اقبال اور قائداعظم 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۔ ندوۃ العلماء۔ دیوبند۔ مدرسۃ الاسلام (سندھ) اسلامیہ کالج (پشاور) انجمن حمایت اسلام (لاہور)

- محمد بن قاسم کے ہندوستان پر حملہ کی وجہ بیان کر سکے
- محمد بن قاسم کے ہندوستان پر حملہ کے اثرات بیان کر سکے
- وہ 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 الاسلام۔ اسلامیہ کالج۔ انجمن حمایت اسلام نے تعلیم کے ذریعہ جو سیاسی شعور مسلمانوں میں پیدا کیا اسے بیان کر سکے۔
- آزادی ہند کے سلسلہ میں تحریک مجاہدین کی خدمات بیان کر سکے۔

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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 hrs**

1.1 First eight essays of Intermediate. English Book-II

2. CLOZE TEST **4 hrs**

1.2 A passage comprising 50-100 words will be selected from the text. Every 11thword or any word for that matter will be omitted. The number of missing word will range between 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 hrs**

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 hrs**

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. **4 hrs**

5. TRANSLATION **6 hrs**

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

RECOMMENDED BOOKS

1. Intermediate English Book-II.
2. An English Grammar and Composition of Intermediate Level.
3. A Hand Book of English Students by Gatherer

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Date: 25/3/19
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Eng-112 ENGLISH

INSTRUCTIONAL OBJECTIVES

PAPER-A

1. DEMONSTRATE BETTER READING, COMPREHENSION AND VOCABULARY

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

2. UNDERSTAND FACTS OF THE TEXT

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

PAPER-B

3. APPLY THE RULES OF GRAMMAR IN WRITING AND SPEAKING

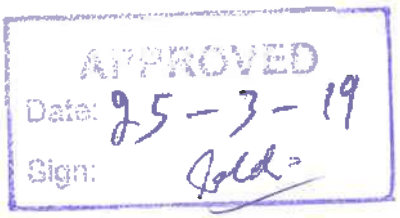
3.1 Use rules of grammar to construct meaningful sentences containing a subject and a predicate.
3.2 State classification of time, i.e. present, past and future and use verb tense correctly in different forms to denote relevant time.
3.3 Identify function words and content words.
3.4 Use marks of punctuation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

4. APPLY THE CONCEPTS OF COMPOSITION WRITING TO PRACTICAL SITUATIONS

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

5. APPLIES RULES OF TRANSLATION

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



Math-113 APPLIED MATHEMATICS

		T	P	C
Total contact hours	96			
Theory		3	0	3

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

AIMS After completing the course the students will be able to

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

COURSE CONTENTS

1	**QUADRATIC EQUATIONS**	**6 Hrs**
1.1	Standard Form	
1.2	Solution	
1.3	Nature of roots	
1.4	Sum & Product of roots	
1 .5	Formation	
1.6	Problems	
2	**ARITHMETIC PROGRESSION AND SERIES**	**3Hrs**
2.1	Sequence	
2.2	Series	
2.3	nth term	
2.4	Sum of the first n terms	
2.5	Means	
2.6	Problems	
3	**GEOMETRIC PROGRESSION AND SERIES**	**3Hrs**
3.1	nth term	
3:2	sum of the first n terms	
3.3	Means	
3.4	Infinite Geometric progression	
3.5	Problems	
4	**BINOMIAL THEOREM**	**6 Hrs**
4.1	Factorials	
4.2	Binomial Expression	
4.3	Binomial Co-efficient	
4.4	Statement	
4.5	The General Term	
4.6	The Binomial Series.	
4.7	Problems	

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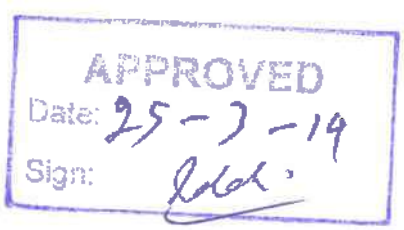
5	**PARTIAL FRACTIONS**	**6 Hrs**
5.1	Introduction	
5.2	Linear Distinct Factors Case I	
5.3	Linear Repeated FactorsCase II	
5.4	Quadratic Distinct Factors Case III	
5.5	Quadratic Repeated Factors Case IV	
5.6	Problems	
6	**FUNDAMENTALS OF TRIGONOMETRY**	**6 Hrs**
6.1	Angles	
6.2	Quadrants	
6.3	Measurements of Angles	
6.4	Relation between Sexagesimal & circular system	
6.5	Relation between Length of a Circular Arc & the Radian Measure of its central Angle	
6.6	Problems	
7	**TRIGONOMETRIC FUNCTIONS AND RATIOS**	**6 Hrs**
7.1	trigonometric functions of any angle	
7.2	Signs of trigonometric Functions	
7.3	Trigonometric Ratios of particular Angles	
7.4	Fundamental Identities	
7.5	Problems	
8	**GENERAL IDENTITIES**	**6 Hrs**
8.1	The Fundamental Law	
8.2	Deductions	
8.3	Sum & Difference Formulae	
8.4	Double Angle Identities	
8.5	Half Angle Identities	
8.6	Conversion of sum or difference to products	
8.7	Problems	
9	**SOLUTION OF TRIANGLES**	**6 Hrs**
9.1	The law of Sines	
9.2	The law of Cosines	
9.3	Measurement of Heights & Distances	
9.4	Problems	
10	**MENSURATION OF SOLIDS**	**30 Hrs**
10.1	Review of regular plane figures and Simpson's Rule	
10.2	Prisms	
10.3	Cylinders	
10.4	Pyramids	
10.5	Cones	



10.6 Frusta
10.7 Spheres

11 VECTORS **9 Hrs**

11.1 Sealers & Vectors
11.2 Addition & Subtraction
11.3 The unit Vectors I, j, k
11.4 Direction Cosines
11.5 Sealer or Dot Product
11.6 Deductions
11.7 Dot product in terms of orthogonal components
11.8 Deductions
11.9 Analytic Expression for a x b.
11.10 Problems.

12 MATRICES AND DETERMINANTS **9 Hrs**

12.1 Definition of Matrix
12.2 Rows & Columns
12.3 Order of a Matrix
12.4 Algebra of Matrices
12.5 Determinants
12.6 Properties of Determinants
12.7 Solution of Linear Equations
12.8 Problems

REFERENCE BOOKS

1. A Text Book of Mathematics (Math-113) by TEVTA, authored by Sana ullah Kan, Tahir Hamid & Nasir ud-Din

APPROVED
Date: 25/3/19
Sign:

Math-113 APPLIED MATHEMATICS-I

INSTRUCTIONAL OBJECTIVES

1 USE DIFFERENT METHODS FOR THE SOLUTION OF QUADRATIC EQUATIONS

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 sum and product of the roots.
1.7 Form a quadratic equation from the given roots.
1.8 Solve problems involving quadratic equations.

2 UNDERSTAND APPLY CONCEPT OF ARITHMETIC PROGRESSION AND SERIES

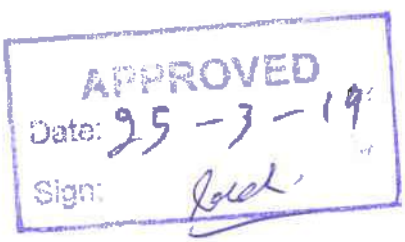
2.1 Define an Arithmetic sequence and a series
2.2 Derive formula for the nth term of an A.P.
2.3 Explain Arithmetic Mean between two given numbers
2.4 Insert n Arithmetic means between two numbers
2.5 Derive formulas for summation of an Arithmetic series
2.6 Solve problems on Arithmetic Progression and Series

3 UNDERSTAND GEOMETRIC PROGRESSION AND SERIES

3.1 Define a geometric sequence and a series.
3.2 Derive formula for nth term of a G.P.
3.3 Explain geometric mean between two numbers.
3.4 Insert n geometric means between two numbers.
3.5 Derive a formula for the summation of geometric Series.
3.6 Deduce a formula for the summation of an infinite G.P.
3.7 Solve problems using these formulas.

4 EXPAND AND EXTRACT ROOTS OF A BINOMIAL

4.1 State binomial theorem for positive integral index.
4.2 Explain binomial coefficients: (n,0), (n,1).....(n,r),.....(n,n)
4.3 Derive expression for the general term.
4.4 Calculate the specified terms.
4.5 Expand a binomial of a given index.
4.6 Extract the specified roots
4.7 Compute the approximate value to a given decimal place.
4.8 Solve problems involving binomials.



5	**RESOLVE A SINGLE FRACTION INTO PARTIAL FRACTIONS USING DIFFERENT METHODS.**
5.1	Define a partial fraction, a proper and an improper fraction.
5.2	Explain all the four types of partial fractions.
5.3	Set up equivalent partial fractions for each type.
5.4	Explain the methods for finding constants involved.
5.5	Resolve a single fraction into partial fractions.
5.6	Solve problems involving all the four types.
6	**UNDERSTAND SYSTEMS OF MEASUREMENT OF ANGLES.**
6.1	Define angles and the related terms.
6.2	Illustrate the generation of angle.
6.3	Explain sexagesimal and circular systems for the measurement of angles
6.4	Derive the relationship between radian and degree.
6.5	Convert radians to degrees and vice versa.
6.6	Derive a formula for the circular measure of a central angle.
6.7	Use this formula for solving problems.
7	**APPLY BASIC CONCEPTS AND PRINCIPLES OF TRIGONOMETRIC FUNCTIONS**
7.1	Define the basic trigonometric functions/ratios of an angle as ratios of the sides of a right triangle.
7.2	Derive fundamental identities.
7.3	Find trigonometric ratios of particular angles.
7.4	Draw the graph of trigonometric functions.
7.5	Solve problems involving trigonometric functions.
8	**USE TRIGONOMETRIC IDENTITIES IN SOLVING TECHNOLOGICAL PROBLEMS**
8.1	List fundamental identities
8.2	Prove the fundamental law
8.3	Deduce important results
8.4	Derive-sum and difference formulas
8.5	Establish half angle, double angle & triple angle formulas
8.6	Convert sum or difference into product& vice versa
8.7	Solve problems
9	**USE CONCEPTS, PROPERTIES AND LAWS OF TRIGONOMETRIC FUNCTIONS FOR SOLVING TRIANGLES**
9.1	Define angle of elevation and angle of depression.
9.2	Prove the law of sins and the law of cosines.
9.3	Explain elements of a triangle.
9.4	Solve triangles and the problems involving heights and distances.
10	**USE PRINCIPLES OF MENSTRUATION IN FINDING SURFACES, VOLUME AND WEIGHTS OF SOLIDS.**
10.1	Define menstruation of plane and solid figures
10.2	List formulas for perimeters & areas of plane figure.
10.3	Define pyramid and cone.

10.4 Define frusta of pyramid and cone.
10.5 Define a sphere and a shell.
10.6 Calculate the total surface and volume of each type of solid.
10.7 Compute weight of solids.
10.8 Solve problems of these solids.

11. USE THE CONCEPT AND PRINCIPLES OF VECTORS IN SOLVING TECHNOLOGICAL PROBLEMS.

11.1 Define vector quantity.
11.2 Explain addition and subtraction of vector
11.3 Illustrate unit vectors I, j, k.
11.4 Express a vector in the component form.
11.5 Explain magnitude, unit vector, direction consines of a vector.
11.6 Derive analytic expression for dot product and cross product of two vector.
11.7 Deduce conditions of perpendicularly and parallelism of two vectors.
11.8 Solve problems

12. USE THE CONCEPT OF MATRICES & DETERMINANTS IN SOLVING TECHNOLOGICAL PROBLEMS

12.1 Define a matrix and a determinant.
12.2 List types of matrices.
12.3 Define transpose, ad joint and inverse of a matrix.
12.4 State properties of determinants.
12.5 Explain basic concepts.
12.6 Explain algebra of matrices.
12.7 Solve linear equation by matrices.
12.8 Explain the solution of a determinant.
12.9 Use Crammers Rule for solving linear equations

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Phy-122 APPLIED PHYSICS

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

AIMS: The students will be able to understand the fundamental principles and concept of physics, use these to solve problems in practical situations/technical courses and understand concepts to learn advance physics/technical courses,

COURSE CONTENTS

1 MEASUREMENTS. **2 Hrs**

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 Hrs**

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

4.1 Torque
4.2 Centre of gravity and centre of mass
4.3 Equilibrium and its conditions
4.4 Torque and angular acceleration
4.5 Rotational inertia

5. WAVE MOTION **5 Hrs**

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 Hrs**

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 effect

7. LIGHT **5 Hrs**

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 Hrs**

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 Hrs**

9.1 Corpuscular theory of light
9.2 Emission and absorption of light
9.3 Stimulated absorption and emission of light
9.4 Laser principle
9.5 Structure and working of lasers
9.6 Types of lasers with brief description.
9.7 Applications (basic concepts)
9.8 Material processing
9.9 Laser welding
9.10 Laser assisted machining
9.11 Micro machining
9.12 Drilling scribing and marking

9.13 Printing

9.14 Lasers in medicine

RECOMMENDED BOOKS

1. A Text Book of Physics , Phy-122 of TEVTA published by National Book Foundation(NBF)

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Phy-122 APPLIED PHYSICS

INSTRUCTIONAL OBJECTIVES

1 USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS

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

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

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

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

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

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

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

5 USE CONCEPTS OR 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.

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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.

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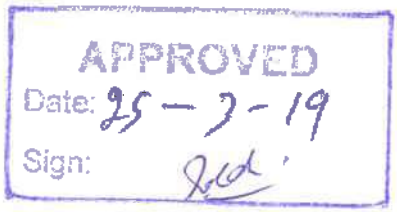
Phy-122 APPLIED PHYSICS

LIST OF PRACTICALS

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



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

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Ch-112 APPLIED CHEMISTRY

T	P	C
1	3	2

Total Contact Hours

Theory **32**

Practical **64**

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

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

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

COURSE CONTENTS

1 INTRODUCTION AND FUNDAMENTAL CONCEPTS **2 Hrs**

1.1 Orientation with reference to this technology

1.2 Terms used & units of measurements in the study of chemistry

1.3 Chemical Reactions & their types

2 ATOMIC STRUCTURE **2 Hrs**

2.1 Sub-atomic particles

2.2 Architecture of atoms of elements, Atomic No. & Atomic Weight

2.3 The periodic classification of elements periodic law

2.4 General characteristics of a period and group

3 CHEMICAL BOND **2 Hrs**

3.1 Nature of chemical Bond

3.2 Electrovalent bond with examples

3.3 Covalent Bond (Polar and Non-polar, sigma & Pi Bonds with examples

3.4 Co-ordinate Bond with examples

4 WATER **2 Hrs**

4.1 Chemical nature and properties.

4.2 Impurities

4.3 Hardness of water (types, causes & removal)

4.4 Scales of measuring hardness (Degrees Clark

4.5 Boiler feed water, scales & treatment

4.6 Sea-water desalination, sewage treatment

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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	

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

BOOKS RECOMMENDED

1. A Text Book of Chemistry (Ch-112) of TEVTA, published by National Book Foundation (NBF)

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Sign:

Ch-112 APPLIED CHEMISTRY

INSTRUCTIONAL OBJECTIVES

1 UNDERSTAND THE SCOPE, SIGNIFICANCE AND FUNDAMENTAL ROLE OF THE SUBJECT

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

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

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

3 UNDERSTAND THE NATURE OF CHEMICAL BOND

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

4 UNDERSTAND THE CHEMICAL NATURE OF WATER

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

5 UNDERSTAND THE NATURE OF ACIDS, BASES AND SALTS

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

6 UNDERSTAND THE PROCESS OF OXIDATION AND REDUCTION

6.1 Define oxidation
6.2 Explain the oxidation process with examples
6.3 Define reduction

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

7 UNDERSTAND THE FUNDAMENTALS OF NUCLEAR CHEMISTRY

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

8 UNDERSTAND THE MANUFACTURE, SETTING AND HARDENING CEMENT

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

9 UNDERSTAND THE PROCESS OF MANUFACTURE OF GLASS.

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

10 UNDERSTAND THE NATURE AND IMPORTANCE OF PLASTICS POLYMERS

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

11 KNOW THE CHEMISTRY OF PAINTS, VARNISHES AND DISTEMPERS

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

12 UNDERSTAND THE PROCESS OF CORROSION WITH ITS CAUSES AND TYPES

12.1 Define corrosion
12.2 Describe different types of corrosion
12.3 State the causes of corrosion
12.4 Explain the process of rusting of iron
J2.5 Describe methods to prevent/control corrosion

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13 UNDERSTAND THE NATURE OF REFRACTORY MATERIALS AND ABRASIVE

13.1 Define refractory materials
13.2 Classify refractory materials

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

14 UNDERSTAND THE NATURE AND IMPORTANCE OF ALLOYS

14.1 Define alloy
14.2 Describe different methods for the preparation of alloys
14.3 Describe important properties of alloys
14 4 Enlist some important alloys with their composition, properties and uses

15 UNDERSTAND THE NATURE OF FUELS AND THEIR COMBUSTION

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

16 UNDERSTAND THE NATURE OF LUBRICANTS.

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

17 UNDERSTAND THENATURE 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

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CH-112 **APPLIED CHEMISTRY** **96 Hours**

1. To introduce the common apparatus, glassware and chemical reagents used in the chemistry lab.
2. To purify a chemical substance by crystallization.
3. To separate a mixture of sand and salt.
4. To find the melting point of substance.
5. To find the pH of a solution with pH paper.
6. To separate a mixture of inks by chromatography.
7. To determine the co-efficient of viscosity of benzene with the help of Ostwald vasomotor.
8. To find the surface tension of a liquid with a stalagmometer.
9. To perform electrolysis of water to produce Hydrogen and Oxygen.
10. To determine the chemical equivalent of copper by electrolysis of Cu SO.
11. To get introduction with the scheme of analysis of salts for basic radicals.
12. To analyse 1st group radicals (Ag^{+} - Pb^{++} - Hg^{+}).
13. To make practice for detection 1st group radicals.
14. To get introduction with the scheme of II group radicals.
15. To detect and confirm II-A radicals (hg^{++}, Pb^{++++}, Cu^{+}, Cd^{++}, Bi^{+++}).
16. To detect and confirm II-B radicals Sn^{+++}, Sb^{+++}, As^{+++}).
17. To get introduction with the scheme of III group radicals (Fe^{+++} - Al^{+++}, Cr^{+++})
18. To detect and confirm Fe^{+++}, Al^{+++} and Cr^{+++}.
19. To get introduction with he scheme of IV group radicals.
20. To detect and confirm An^{++} and Mn^{++} radicals of IV group.
21. To detect and conform Co^{++} and NI^{++} radicals of IV group.
22. To get introduction with the Acid Radical Scheme.
23. To detect dilute acid group.
24. To detect and confirm CO''_3 and HCO'_3 radicals.
25. To get introduction with the methods/apparatus of conducting volumetric estimations.
26. To prepare standard solution of a substance.
27. To find the strength of a given alkali solution.
28. To estimate HCO'_3 contents in water.
29. To find out the %age composition of a mixture solution of KNO_3 and KOH volumetrically.
30. To find the amount of chloride ions (Cl') in water volumetrically.

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Mech-127 WORKSHOP PRACTICE - I

Total Contact Hours		**T**	**P**	**C**
Theory:	64 Hrs	**2**	**15**	**7**
Practical:	480 Hrs			

Pre-requisites: None

AIMS: The students will familiarize with the Tools, Equipment, Machines used in the Metal work, Welding & Forging, Wood Work, Foundry and Basic machine shop. The student will achieve the Basic skills in the above fields by preparing specific jobs in each part of the subject.

Corse Contents:

1.	**A - General Metal work**	**12 Hrs**
2.	**B - Wood Work**	**13 Hrs**
3.	**C - Welding and Forging**	**13 Hrs**
4.	**D - Foundry**	**13 Hrs**
5.	**E - Basic Machine Shop-I**	**13 Hrs**

Detail of Contents: (Theory)

A) General Metal Work

1. Introduction To Metal Work and Metal Working Tools **1 Hr**

1.1 Observe safety precautions and proper care of Metal working tools and machines

2. Kinds of Tools and Machines **11Hrs**

2.1 Hand tools
- 2.1.1 Measuring tools
- 2.1.2 Layout tools
- 2.1.3 Cutting tools
- 2.1.4 Chisels
- 2.1.5 Files and Filing
- 2.1.6 Hacksaws and Hack sawing
- 2.1.7 Drills & Reamers
- 2.1.8 Taps, Taping and Threading dies

2.2 Machines
- 2.2.1 Drilling machines
- 2.2.2 Power Hacksaw
- 2.2.3 Bending machines
- 2.2.4 Rolling machine
- 2.2.5 Shearing machine

2.3 Fasteners
- 2.3.1 Introduction to Fasteners

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2.3.2 Screws, Nuts, Bolts, Rivets,
2.3.2 Types and applications of related tools

B) Wood Work

3. Wood Working Tools — 4 Hrs

3.1 Wood working shop orientation
3.2 Impact Tools
3.3 Measuring tools
3.4 Cutting tools
3.5 Marking tools
3.6 Holding tools

4. Wood Working Machine — 3 Hrs

4.1 Introduction
4.2 Radial saw
4.3 Circular saw
4.4 Band saw
4.5 Jointer and planner
4.6 Wood turning lathe
4.7 CNC Router
4.8 Jig saw
4.9 Safety precautions for above wood working machine

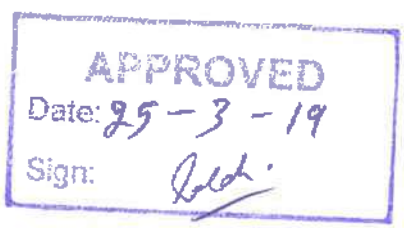
5. Wood Cuts and Wood Joints, Wood Finishing and Polishing — 6Hrs

5.1 Types and uses of wood cuts
5.2 Classification and uses of wood joints.
5.3 Making wood cuts and wood joints.
5.4 Wood glue and wood fastener.
5.5 Kind and seasoning of wood
5.6 Importance of wood finishing and polishing
5.7 Classify abrasive sheets' (size, nature and their international Grades)
5.8 Sanding application and sanding machine
5.9 Pattern filling and its application
5.10 Polishing of wood and care in use of polishing brush
5.11 Types of Polishes & Paints
5.12 Types of Modern Furniture Material

C) Welding and Forging

6. Welding shop and Forging shop Machinery, Tools and Equipment — 4 Hrs

6.1 Definition of welding
6.2 Welding Processes
  6.2.1 Pressure welding
  6.2.2 Fusion welding process
6.3 Types of pressure welding process
  6.3.1 Forge welding
  6.3.2 Resistance welding
    6.3.2.1 Types of Resistance welding
6.4 Types of Fusion welding
  6.4.1 Oxy acetylene gas welding
  6.4.2 Arc welding
  6.4.3 Thermo welding



6.4.4 TIG welding
6.4.5 MIG welding
6.4.6 Submerged Arc welding

7. Detail of Fusion Welding (Oxy acetylene gas welding, Arc welding) 4 Hrs

7.1 Oxy acetylene gas welding List of Oxy acetylene gas welding tools/equipment with Their uses
7.2 Arc welding
7.2.1 Introduction to Arc welding machine
7.2.2 List of Arc welding tools equipments with their uses
7.3 Welding Materials
7.3.1 Flux
7.3.2 Types of filler rod
7.3.3 Types of Electrode
7.4 Safety method in welding shop
7.4.1 Flash back and its remedy
7.4.2 Back fire and its remedy
7.5 Welding Defects & Tests (DPT, NDTs)
7.6 Welding Certifications

8. Forging 5 Hrs

8.1 Introduction to Forging
8.2 Forging tools Equipments
8.3 Classification of forging
8.3.1 Hand Forging
8.3.2 Machine Forging
8.3.3 Forging equipments
8.3.3.1 Machine
8.3.3.2 Furnaces
8.4 Forging operations
8.4.1 Drawing Down
8.4.2 Up Setting
8.4.3 Cutting
8.4.4. Swaging
8.4.5 Punching
8.4.6 Twisting

D) Foundry

9. Foundry 3Hrs

9.1 Introduction to foundry and basic steps in casting process.
9.2 Shop safety procedure
9.3 Pattern

10. Foundry tools and equipment 5Hrs

10.1 Molding hand tools
10.2 Molding machines
10.3 Sand mixing machine
10.4 Shot blasting machines
10.5 Furnaces

11. Foundry sand 5Hrs

11.1 Green sand and its composition
11.2 Dry sand and its composition

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11.3 Characteristics of foundry sand
11.4 Parting sand
11.5 Facing sand

E) Basic Machine Shop-I

12. Lathe construction — 13Hrs

12.1 Parts of lathe
- 12.1.1 Lathe accessories

12.2 Lathe cutting tools and materials
- 12.2.1 Cutting tools material
- 12.2.2 Types of Lathe cutting tools

12.3 Cutting speed and feed
- 12.3.1 Cutting speed feed and depth of cut

12.4 Lathe Operations
- 12.4.1 Introductions
- 12.4.2 Centering of work piece
- 12.4.3 Facing
- 12.4.4 Straight turning
- 12.4.5 Step turning
- 12.4.6 Knurling
- 12.4.7 Center drilling and drilling
- 12.4.8 Taper turning

12.5 Tool Grinder
12.6 Shaper

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Mech-127 WORKSHOP PRACTICE– I

Instructional Objectives:

A) General Metal Work

1. Introduction To Metal Work and Metal Working Tools

1.1 Observe safety precautions and proper care of Metal working tools and machines

2. Kinds of Tools and Machines

2.1 Understand Metal Working Hand tools

- 2.1.1 Classify Metal Working Measuring tools
- 2.1.2 Describe Layout tools and Practice
- 2.1.3 Describe Cutting tools and Practice
- 2.1.4 Describe Chisels and Chiseling
- 2.1.5 Describe Files and Filing
- 2.1.6 Describe Hacksaws and Hack sawing
- 2.1.7 Describe Drills, Drilling and Reamers
- 2.1.8 Describe Taps, Taping and threading dies

2.2 Understand Metal Working Machines

- 2.2.1 Explain Drilling machines
- 2.2.2 Explain Power Hacksaw
- 2.2.3 Explain Bending machines
- 2.2.4 Explain Rolling machine
- 2.2.5 Explain Shearing machine

2.3 Understand Fasteners

- 2.3.1 Introduction to Fasteners
- 2.3.2 Explain Types of Screws, Nuts, Bolts, Rivets
- 2.3.2 Explain Types and applications of related tools

B) Wood Work

3. Wood Working Tools

3.1 Introduction to Wood Workshop

- 3.1.1 Describe the basic concept of wood work shop and its importance for pattern making and packing.
- 3.1.2 Observe safety precautions and proper care of wood working hand tools

3.2 Describe the use of Impact Tools

3.3 Describe the use of Measuring tools

3.4 Describe the use of Cutting tools

- 3.4.1 Describe sharpening of wood cutting tools

3.5 Describe the use of Marking tools

3.6 Describe the use of Holding tools

4. Operates Effectively all Wood Working Machine

4.1 Identify all wood working machines

- 4.1.1 Classify wood working machine according to their uses

4.2 Describe Radial saw

4.3 Describe Circular saw

4.4 Describe Band saw

4.5 Describe Jointer and planner

4.6 Describe Wood turning lathe

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4.7 Describe Jig saw
4.8 Observe Safety precautions for above wood working machine

5. Explain Wood Cuts and Wood Joints, Wood Finishing and Polishing

5.1 Describe Types of joints and wood cuts
5.2 Describe the use of wood joints
5.3 Select the appropriate joints for the given wood
5.4 Manipulate wood fasteners and glues
5.5 Describe the kinds of wood, their classification and uses
  5.5.1 Describe seasoning methods of wood
5.6 Describe importance of wood finishing and polishing
5.7 Classify abrasive sheets according to the size of grit
  5.7.1 Classify abrasive sheets according to the nature of abrasive.(Aluminum Oxide and silicon)
  5.7.2 Used of abrasive sheets, backing process, belt making, fitting and their international grades
5.8 Describe sanding and sanding machine
  5.8.1 Process of manual sanding
  5.8.2 Process of machine sanding (Flat belt sanding, Drum sanding, Disk Sanding)
  5.8.3 Selection of cutting speed and tension for machine sanding process
  5.8.4 Describe types of pattern
  5.8.5 State methods of pattern application
  5.8.6 Describe polishing (Grain making), types of function and care in use of polishing brush

C) Welding and Forging

6. Familiarized with Welding shop and Forging shop Machinery, Tools and Equipments

6.1 Define welding
6.2 Describe Welding Processes
  6.2.1 Describe Pressure welding
  6.2.2 Describe Fusion welding process
6.3 Describe Types of pressure welding process
  6.3.1 Describe Forge welding
  6.3.2 Describe Resistance welding of Spot welding, Seam welding, Flash welding
6.4 Describe Types of Fusion welding
  6.4.1 Describe Oxy acetylene gas welding
  6.4.2 Describe Arc welding
  6.4.3 Describe Thermo welding
  6.4.4 Describe TIG welding
  6.4.5 Describe MIG welding
  6.4.6 Describe Submerged Arc welding

7. Understand the use of Fusion Welding Tools (Oxy acetylene gas welding, Arc welding)

7.1 Demonstrate oxy-acetylene gas welding
  7.1.1 Describe Tools and equipments
  7.1.2 Describe the function and proper uses of oxy-acetylene gas welding
  7.1.3 Demonstrate the pressure regulators function, Oxygen Cylinder, acetylene cylinder, injector and non injector type of blow pipe
7.2 Understand the use of Arc welding machines and equipments
  7.2.1 Describe the function of step down transformer.

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7.2.2 Describe the function of welding tools and their uses
7.2.3 Identification of Arc welding and their uses.
7.2.4 Describe the arc welding processes

7.3 Describe Welding Materials
7.3.1 Definition of Flux, its uses and advantages
7.3.2 Describe types of filler rod
7.3.3 State types of Electrode

7.4 Apply the safety method in welding shop
.7.4.1 Describe the flash back, causes of flash back
7.4.2 Explain the back fire, its causes and how to avoid
7.4.3 Explain the safety precautions applied during Arc welding,gas welding, forging and grinding

7.5 Describe the welding defects like
7.5.1 Describe Lack of penetration
7.5.2 Describe Slag inclusion
7.5.3 Describe Undercut
7.5.4 Describe Blow holes

8. Forging Operation

8.1. Describe the forging
8.1.1 Difference between hot and cold forging

8.2 Understand the forging tools and equipment
8.2.1 Explain the working procedure of forge furnace and names its parts
8.2.2 Identify the forging equipments, tools and their uses
8.2.3 Describe the proper use of equipments and tools
8.2.4 Explain the building and maintaining the forge fire
8.2.5 Describer the different forge fuels

8.3 Understand the forging processes
8.3.1 Describe hand forging and machine forging
8.3.2 Describe the advantages of forging
8.3.3 Explain safety rules applied in forging shop

8.4 Describe the forging operations
8.4.1 Cutting of hot metal with chisel
8.4.2 Cutting of hot metal with hardy
8.4.3 Explain the drawing down and up setting process
8.4.4 Demonstrate the drawing down operations and use of flatter
8.4.5 Describe the fullering and swaging .Apply the proper tools for swaging operation

D) Foundry

9. Foundry

9.1 Introduction to foundry and basic steps in casting process
9.2 Describe Shop safety procedure
9.3 Describe Pattern
9.3.1 Describe types of a pattern
9.3.2 Describe pattern materials

10. Foundry tools and equipment

10.1 Describe Molding hand tools
10.2 Describe Jolting and Squeezing Molding machines
10.3 Introduction to Sand mixing machine
10.4 Describe Sand and Shot blasting machines

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10.5 Describe Pit Furnaces and Tilting Furnaces

11. Foundry sand

11.1 Describe Green sand and its composition

11.2 Describe Dry sand and its composition

11.2.1 Binders for foundry sand

11.2.2 Describe preparation of sand for CO_2 molding process

11.3 Describe Characteristics of foundry sand

11.4 Describe Parting sand

11.5 Describe Facing sand

E) Basic Machine Shop-I

12. Lathe construction

12.1 List the parts of Lathe

12.1.1 Explain the function of each part

12.1.2 Name the "Lathe accessories"

12.1.3 Describe the use of each accessory

12.2 List the materials used for cutting tools

12.2.1 Describe the characteristics of each material

12.2.2 Name the types of cutting tools according to their use.

12.3 Cutting speed and feed

12.3.1 Define cutting speed, feed and depth of cut for lathe work

12.3.2 Describe calculations of cutting speed

12.3.3 Factors effecting cutting speed and feed

12.4 List the lathe operations

12.4.1 Define Centering of work piece on four jaws independent chuck

12.4.2 Describe the importance of centering the work piece

12.4.3 Define facing

12.4.4 Describe the method of facing a work piece held in a chuck

12.4.5 Define straight turning

12.4.6 Describe the method of rough and finish turning

12.4.7 Define step turning

12.4.8 Define shoulder

12.4.9 Describe the types of shoulder

12.4.10 Define knurling

12.4.11 Describe the purpose of knurling

12.4.12 Describe the types of knurling according to shape and grade

12.4.13 Define center drilling

12.4.14 Define drilling

12.4.15 Describe the method of drilling and center drilling on lathe machine

12.4.16 Define taper and taper turning

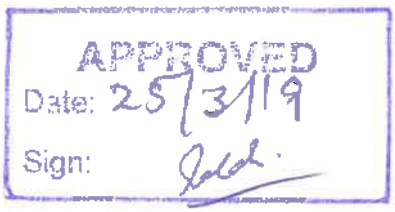
12.4.17 Describe the compound slide method of taper turning

12.5 List parts of tool grinder

12.5.1 Describe each part

12.6 List parts of shaper

12.6.1 Describe each part



Mech-127 WORKSHOP PRACTICE-I

List of Practical:

A) General Metal Work

1. Preparation of name plate
2. Sawing exercise
3. Preparation of inside caliper
4. Preparation of Bottle opener
5. Preparation of dove-tail joint
6. Preparation of small size Try-square
7. Preparation of Coat hook
8. Preparation of funnel (sheet)
9. Preparation Pin tray (sheet)
10. Preparation of Drawer handle
11. Preparation of bevel square
12. Preparation of spanner (small size)

B) Wood Work

1. Safety precautions in wood working shop
2. Assembly and disassembly of jack-plane
3. Using of various wood working planes. (Tool exercise)
4. Plane and squaring to dimensions. (Job-I)
5. Sharpening plane-iron.
6. Introducing different wood working, layout and measuring tools.
7. Sawing exercise (Job-2)
8. Identifying different types of handsaws, and making sketches of all saws
9. Sharpening 'band saws'
10. Wood chiseling (Chipping)
11. Making Mortise and Tenon joint (Job-3)
12. Sharpening wood chisel
13. Making dado-joint (Job-4)
14. Making cross-lap joint (Job-5)
15. Observing wood chisel
16. Identify and comparing soft and hard wood
17. Spirit polishing (preparing wood surface for polishing, staining and lacquering)
18. Boring process, making holes of different diameters in wood. (Job-6)
19. Nailing and wood screwing process (Job+8)
20. Making middle half cross-lap joint (Job-9)
21. Making dove-tail joint (Job-10)
22. Wood working projects etc

C) Welding and Forging

(OXY ACETYLENE)

1. Flame making gas welding
   (a) Harsh Flame (b) Carburizing Flame (c) Neutral Flame (d) oxidizing

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2. Pool making
3. Bead making
4. Edge joint
5. Open square butt joint (MS Flat 3mm thick)
6. Open square butt joint (MS Flat 5mm thick)
7. 'V' Groove butt joint (Flat Position)
8. Corner joint
9. Open square brazing butt joint (MS Flat 3mm thick)

(ARC WELDING)

10. Types of Arc welding machines and their operation with current adjustment
11. Arc making
12. Bead making
13. Open square Butt joint (MS Flat 5mm thick)
14. 'V' Groove Butt joint
15. Lap joint
16. Corner joint (Vertical Position)
17. Spot welding practice (0.5 mm M.S Sheet)
18. Seam welding practice (0.5 mm M.S Sheet)

(FORGING)

19. Practice of drawing down
20. Practice of up setting

D) Foundry Shop

1. Introduction and layout of foundry shop
2. Introduction to foundry sand
   - 2.1 Dry sand molding
   - 2.2 Green Sand Moulding
   - 2.2 Binding materials
3. Introduction to hand molding tools, equipment and molding boxes/flasks.
4. Introduction and practice of sand cleaning and mixing machines
5. Sand preparation and tempering practice
6. Practice of mould making
   - 6.1 Dry sand molding
   - 6.2 Green sand molding
7. **Practice use of single piece patterns (one piece patterns)**
   - 7.1 English letters (Alphabet)
   - 7.2 Paper weight
   - 7.3 Simple square, triangular and hexagonal patterns)
8. **Practice use of split patterns (two piece patterns)**
   - 8.1 Anvil
   - 8.2 Journal bearing body
   - 8.3 Pulley

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E) Basic Machine Shop-I

1. Practice of cleaning and oiling the lathe machine
2. Practice of centering the job by tool method
3. Practice of centering the job held in a four jaw chuck or face plate by surface gauge
4. Practice of facing
5. Practice of straight turning
6. Practice of center drilling
7. Practice of drilling on lathe
8. Practice of step turning
9. Practice of knurling
10. Practice of boring a straight hole
11. Practice of tool grinding
12. Practice of taper turning by compound rest method
13. Practice of cutting metric threads on lathe machine
14. Practice of Chamfering
15. Preparation of center punch

Recommended Textbooks:

1. Technology of Machine Tools by Steve F. Krar, Albert F. Check
2. Machine Tools Technology by Willard J. McCarthy, Dr. Victor E. Repp
3. Machine Tools Metal working by Jhon L. Feirer
4. Shop Theory by James Anderson, Earl E. Tatro, Latest Ed.
5. Workshop Practices By Ludwig

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COMP-152 COMPUTER APPLICATIONS

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

Pre-requisites: None

AIMS: This subject will enable the student to be familiar with the fundamental concepts of Computer Science. He will also learn MS-Windows, MS-Office, and Internet to elementary level.

Course Contents:

1. ELECTRONIC DATA PROCESSING (E.D.P.) 6 Hrs

1.1 Basic Terms of Computer Science Data & its, types, Information, Hardware, Software
1.2 Computer & its types
1.3 Generations of Computers
1.4 Block diagram of a computer system
1.5 BIT, Byte, RAM & ROM
1.6 Input &Output devices
1.7 Secondary storage devices
1.8 Types of Software
1.9 Programming Languages
1.10 Applications of computer in different fields
1.11 Application in Engineering, Education & Business

2. MS-WINDOWS -2010 2 Hrs

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

3. MS-OFFICE (MS-WORD -2016) 8 Hrs

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

3.13 Saving a document file as PDF format

4. MS-OFFICE (MS-EXCEL -2016) **9 Hrs**

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

5. MS. OFFICE (MS-POWER POINT- 2016) **4 Hrs.**

5.1 Introduction to MS-Power point
5.2 Creating a, presentation
5.3 Editing & formatting a text box
5.4 Adding pictures & colors to a slide
5.5 Making slide shows
5.6 Slide Transition

6. INTERNET & E-MAIL **3Hrs**

6.1 Introduction to Internet & browser window
6.2 Searching, Saving and Print a page from internet
6.3 Creating, Reading & Sending E-Mail
6.4 Drop Box / Online/ Sky drive/ Cloud data etc.
6.5 File attachment.
6.6 Uploading and downloading file(s) and software(s)
6.7 Explain some advance features over the internet and search engines
6.8 Difference between Internet, Intranet and Extranet

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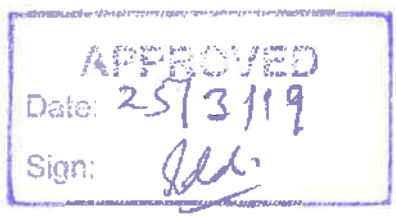
COMP-152 COMPUTER APPLICATIONS

Instructional Objectives:

1. **UNDERSTAND ELECTRONIC DATA PROCESSING (E.D.P)**
   - 1.1. Describe Basic Terms of Computer Science. Data & its Types, Information, Hardware, Software
   - 1.2. Explain Computer & its types
   - 1.3. Generations of Computers
   - 1.4. Explain Block diagram of a computer system
   - 1.5. State the terms such as BIT, Byte, RAM & ROM
   - 1.6. Identify Input & Output devices
   - 1.7. Describe Secondary Storage devices
   - 1.8. Explain Types of Software
   - 1.9. Introduction to Programming Language
   - 1.10. Explain Applications of computer in different fields
   - 1.11. Application in Engineering, Education & Business
2. **UNDERSTAND MS-WINDOWS-2010**
   - 2.1 Explain Introduction to Windows
   - 2.2 How to install Drivers & Windows
   - 2.3 Describe Loading & Shut down process
   - 2.4 Explain Introduction to Desktop items(Creation of Icons, Shortcut, Folder & modify Taskbar)
   - 2.5 Explain Desktop properties
   - 2.6 Describe Use' of Control Panel (add/remove program, time & date, mouse and create user account)
   - 2.7 Explain the method of searching a document
3. **UNDERSTAND MS-OFFICE (MS-WORD - 2016)**
   - 3.1 Explain Introduction to MS-Office
   - 3.2 Describe -Introduction to MS-Word & its Screen
   - 3.3 Describe create a new document
   - 3.4 Explain Editing & formatting the text
   - 3.5 Describe saving & Opening a document
   - 3.6 Explain Page setup, (Set the Margins & Paper)
   - 3.7 Describe Spell Check & Grammar
   - 3.8 Explain Paragraph Alignment
   - 3.9 Explain Inserting Page numbers, Symbols, Text box & Picture in the document
   - 3.10 Describe Use the different Format menu drop down commands(Drop Cap, Change Case, Bullet &Numbering and Border & Shading)
   - 3.11 Explain Insert the Table and its Editing and modifying
   - 3.12 Describe printing the document
   - 3.13 Describe the method of file saving as a PDF Format
4. **UNDERSTAND MS-OFFICE (MS-EXCEL- 2016)**
   - 4.1 Explain Introduction to MS-Excel & its Screen
   - 4.2 Describe Entering data & apply formulas in worksheet
   - 4.3 Describe Editing &Formatting the, Cells, Row & Column
   - 4.4 Explain Insert Graphs in sheet
   - 4.5 Describe Page setup, Print preview & Printing
   - 4.6 Explain in details formulas for sum, subtract, multiply, divide, average



4.7 Explain in details the types of charts e.g pie chart, bar chart

5. **UNDERSTAND MS-OFFICE (MS-POWER POINT-2016)**
   - 5.1 Describe Introduction to MS-Power point
   - 5.2 Explain creating a presentation
   - 5.3 Describe Editing & formatting a text box
   - 5.4 Explain Adding pictures & colors to a slide
   - 5.5 Describe Making slide shows
   - 5.6 Explain Slide Transitions

6. **UNDERSTAND INTERNET &E-MAIL**
   - 6.1 Explain Introduction to Internet and browser window
   - 6.2 Explain Searching, Saving and Print a page from internet
   - 6.3 Describe Creating, Reading & Sending E-Mail
   - 6.4 Interpret Drop Box / Online/ Sky drive/ Cloud data etc.
   - 6.5 File attachment.
   - 6.6 Uploading and downloading file(s) and software(s)
   - 6.7 Explain some advance features over the internet and how to search topics on different search engines
   - 6.8 Enlist the Difference between Internet, Intranet and Extranet

Recommended Textbooks:

1. **Bible Microsoft Office 2016 by John Walkenbach**
2. **Bible Microsoft Excel 2016 by John Walkenbach**
3. **Bible Microsoft PowerPoint 2016 by John Walkenbach**

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COMP-152 COMPUTER APPLICATIONS

List of Practical:

1. **Identify key board, mouse, CPU, disk drives, disks, monitor, and printer and** **3Hrs**

2. **MS WINDOWS 2010** **12 Hrs**
   - 2.1 Practice of loading and shutdown of operating system
   - 2.2 How to install Drivers & Windows
   - 2.3 Creating items (icons, shortcut, folders etc) and modifying taskbar
   - 2.4 Changing of wallpaper, screensaver, and resolution
   - 2.5 Practice of control panel items (add/remove, time and date, mouse, and create user account)

3. **MS OFFICE (MS-WORD 2016)** **27 Hrs**
   - 3.1 Identifying the MS Word Screen and its menu
   - 3.2 Practice of create a new document, saving and re-opening it from the location and spell check & grammar
   - 3.3 Practice of Page Formatting (Borders, Character Spacing, Paragraph, Bullets & Numberings and Fonts)
   - 3.4 Practice of different tool bars like standard, format& drawing tool bars
   - 3.5 Practice of Insert pictures, clipart, and shapes
   - 3.6 Practice of header and footer
   - 3.7 Practice of insert table and also format of table
   - 3.8 Practice of page setup, set the page margins, and printing documents

4. **MS OFFICE (MS-EXCEL 2016)** **27 Hrs**
   - 4.1 Identifying the MS EXCEL Screen and its menu
   - 4.2 Practice of create a new sheet, saving and re-opening it from the location and spell check
   - 4.3 Practice of insert and delete of row and columns (format of cell)
   - 4.4 Practice of entering data and formulas in worksheet(Add, Subtract, Multiplying, and Divide & Average)
   - 4.5 Repeating practical serial number04
   - 4.6 Practice of insert chart and its types
   - 4.7 Practice of page setup, set the page margins, and printing

5. **MS OFFICE (MS-POWER POINT 2016)** **15 Hrs**
   - 5.1 Identifying the MS POWER POINT Screen and its menu
   - 5.2 Practice of create a new presentation and save
   - 5.3 Practice of open saves presentations
   - 5.4 Practice of inset picture and videos

6. **INTERNET & E-MAIL** **12 Hrs**
   - 6.1 Identifying internet explorer
   - 6.2 Practice of searching data from any search engine
   - 6.3 Practice of create an E-Mail account and how to send and receive mails, download attachments
   - 6.4 File attachment.
   - 6.5 Uploading and downloading file(s) and software(s)

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Mech-151 OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENT

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

Pre-requisites: None

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

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

Course Contents:

1.	Introduction and Importance of Safety	1 Hr
2.	Accident In Chemical Industry	2 Hrs
3.	Accidents In Mechanical Industry	3 Hrs
4.	Accidents in Process Industry	2 Hrs
5.	Accidents in other Industries	2 Hrs
6.	Electric shocks (Prevention and its remedies)	2 Hrs
7.	Fire Accidents and their preventions	3 Hrs
8.	Safety in Plant layout	2 Hrs
9.	Personal Protective Equipment (PPE)	2 Hrs
10.	Environmental Safety	3 Hrs
11.	Pollution	2 Hrs
12	First Aid	2 Hrs
13.	Analyzing Causes of Accidents	3 Hrs
14.	Promoting Safety Culture	1 Hr

15. Safety Regulations & adherence to International Safety Standards **2 Hrs**

Detail of Contents:

1. Introduction and Importance of Safety **1Hr**

- **1.1** Introduction to safety and House keeping
- 1.2 Importance in Institute workshops /labs
- 1.3 Importance in industry
- 1.4 Accident cost

2. Accidents in Chemical Industry **2 Hrs**

- 2.1 Accidents in petroleum, paint and fertilizer industry
- 2.2 Explosive vapors and gases

3. Accidents in Mechanical Industry **3 Hrs**

- 3.1 Due to material handling and transportation
- 3.2 Accidents due to hand tools
- 3.3 Accidents in machines shop
- 3.4 Accidents in Metal workshop
- 3.5 Accidents in wood working shop
- 3.6 Accidents in foundry, welding and forging shop
- 3.7 Safety in CNC machines operation

4. Accidents in Flow Production Industry **2 Hrs**

- 4.1 Accidents in textile mills, paper mills & food industries

5. Accidents in other Industries **2Hrs**

- 5.1 Accidents in mines
- 5.2 Accidents in leather industries
- 5.3 Accidents in power plant

6. Electric shocks & Earthling (Prevention and its remedy) **2Hrs**

- 6.1 Electricity as danger
- 6.2 Electric shock phenomena

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6.3 Reasons of electric shock

6.4 Prevention of electric shock

6.5 First aid in electric shock

7. Fire accidents and their prevention **3 Hrs**

7.1 Fire accidents and their prevention

7.2 Fire hazard and their types

7.2.1 Causes of fire hazard

7.3 Firefighting equipment, and fire extinguishers

7.4 Plant lay out for fire safety

7.5 How to store flammable & hazardous materials

7.6 Disposal of flammable & hazardous materials

7.7 Fire Exercise with Rescue-1122

8. Safety in plant Lay-out **2 Hrs**

8.1 Safety in Plant lay out

8.2 Housekeeping for safety

8.3 Safety instruction during maintenance

8.4 Safety instruction in use of electricity

8.5 Implementation of 3S and 5S in Workplace

9. Personal Protective Equipment (PPE) **2 Hrs**

9.1 Useful protective device

9.2 Personal protective device and its importance

9.3 Protection from chemicals and gases

10. Environmental Safety **3 Hrs**

10.1 Environmental Safety

10.2 Industrial ventilation

10.3 Exhaust systems

10.4 Industrial noise

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10.5 Illumination for safety and comfort

10.6 Industrial hygiene and plant sanitation

10.7 Thermal radiation

10.8 Waste Disposal, Dust and fumes, Over Crowding

10.9 The Artificial humidification

10.10 Drinking water

11. Pollution **2 Hrs**

11.1 Atmosphere

11.2 Water pollution

11.3 Solid waste management

12. First Aid **2 Hours**

12.1 Importance

12.2 Procedure and training

12.3 Extended medical services

13. Analyzing Causes of Accidents **3 Hrs**

13.1 Accident prevention fundamentals

13.2 Plant inspections and accidents investigation

13.3 Safety inventory, auditing, records and annual reports

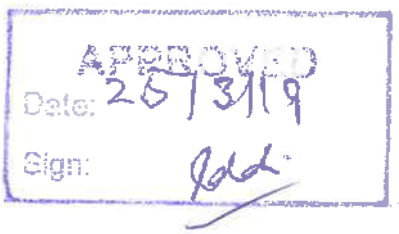
14. Promoting Safety Culture **2 Hrs**

14.1 Employees training culture
14.2 Displays
14.3 Guidance
14.4 Introduction to Sustainability

15. Safety Regulations & adherence to International Safety Standards 2Hrs

15.1 Safety Regulations & adherence to International Safety Standards
15.2 Pakistan Factory Act (laws concerning to safety)
15.3 Workman compensation act
15.4 Industrial insurance and social security
15.5 Legal aspects of safety

15.6 Introduction to NEBOSH & OSHA



Mech-151 OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT

Instructional Objectives:-

Note: **(i) Practical's should be demonstrated during classes (Lectures) with the help of actual exercise, charts and video etc.**

(ii) Safety lab should be established and the period should be conducted in the same lab

1. **Know importance of safety practices and its necessity in the industry**

   1.1 Describe importance of housekeeping, Safety and accidents

   1.2 Describe the importance of safety practices in Institute shops/labs

   1.3 Describe the hazards for not observing safety

   1.4 State necessity/importance of observing safety in the industry at the Cost of accident

2. **Know causes and preventions of accident in chemical based industry**

   2.1 State the type and causes of accidents in petroleum, fertilizer, plaint and chemical based industry

      2.1.1 Enlist causes and preventions of chemical based industrial accidents

   2.2 Describe accidental causes and effects of explosive gases and vapors

      2.2.1 Describe toxic chemicals and their effects on human

      2.2.2 List of preventions for accidental causes due to explosive gases and vapors

3. **Know causes and prevention of accidents in mechanical industry**

   3.1 List of accidents in material handling and transportation in industry

      3.1.1 Describe the methods of prevention of accident due to material and machine handling in manufacturing Industry

   3.2 Explain proper use of hand tools to prevent accident

   3.3 Describe accidents in machines shop

   3.4 Describe accidents in Metal workshop

   3.5 Describe accidents in wood working shop

   3.6 Describe accidents in foundry, welding and forging shop

3.7 Describe Safety in CNC machines operation

4. Know causes and methods of prevention of accident in flow process industry

4.1 State the types of accident in flow process industry

4.1.1 List the accident in textile mills, paper and board mills and food industry

4.1.2 Describe the methods of prevention of accidents in above listed industries

5. Describe accidents and their remedy

5.1 Describe accidents in Mines

5.2 Describe accidents in Leather industries

5.3 Describe accidents in Power plant (Steam)

6. Electric shocks & Earthling (Prevention and its remedy)

6.1 Describe Electricity as danger
6.2 Describe Electric shock phenomena
6.3 Describe Reasons of electric shock
6.4 Describe Prevention of electric shock
6.5 Describe First aid in electric shock

7. Fire Accidents and their prevention

7.1 Describe prevention of fire accidents on plant

7.2 Know the causes of fire hazard

7.2.1 Identify fire hazard and their types

7.2.2 List the causes of accidents due to fire

7.3 Know Steps to control fire/fire fighting

7.3.1 Training of fire fighting with the help of Rescue 1122

7.3.2 Know the types of fire extinguishers and their use

7.4 Identify the fire safety points in plant layout

7.5 Describe how to store flammable & hazardous materials

7.6 Understand disposal of flammable & hazardous materials

7.7 Explain the steps of Fire Exercise with Rescue-1122

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8. Know the basic concept of safety in plant layout

8.1 Identify the safety aspect in plant layout

8.2 Describe the house keeping procedure for safety

8.3 Identify the procedure to lay out machines and equipment by considering safety aspect

8.4 Explain the instructions use of electricity

8.5 Interpret Implementation of 3S and 5S in Workplace

9. Know principle method and importance of personal protective device

9.1 State useful protective devices

9.2 List personal protective devices and describe their importance

9.2.1 Describe protection devices protecting Hand, faces, Ear, Leg, Foot and Eyes

9.2.2 Describe protection

9.2.3 Describe personal safety equipment

9.2.4 Describe lather safety belt, fire ropes, chain, slings and other supports for precautions

9.3 Describe use of protection devices for protecting from chemicals and gases

10. Understands the environmental effect of accident and their remedies

10.1 Knows environmental effects on human beings and surroundings

10.2 Explain importance and purpose of industrial ventilation

10.3 Describe exhaust system in industry and their important

10.4 Identify effect of noise on environment and its role in accidents

10.4.1 Causes of audible (Noise) their control vibrations and vibration dampers and necessity of hearing protectors

10.5 Identify the advantages of illumination for safety and comfort

10.6 Explain necessity of plant hygiene for safety and comfort

10.7 Explain causes of thermal radiation and its remedy

10.8 Explain causes and remedy of spittns dust, fumes, improper light and overcrowding accidents

10.9 Explain needs of artificial humidification

10.10 Explain effects of polluted water

11. Pollution

11.1 Describe different stages of Atmosphere i.e. stratosphere, mesosphere, ionosphere etc.

11.2 Describe the international standards of pure water

11.2.1 State how water get polluted

11.2.2 Describe methods of purification of polluted water at different Level

11.3 Describe the solid waste types and its management

11.3.1 State different methods of solid waste collection

11.3.2 Describe recycling and disposal of solid waste

12. Know the methods of providing first aid

12.1 Identify the importance of first aid

12.2 Explain the methods of providing fist aid and their training may be arranged to train the students in first aid procedure (a video)

12.3 Identify the step by step procedure of providing medical services

12.3.1 Describe protection of respiration system and methods of artificial respiration

13. Analyzing the causes of accidents

13.1 Understand the procedure of analyzing the causes of accidents

13.1.1 Identify the general causes of accident

13.1.2 Explain step by step procedure to analyze the accidents

13.2 Know the use of data for investigation and resident reports for analyzing the causes of accident

13.2.1 Record safety inventory, accident report and investigation reports, annual reports

13.2.2 Collect the data of accident for analyzing the root of accidents

13.3 Identify safety rules procedures in the light of annual accidents report for safe guard

14. Understand the methods and procedures for promoting safety culture

14.1 Identify the importance of safety

14.2 Describe methods of promoting safety concept by display charts, play cards, Banners and wall chalking; through guidance

14.3 List methods of promoting safety concepts

14.4 Identify the factor & phenomenon of Sustainability

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15. Understand Safety Regulations & adherence to International Safety Standards

15.1 Explain safety Regulations & adherence to International Safety Standards

15.2 Describe clauses of Pakistan Factory Act related to safety

15.3 Describe Workman compensation Act

15.4 Identify the procedure for industrial insurance and social security

15.5 Describe legal procedure in case of serious accidents

15.6 Understand the terms of NEBOSH & OSHA

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Mech-173 ENGINEERING DRAWING & GRAPHICS

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

Pre-requisites : None

AIMS: At the end of this course the students will be able to understand the Fundamentals of Engineering Drawing used in the various fields of industry especially in the Mechanical Technology. The students will be familiarizing with the use of conventional drawing equipment as well as the modern techniques used for this subject.

Details of course contents:

(PART-A) BASIC ENGINEERING DRAWING (50%)

1. Introduction of Technical Drawing/Drafting — **1Hr**
- 1.1 Importance of Technical Drawing
- 1.2 Uses/Applications of Technical Drawing
- 1.3 Type of Drawing used in Engineering

2. Drafting Instruments and Accessories — **2Hrs**
- 2.1. Introduction and importance of drafting instruments
- 2.2. List of drawing Instruments
- 2.3. Construction, uses and care of all instruments and accessories

3. Lines and Symbols — **2Hrs**
- 3.1. Basic lines
- 3.2. Importance of lines and Symbols
- 3.3. Common Types (Alphabets) of lines
- 3.4. Common Symbols used in Industry

4. Lettering — **1Hr**
- 4.1. Importance of good lettering
- 4.2. General Proportion/ Composition of letters
- 4.3. Uses of Guide lines in Lettering
- 4.4. Classification of lettering

5. Drafting Geometry and Curves — **4Hrs**
- 5.1. Introduction to geometry, plane and solid type
- 5.2. Definition of terms
- 5.3. Basic geometric constructions
- 5.4. Introduction to engineering curve
- 5.5. Application of engineering curves
- 5.6. Cone and conic section
- 5.7. Geometrical Solid and its types

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5.8. Geometrical Surfaces and its types

6. Freehand Sketching **1Hr**

6.1. Introduction to sketching techniques
6.2. Sketching of basic lines and shapes
6.3. Sketching of pictorial drawings

7. Theory of Projections **4Hrs**

7.1. Introduction to the plane and its types
7.2. Dihedral and Trihedral angles
7.3. Projection of point, lines, plane and solids
7.4. Perceptual views of plan of projections
7.5. Orthographic projections
7.6. 1st angle and 3rd angle projection
7.7. Principal views and its arrangements
7.8. Multi-view drawings and missing lines

8. Dimensioning **1Hr**

8.1. Dimensioning and its types
8.2. Principles of Dimensioning
8.3. Methods of indicating Dimensions

(PART-B) ADVANCED ENGINEERING DRAWING (50%)

9. Introduction to Pictorial drawing **3Hrs**

9.1. Uses of pictorial /3D Views
9.2. Classification of pictorial views
9.3. Isometric drawing and its types
9.4. Oblique drawing and its types
9.5. Perspective drawing and its types

10. Development and Intersection **3Hrs**

10.1. Introduction and importance of development
10.2. Applications of development in industry
10.3. Methods to develop the surfaces
10.4. Frustum and truncation of solids
10.5. Introduction and importance of intersection
10.6. Applications of intersection in industry
10.7. Methods to develop the intersection

11. Sectioning **1Hr**

11.1. Sectioning and its purposes
11.2. Cutting Plane, Section Lines
11.3. Type of sectional views
11.4. Parts not sectioned
11.5. Conventional Breaks

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12. Fasteners and its Types **6Hrs**

12.1. Fasteners and their types
12.2. Threads nomenclature
12.3. Screw Threads, their types
12.4. Rivet, Rivet heads
12.5. Riveted joints
12.6. Caulking and fullering in riveting
12.7. Key and its types
12.8. Cotters and its types
12.9. Bearing and its types
12.10. Shaft Coupling
12.11. Types of coupling

13. Working / Production Drawings **2Hrs**

13.1. Working / production drawing
13.2. Types of production drawings
13.3. Importance of detail and assembly drawings
13.4. Title blocks
13.5. Essentials Requirements for making detail and assembly drawings

14. Study of Drawings standards (with related sheet example) **1Hr.**

14.1 Japanese
14.2 Chinese
14.3 European
14.4 American
14.5 British
14.6 Standards

Recommended Textbooks:

1. Engg. Drawing By N.D Bhatt, 53rd Edition (2014)
2. A First year Engg. Drawing By A.C Parkinson; Pitman Publisher, Latest Edition
3. Mechanical Drawing (12th Addition) by French. Svensen, Helsel and Urbanick
4. Drafting Fundamentals by scot. Foy, Schwendan
5. Text Book of machine Drawing by R.K. Dhawan
6. Engineer Drawing by M.B. Shah (B.C.Rana)

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Mech-173 ENGINEERING DRAWING & GRAPHICS

Total Contact Hours

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

Details of course objectives

(PART-A) BASIC ENGINEERING DRAWING (50%)

1. Introduction of Technical Drawing/Drafting

1.1 Describe the Importance of Technical Drawing
1.2 Explain the Uses/Applications of Technical Drawing
1.3 Describe the type of Drawing used in Engineering

2. Drafting Instruments and Accessories

2.1. State the Introduction and importance of drafting instruments
2.2. State a List of drawing Instruments
2.3. Explain construction, uses and care of all instruments and accessories

3. Lines and Symbols

3.1. Describe Basic lines
3.2. Explain the Importance of lines and Symbols
3.3. Describe Common Types (Alphabets) of lines
3.4. Explain Common Symbols used in Industry

4. Lettering

4.1. Describe the Importance of good lettering
4.2. Explain General Proportion/ Composition of letters
4.3. Explain Uses of Guide lines in Lettering
4.4. Describe Classification of lettering

5. Drafting Geometry and Curves

5.1. Describe the Introduction to geometry, plane and solid type
5.2. State the Definition of terms
5.3. State Basic geometric constructions
5.4. Describe Introduction to engineering curve
5.5. Describe Application of engineering curves
5.6. Define Cone and explain conic section
5.7. Describe Geometrical Solid and its types
5.8. Explain Geometrical Surfaces and its types

6. Freehand Sketching

6.1. Describe Introduction to sketching techniques
6.2. Explain Sketching of basic lines and shapes
6.3. Explain Sketching of pictorial drawings

7. Theory of Projections

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7.1. Describe Introduction to the plane and state its types
7.2. Explain Dihedral and Trihedral angles
7.3. Explain Projection of point, lines, plane and solids
7.4. Explain Perceptual views of plan of projections
7.5. Explain Orthographic projections
7.6. Compare 1st angle and 3rd angle projection
7.7. State Principal views and its arrangements
7.8. Explain Multi-view drawings and missing lines

8. Dimensioning

8.1. Define Dimensioning and describe its types
8.2. Explain Principles of Dimensioning
8.3. Explained Methods of indicating Dimensions,

(PART-B) ADVANCED ENGINEERING DRAWING (50%)

9. Introduction to Pictorial drawing

9.1. Explain Uses of pictorial /3D Views
9.2. Explain the Classification of pictorial views
9.3. Describe Isometric drawing and its types
9.4. Describe Oblique drawing and its types
9.5. Describe Perspective drawing and its types

10. Development and Intersection

10.1. Describe Introduction and importance of development
10.2. Explain Applications of development in industry
10.3. Explain Methods to develop the surfaces
10.4. Distinguish Frustum and truncation of solids
10.5. Explain the Introduction and importance of intersection
10.6. Explain Applications of intersection in industry
10.7. Describe the Methods to develop the intersection

11. Sectioning

11.1. Define Sectioning and describe its purposes
11.2. State Cutting Plane, Section Lines
11.3. Explain type of sectional views
11.4. State Parts not sectioned
11.5. Describe Conventional Breaks

12. Fasteners and its Types

12.1. Describe Fasteners and their types
12.2. State Threads nomenclature
12.3. Describe Screw Threads, their types
12.4. Define Rivet, state Rivet heads
12.5. Explain Riveted joints
12.6. State Caulking and fullering process in riveting
12.7. Define Key and state its types
12.8. State Cotters and its types
12.9. Describe Bearing and its types

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12.10. Describe Shaft Coupling
12.11. Explain Types of coupling

13. Working / Production Drawings

13.1. Explain Working / production drawing
13.2. Describe Types of production drawings
13.3. Explain Importance of detail and assembly drawings
13.4. State Title blocks
13.5. Explain Essentials Requirements for making detail and assembly drawings

14. Study of Drawings standards

14.1 Explain Japanese drawing standards.
14.2 Explain Chinese drawing standards.
14.3 Explain European drawing standards.
14.4 Explain American drawing standards.
14.5 Explain common Standards.

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Mech-173 ENGINEERING DRAWING & GRAPHICS

Practical: **192Hrs**

List of Practical

(PART-A) BASIC ENGINEERING DRAWING

1. Practice of single stroke capital **vertical** lettering on graph and drawing sheet
2. Practice of single stroke capital **inclined** lettering on graph and drawing sheet

   Practice of single stroke capital **vertical & inclined** lettering on drawing sheet (Home Assignment)
3. Double stroke lettering on self developed graph.
4. Practice to draw horizontal, vertical and inclined lines (use of tee square and set squares)
5. Drawing of lines, centers, curves, and crossing of lines
6. Construction of angles and triangles
7. Construction of quadrilaterals and circles elements
8. Construction of parallel-lines, perpendiculars, bisects line, angles and equal division of lines
9. Different types of drawing lines
10. Plumbing and Piping Symbols.
11. Welding Symbols & Threads Symbols
12. Material Symbols and Conventional Breaks.
13. Construction of inscribe and circumscribe figures (square, triangle and hexagon)
14. Construction of Pentagon, Hexagon & Octagon, by general and different methods
15. Construction of Tangents of circles (Inside & Outside)
16. Construction of Ellipse by four different methods
17. Construction of Parabola and Hyperbola curves.
18. Construction of Archimedean spiral, cycloid & involute curve of square, circle.
19. Orthographic projection 1 and 3rd angle wooden block-1
20. Orthographic projection 1 and 3rd angle wooden block-2
21. Orthographic projection 1 and 3rd angle wooden block-3

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(Part-B) ADVANCED ENGINEERING DRAWING

22. Orthographic projection and Isometric Drawing-I
23. Orthographic projection and Isometric Drawing-II
24. Orthographic projection and Oblique Drawing
25. Construction of perspective drawing. (One Point and Two Point)
26. Development of Right and Truncated Prisms (Square, Hexagon)
27. Development of Right Pyramids and Frustum & Truncated Pyramid (Square, Hexagon)
28. Development of right and oblique Cones (Frustum & Truncated)
29. Development of right and oblique Cylinders (Truncated)
30. Line of Intersection of Plane Surfaces (Two square prism)
31. Line of Intersection of curved surfaces (Two Cylinders Having unequal dia)
32. Nut & Bolt (Hex. & Square Type)
33. Threads forms and multiple threads, (Locking devices Home Assignment)
34. Lap Joints (Single & Double Riveted) Chain and Zigzag type
35. Butt Joints (Single & Double Riveted) Chain and Zigzag type Rivets head Home Assignment)
36. Sketching of Keys and Cotters
37. Bushed Bearing (Half Section)
38. Multi view drawing of Gland
39. Split Muff Coupling and Oldham coupling
40. Flanged Coupling and Hook's Coupling
41. Plummer Block (Details and Assembly)
42. Screw Jack (Details and Assembly)
43. Tail stock (Detail)-I & II
44. Tail Stock (Assembly)-I & II

Practical Objective (Part-A)

1. **Practice of single stroke capital vertical lettering on graph and drawing sheet**
   - 1.1 Draw the Border Line and title strip
   - 1.2 Construct the letters and numerals in correct shape and size using graph paper and drawing sheet
   - 1.3 Develop skill to letter in proper sequence of strokes

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1.4 Construct the letters and numerals in single stroke

1.5 Draw guidelines and maintain spacing between letters and numerals

2. Practice of single stroke capital Inclined lettering on graph and drawing sheet

2.1 Develop the skill for border line and title strip

2.2 Construct the letters and numerals in single stroke inclined at an angle of 67 ½ degree

2.3 Draw guideline (Horizontal and inclined) to maintain space between letters and numerals

Practice of single stroke capital vertical & Inclined lettering on Sheet (Home Assignment)

2.4 Draw the border line and title strip

2.5 Draw the parallel lines, vertical & inclined guide lines

2.6 Construct the vertical and inclined letters and numerals with correct shape and size

2.7 Develop skills to letters in proper sequence of stroke

3. Double stroke lettering on self developed graph.

3.1 Draw the border line and title strip

3.2 Draw the horizontal and vertical parallel lines

3.3 Use smoothly tee, set square and compass

3.4 Draw the curves, semi circles and inclined lines

3.5 Develop skill to double stroke letters in proper shape and size

3.6 Maintain the uniform thickness of letters and numerals

4. Practice to draw horizontal, vertical and inclined lines (use of tee square and set squares)

4.1 Draw the Horizontal and vertical lines

4.2 Draw the inclined lines at any angle.

4.3 Develop the skill to construct the figures having Horizontal, vertical and inclined lines

5. Drawing of lines, centers, curves, and crossing of lines

5.1 Develop the skill for border line and title strip

5.2 Draw the Horizontal, vertical and inclined lines

5.3 Develop the skill to construct the figures having circles, curves and different radius

6. Construction of angles and triangles

6.1 Draw the different angles

6.2 Draw the different triangles

7. Construction of quadrilateral's and circles elements

7.1 Draw different types of quadrilaterals and circle elements

7.2 Develop the skill to use of drawing instruments.

7.3 Identify the above said 2D-figures

8. Construction of parallel-lines, perpendiculars, bisects line, angles and equal division of lines

8.1 Draw the lines parallel lines, arcs

8.2 Bisect the lines, angles and arcs

8.3 Develop the skill to use of drawing instruments

9. Different types of drawing lines

9.1 Draw the alphabet of lines

9.2 Develop the proper line weight & shape.

10. Plumbing and Piping Symbols.

10.1 Draw the plumbing and piping symbols

10.2 Identify the Plumbing and Piping Symbols

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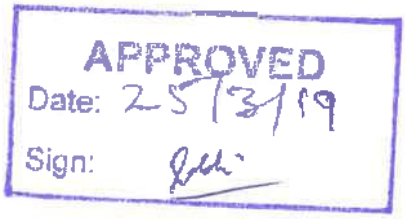
11. **Welding Symbols & Threads Symbols**
    - 11.1 Draw the welding and thread symbols
    - 11.2 Identify the Welding and Thread Symbols
12. **Material Symbols and Conventional Breaks.**
    - 12.1 Draw the material symbols and conventional breaks
    - 12.2 Identify the Material Symbols & Conventional Breaks
13. **Construction of inscribe and circumscribe figures (square, triangle and hexagon)**
    - 13.1 Draw the inscribed square, triangle and hexagon
    - 13.2 Draw the circumscribed square, triangle and hexagon
    - 13.3 Develop the skill to use of drawing instruments
14. **Construction of different Polygons, by general and different methods**
    - 14.1 Draw the polygon by general method 1
    - 14.2 Draw the pentagon, Hexagon, Heptagon, Octagon etc. by the general method 2
    - 14.3 Develop the skill to use of drawing instruments
15. **Construction of Tangents of circles (Inside & Outside)**
    - 15.1 Draw the tangent of the circles internally and externally
    - 15.2 Develop the skill to use of drawing instruments
16. **Construction of Ellipse by four different methods**
    - 16.1 Develop the skill for border line and title strip
    - 16.2 Construct the "Ellipse" by different method
17. **Construction of Parabola Hyperbola and curves,**
    - 17.1 Develop the skill for border line and title strip
    - 17.2 Construct the "Parabola" by different method
    - 17.3 Construct the "Hyperbola" by different method
18. **Construction of Archimedean spiral and cycloid curves & involute curve of square and circle.**
    - 18.1 Construct the spiral Curve & Involutes
    - 18.2 Draw the skill to construct the Archimedean spiral curve
    - 18.3 Understand and draw the cycloid curve
19. **Orthographic projection 1st and 3rd angle wooden block-1**
    - 19.1 Placement of views properly
    - 19.2 Draw the Orthographic views of simple block in first angle and third angle projection
    - 19.3 Dimension the views
20. **Orthographic projection 1st and 3rd angle wooden block-2**
    - 20.1 Draw the Orthographic views of step block in first angle and third angle projection
    - 20.2 Dimension and placement of views properly
21. **Orthographic projection 1st and 3rd angle wooden block-3**
    - 21.1 Draw the Orthographic views of given block in first angle and third angle projections
    - 21.2 Understand the theory of first angle and third angle of projection
    - 21.3 Understand the dimension on pictorial views



Practical Objective (Part-B)

22. Orthographic projection and Isometric Drawing-I

- 22.1 Visualize multi-view and constructions of isometric drawing
- 22.2 Understand the steps for constructing isometric drawing
- 22.3 Constructing isometric drawing of simple objects

23. Orthographic projection and Isometric Drawing-II

- 23.1 Visualize views and select suitable direction for construction of isometric drawings
- 23.2 Construct isometric drawing using learned steps in previous activity
- 23.3 Identify the steps for isometric circles using four center methods
- 23.4 Construct isometric circle in isometric drawings

24. Orthographic projection and Oblique Drawing

- 24.1 Visualize multi views for construction of oblique drawing
- 24.2 Understand the steps for constructing Oblique drawing
- 24.3 Constructing Oblique drawing of simple objects

25. Construction of perspective drawing. (One and Two Point)

- 25.1 Understand and draw one and two point perspective of a simple object.
- 25.2 Understand the Horizon, vanishing point, station point and picture plane
- 25.3 Understand and draw the projection lines for parallel perspective

26. Development of Right and Truncated Prisms (Square, Hexagon)

- 26.1 Identify prism and its terminology
- 26.2 Draw development of prism (Square Hexagon)
- 26.3 Apply the procedure of parallel line development

27. Development of Right, Frustum & Truncated Pyramids (Square, Hexagon)

- 27.1 Identify the terminology of pyramid
- 27.2 Construct true length diagram
- 27.3 Develop the layout of right pyramids

28. Development of right and oblique Cone (Frustum & Truncated)

- 28.1 Identify the terminology of right cone
- 28.2 Develop the lateral surface of the cone (Right & Oblige)

29. Development of right and oblique Cylinder (Truncated)

- 29.1 Identify cylinder and its terminology
- 29.2 Develop the surface of cylinder (Right Oblige)

30. Line of Intersection of Plane Surfaces (Two Square Prism)

- 30.1 Draw the intersection of plane surfaces like prism & pyramid
- 30.2 Generate the line of Intersection

31. Line of Intersection of curved surfaces (Two cylinders having unequal Dia)

- 31.1 Draw the development of curve surfaces like cylinder and cone
- 31.2 Generate the curved of Intersection

32. Nut & Bolt (Hex. & Square Type)

- 32.1 Draw the three views of Hexagonal and Square nuts
- 32.2 Draw the three views of Hexagonal and Square bolts

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33. **Threads forms and multiple threads (Locking devices Home Assignment)**
    - 33.1 Draw the different forms of thread
    - 33.2 Develop skills to draw the vee and square multiple threads
34. **Lap Joints (Single & Double Riveted) Chain and Zigzag type**
    - 34.1 Identify and draw the Rivet Heads with their proportions
    - 34.2 Draw the views of single Riveted and double Riveted Lap joint (Chain and Zigzag type)
35. **Butt Joints (Single & Double Riveted) Chain and Zigzag type, Rivets head (Home Assignment**
    - 35.1 Draw the views of Butt joint in single and double Riveted Shape (Chain and Zigzag type)
    - 35.2 Identify the type of Joints
36. **Sketching of keys and cotters**
    - 36.1 Develop the skill to sketch the different types of keys and cotters
    - 36.2 Identify the keys & cotters types.
37. **Bushed Bearing (Full Section)**
    - 37.1 Draw the Full sectional, Front, Side and Top view of Bushed bearing assembly
    - 37.2 Identify the parts and their material
38. **Construction of Multi view drawing of Gland (Half Section)**
    - 38.1 Draw the Half sectional, Front, Side and Top view of gland
    - 38.2 Draw the three views of the gland
39. **Plummer Block (Detail)(Full Section)**
    - 39.1 Know the various parts of Plummer block
    - 39.2 Draw the detail of Plummer Block
    - 39.3 Draw the assembly of Plummer Block In full sections
40. **Split Muff Coupling and Oldham coupling**
    - 40.1 Draw the views of Split Muff Coupling
    - 40.2 Develop the skill to draw the detail and assembly of Old Hum Coupling
    - 40.3 Develop the skill to dimension the views accordingly.
41. **Flanged Coupling and Hook's Coupling**
    - 41.1 Draw the views of Flanged Coupling (Protective and non-protective type)
    - 41.2 Draw the detail views of Hooks Coupling parts
42. **Screw Jack (Details and Assembly)**
    - 42.1 Know and draw the parts detail of Screw Jack
    - 42.2 Draw the assembly drawing of Screw Jack
    - 42.3 Identify the parts of Screw Jack
43. **Tail stock (Detail)**
    - 43.1 Develop the skill to draw the views of Tail Stock parts
    - 43.2 Identify the parts of Tail Stock
    - 43.3 Dimension the parts
44. **Tail Stock (Assembly)**
    - 44.1 Draw the assembly of Tail stock in full section showing its parts
    - 44.2 Draw the assembly of various parts
    - 44.3 Identify the material of various parts of Tail Stock

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REVISED CURRICULUM

OF

DIPLOMA OF ASSOCIATE ENGINEER

IN

MECHANICAL TECHNOLOGY

(SECOND YEAR)

REVISED-2019

APPROVED
Date: 25/3/19
Sign:

Revised Scheme of Studies D.A.E. 2ND Year Mechanical

Code		Subject	T	P	C
Gen	211	Islamiat and Pak Studies	1	0	1
Phy	212	Applied Mechanics	1	3	2
Math	212	Applied Mathematics-II	2	0	2
MGM	201	Communication Skills & Report Writing	1	0	1
MGM	221	Business Management and Industrial Economics	1	0	1
Elect.	212	Applied Electricity and Electronics	1	3	2
Mech.	233	Computer Aided Design	1	6	3
Mech.	246	Workshop Practice-II (A) Basic Machine Shop-II 0 6 (B) Foundry and Pattern Making 0 3 (C) Adv. Welding 0 3 Theory 2 0	2	12	6
Mech.	262	Metallurgy	2	0	2
Mech.	272	Metrology	1	3	2
TOTAL			13	27	22

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اسلامیات/مطالعہ پاکستان

نصاب (سال دوم)

حصہ اول	اسلامیات	Gen 211	ٹی	پی	سی
			1	0	1

حصہ دوم مطالعہ پاکستان

کل وقت:20 گھنٹے

موضوعات

1۔ سورہ المومنون ایک تا گیارہ آیات معہ ترجمہ

2۔ درس منتخب احادیث معہ ترجمہ و تشریح

- خیر کم من تعلم القران و علمه
- لاایمان لمن لا امانة له و لادین لمن عهدله
- ایاکم والظن ان الظن اکذب الحدیث
- من احدث فی امرنا هذا ما لیس منه فهورد
- من حمل علینا السلاح فلیس منا
- اناو کا فل الیتیم فی الجنة هکذا
- لا یومن احد کم حتیٰ اکون احب الیه من والده و ولده و الناس اجمعین
- من بنی لله مسجد ابنی الله له بیتاً فی الجنة
- لاضرر ولا ضرار فی الاسلام
- کلکم راع و کلکم مسئول عن رعیته

3۔ سیرت طیبہ

- مکی زندگی، ولادت، بعثت، ہجرت

مدنی زندگی، مواخات، میثاق مدینہ، فتح مکہ (اسباب ونتائج)

خطبہ حجۃ الوداع

4۔ حضور ﷺ بحیثیت:

معلم کامل۔ سربراہ خاندان

5۔ اسلامی معاشرہ

نظام تعلیم اور اس کے مقاصد۔ عدل وانصاف۔ امر بالمعروف ونہی عن المنکر

جہاد، کسب حلال، مسجد (اہمیت وفضیلت)

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

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سال دوم　　اسلامیات

تدریسی مقاصد

قرآن مجید　　منتخب آیات قرآنی

عمومی مقصد۔ طالب علم پہچان سکے کہ آیات قرآنی کی روشنی میں مومن کے اوصاف کیا ہیں۔

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 اسلام کی 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 میں 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۔
- حضور ﷺ کی بطور سربراہ خاندان خصوصیات بیان کر سکے۔

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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 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 بارے میں اقدامات کو جان 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 کے لئے جدوجہد کر سکے۔

نصاب اخلاقیات (غیر مسلم طلباء کیلئے)

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سال دوم

کل وقت 20 گھنٹے

موضوعات

معاشرتی اقدار (بلحاظ ہمسایہ، اقوام، قومی سطح، شہری سطح، صنعتی اداروں کی سطح، ضروریات، ورثہ

- حقوق و فرائض
- قوت برداشت
- قوت ارادی
- لگن و جذبہ
- وسیع النظری
- بے غرضی
- انسان دوستی
- حفاظتی شعور
- پاس آزاری
- کامل آگاہی
- تغیرات کو قبول کرنا
- خود شناسی

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Sign:

نصاب اخلاقیات

سال دوم

تدریسی مقاصد

عمومی مقاصد طالب علم

اخلاقیات کی اہمیت وضرورت سے آگاہ ہو سکے اور بیان کر سکے۔

خصوصی مقاصد طالب علم اس قابل ہو۔

- 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 غرضی، انسان 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۔

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نصاب مطالعہ پاکستان

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کل وقت 12 گھنٹے

سال دوم

حصہ دوم

موضوعات

- دوقومی نظریہ
- تحریک پاکستان
- انڈین کانگرس
- مسلم لیگ
- تقسیم بنگال
- میثاق لکھنو
- تحریک خلافت
- سندھی تحریک
- تجاویز دھلی
- نہرو رپورٹ
- قائداعظم کے چودہ نکات
- خطبہ الہ آباد
- انتخابات 1938 اور انتقال اقتدار
- قرارداد پاکستان

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Date: 25/3/19
Sign:

حصہ دوم

مطالعہ پاکستان

تدریسی 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 کی 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 کے لیے علامہ اقبال اور قائداعظم کی مساعی بیان کر سکے۔
- قیام پاکستان سے مستقبل میں اسلامی مملکت کے قیام کے لئے مسلم عوام کی کوششوں کو بیان کر سکے۔
- مسلم لیگ کی قیام پاکستان کے لیے جدوجہد بیان کر سکے۔

Phy-212 **APPLIED MECHANICS**

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

AIMS
1. Apply the concepts of Applied Physics to understand Mechanics
2. Apply laws and principles of Mechanics in solving technological problems
3. Use the knowledge of App. Mechanics in learning advance technical courses.
4. Demonstrate efficient skill of practical work in Mechanics Lab.

COURSE CONTENTS

1. MEASUREMENTS **2 Hours**
- 1.1 Review: Dimensional formula of Equations of Motion
- 1.2 Review: Systems of measurement, S.I. Units, conversion
- 1.3 Significant Figures
- 1.4 Degree of accuracy

2. EQUILIBRIUM OF CON-CURRENT FORCES **4 Hours**
- 2.1 Concurrent forces
- 2.2 Addition and Resolution of Vectors
- 2.3 Toggle Joint, Hanging Chains
- 2.4 Roof Trusses, Cranes.
- 2.5 Framed structures

3. MOMENTS AND COUPLES: **3 Hours**
- 3.1 Principle of Moments - Review
- 3.2 Levers
- 3.3 Safety valve
- 3.4 Steel yard
- 3.5 Parallel forces, couple
- 3.6 Torque

4. EQUILIBRIUM OF NON CONCURRENT FORCES: **4 Hours**
- 4.1 Non-concurrent forces
- 4.2 Free body diagram
- 4.3 Varignon's theorem
- 4.4 Conditions of total Equilibrium (Review)
- 4.5 Ladders

5. MOMENT OF INERTIA: **4 Hours**
- 5.1 Review: Rotational Inertia
- 5.2 Moment of Inertia, Theorems
- 5.3 Moment of Inertia of symmetrical bodies
- 5.4 M.I. of Fly wheel with applications
- 5.5 Energy stored by Fly wheel

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6. FRICTION: **4 Hours**

6.1 Review: Laws of friction
6.2 Motion of body along an inclined plane (up & down)
6.3 Rolling friction & Ball Bearings
6.4 Fluid Friction, Stokes' Law

7. WORK, ENERGY AND POWER **3 Hours**

7.1 Work-Energy relationship
7.2 Work done by variable .
7.3 Power
7.4 I.H.P, B.H.P and Efficiency
7.5 Dynamometer.

8. TRANSMISSION OF POWER

8.1 Belts, Ropes
8.2 Chains
8.3 Gears
8.4 Clutches, functions and types with application.

9. MACHINES: **3 Hours**

9.1 Efficiency of machines
9.2 Inclined plane - Review
9.3 Reversibility of machines
9.4 Single purchase crab
9.5 Double purchase crab.
9.6 Worm and worm wheel.
9.7 Differential Screw Jack.
9.8 Differential Pulley, Wheel and Axle

10. VIBRATORY MOTION: **2 Hours**

10.1 S.H.M. - Review
10.2 Pendulums
10.3 Speed Governors
10.4 Helical spring
10.5 Cams
10.6 Quick return motion

11. ELASTICITY: **3 Hours**

11.1 Three Moduli of Elasticity
11.2 Loaded Beams, Types of Beam & Loads
11.3 Bending Stress
11.4 S.F & B.M diagram
11.5 Torsion and Torsional Stresses

12. Simple Mechanism

12.1 Introduction
12.2 Kinematic link or element
12.3 Kinematic pair and types
12.4 Kinematic chains and types

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13. Velocity in mechanism

- 13.1 Introduction
- 13.2 Instantaneous center
- 13.3 Instantaneous velocity
- 13.4 Velocity of a link by Instantaneous center method
- 13.5 Relative velocity of two bodies in straight line
- 13.6 Velocity of a link by relative velocity method

BOOKS RECOMMENDED:

1. A Text Book of Applied Mechanics (Mech-212) of TEVTA, published by National Book Foundation
2. Applied Mechanics by R.S. Khurmi

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Phy. 212 APPLIED MECHANICS

INSTRUCTIONAL OBJECTIVES

1. **USE THE CONCEPTS OF MEASUREMENT IN PRACTICAL SITUATIONS/PROBLEMS**
   - 1.1 Explain Dimensional formula
   - 1.2 Explain systems of measurement
   - 1.3 Use concept of significant figures and degree of accuracy to solve problems

2. **USE THE CONCEPT OF ADDITION AND RESOLUTION OF VECTORS TO PROBLEMS ON EQUILIBRIUM INVOLVING CONCURRENT FORCES**
   - 2.1 Describe concurrent forces
   - 2.2 Explain resolution of vectors
   - 2.3 Use the analytical method of addition of vectors for solving problems.
   - 2.4 Use the graphical method of addition of vectors for solving problems.
   - 2.5 Solve problems on forces with emphasis on roof trusses, cranes simple frames and framed structures.

3. **USE THE PRINCIPLE OF MOMENTS AND CONCEPT OF COUPLE TO SOLVE PROBLEMS.**
   - 3.1 Describe the principle of moments.
   - 3.2 Use the principle of moments to solve problems on compound levers, safety valve, steel-yard.
   - 3.3 Describe couple and torque.
   - 3.4 Use the concept to solve problems on torque.

4. **USE THE LAWS OF TOTAL EQUILIBRIUM OF FORCES TO SOLVE PROBLEMS INVOLVING FORCES IN EQUILIBRIUM.**
   - 4.1 Distinguish between concurrent and non-concurrent forces.
   - 4.2 Prepare a free body diagram of an object or a structure.
   - 4.3 Explain Varignon's theorem
   - 4.4 Explain second condition of equilibrium
   - 4.5 Use laws of total equilibrium to solve problems on forces involving framed structure and ladders.

5. **USE CONCEPTS OF MOMENT OF INERTIA TO PRACTICAL SITUATIONS AND PROBLEMS.**
   - 5.1 Explain moment of inertia.
   - 5.2 Explain the theorems of Parallel and perpendicular Axis.
   - 5.3 Describe the M.I. of regular bodies
   - 5.4 Explain M.I. of Fly wheel
   - 5.5 Explain Energy stored by Fly Wheel
   - 5.6 Use these concepts to solve simple problems.

6. **UNDERSTAND THE CONCEPTS AND LAWS OF SOLID AND FLUID FRICTION.**
   - 6.1 Define Coefficient of friction between a body placed on an inclined plane and the surface.
   - 6.2 Explain motion of a body placed on an inclined plane
   - 6.3 Calculate the force needed to move a body up and down an inclined plane.

6.4 Explain rolling friction and use of ball bearings.

6.5 Describe fluid friction and Stoke's law.

7. UNDERSTAND WORK, ENERGY AND POWER.

7.1 Derive work-energy relationship

7.2 Use formulae for work done by a variable force to solve problems.

7.3 Explain Power, I.H.P, B.H.P and efficiency.

7.4 Describe dynamometers.

7.5 Use the concepts to solve problems on power and work-energy

8. Understand transmission of power through ropes and belts

8.1 Describe the need for transmission of power

8.2 Describe the method of transmission of power

8.3Understand transmission of power through ropes and belts

8.4 Write formula for power transmitted through ropes and belts

8.5 Describe transmission of power through friction gears and write formula

8.6 Describe transmission of power through chains and toothed wheels/gears

8.7 Use the formula to solve/problem on transmission of power

8.8 Describe types and functions of clutches with applications

9. USE THE CONCEPTS OF MACHINES TO PRACTICAL SITUATIONS.

9.1 Explain theoretical, actual mechanical advantage and efficiency of simple machines.

9.2 Use the concept to calculate efficiency of an inclined plane.

9.3 Describe reversibility of machines.

9.4 Calculate the efficiency of:

i. Single purchase crab.

ii. Double purchase crab.

iii. Worm and worm wheel.

iv. Differential screw jack, Diff. Pulley, Wheel and Axle.

9.5 Use the formulae to solve the problems involving efficiency, M.A of the above machines.

10. USE THE CONCEPTS OF VIBRATORY MOTION TO PRACTICAL SITUATIONS.

10.1 Define vibratory motion giving examples.

10.2 Describe circular motion and its projection on diameter of the circular path.

10.3 Relate rotatory motion to simple vibratory motion.

10.4 State examples of conversion of rotatory motion to vibratory motion and vice versa.

10.5 Derive formulae for position, velocity and acceleration of a body executing S.H.M.

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10.6 Use the concept of S.H.M to helical springs.

10.7 Use the concept S.H.M to solve problems on pendulum.

11. UNDERSTAND BENDING MOMENTS AND SHEARING FORCES.

11.1 Define three types of stresses and moduli of elasticity.

11.2 Describe types of beams and loads.

11.3 Explain shearing force and bending moment.

11.4 Use these concepts to calculate S.F and B.M in a given practical situation for point loads, uniformly distributed loads.

11.5 Prepare S.F and B.M diagram for loaded cantilever and simply supported beams.

11.6 Describe torsion and torsional stresses giving formula

12. Understand Simple Mechanism

12.1 Define simple mechanism

12.2 Define kinematics

12.3 Explain kinematic links or elements

12.4 Explain kinematic chains

12.5 Distinguish between types of kinematic chains

13. Understand the method of finding velocity in mechanisms

13.1 Explain relative velocity

13.2 Explain instantaneous center

13.3 Explain instantaneous velocity

13.4 Explain the method of finding velocity of a link by:

i. Relative velocity method

ii. Instantaneous center method

Phy-212 APPLIED MECHANICS

LIST OF PRACTICAL

1. Find the weight of the given body using Law is theorem.
2. Find unknown forces in a given set of concurrent forces in equilibrium using Grave-sands apparatus
3. Set a jib crane and analyze forces in its members
4. Set a Derrick Crane and analyze forces in its members
5. Study forces shared by each member of a Toggle Joint
6. Set a Roof Truss and find forces in its members
7. Verify Principle of Moments in a compound lever
8. Calibrate a steelyard
9. Find the Reactions at the ends of a loaded beam
10. Use reaction of beams apparatus to study resultant of parallel forces
10. Find the Moment of Inertia of a Flywheel
11. Find the angle of reaction for a wooden block placed on an inclined plane
12. Find the B.H.P. of a motor
13. Find M.A. and Efficiency of worm and worm wheel
14. Study the transmission of power through friction gears
15. Study the transmission of power through belts
16. Study the transmission of power through toothed wheels
17. Study the function of clutches
18. Find M.A. and efficiency of differential wheel and axle
19. Find the efficiency of a screw
20. Find the efficiency of a differential pulley
21. Verify Hooke's Law using Helical Spring
22. Study conversion of rotatory motion to S.H.M using S.H.M Model/apparatus
23. Study conversion of rotatory motion to vibratory motion of piston in a cylinder
24. Study the reciprocating motion
25. Study the working of cams
26. Study the quick return motion
27. Compare the Elastic constants of the given wires
28. Verify Hooke's Law using Helical Spring
29. Find the coefficient of Rigidity of a wire using Maxewell's needle

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30. Find the coefficient of rigidity of a round bar using torsion apparatus
31. Find the coefficient of Rigidity of a rectangular bar using Deflection of Beam Apparatus
32. Determine S.F. and B.M. in a loaded canti-lever (Point Loads)
33. Determine S.F. and B.M. in a simply supported Beam (Point Loads)
34. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed load)
35. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed)
36. Study working and function of link mechanism of different types

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MATH-212 **Applied Mathematics-II**

	T	P	C
Total Contact Hours:	2	0	2

Theory: 64 Hours.

Aims & Objectives:

After completing the course the students will be able to solve the problems of calculus and analytical Geometry.

COURSE CONTENTS:

1. FUNCTIONS & LIMITS. **4 Hours**

- 1.1 Constants and variables
- 1.2 Functions & their types
- 1.3 The concept of limit
- 1.4 Limit of a function
- 1.5 Fundamental theorems on limit
- 1.6 Some important limits
- 1.7 Problems

2. DIFFERENTIATION. **4 Hours**

- 2.1 Increments
- 2.2 Different Coefficient or Derivative
- 2.3 Differentiation ab-initio or by first principle
- 2.4 Geometrical Interpretation of Differential Coefficient
- 2.5 Differential Coefficient of Xa, (ax + b)a
- 2.6 Three important rules
- 2.7 Problems.

3. DIFFERENTIATION OF ALGEBRIC FUNCTION. **4 Hours**

- 3.1 Explicit function
- 3.2 Implicit function
- 3.3 Parametric forms
- 3.4 Problems

4. DIFFERENTIATION OF TRIGONOMETRIC FUNCTION. **4 Hours**

- 4.1 Differential coefficient of sin x ,cos x ,tang x from first principle.
- 4.2 Differential coefficient of Cosec x, Sec x, Cot x.
- 4.3 Differentiation of inverse trigonometric function.
- 4.4 Problems.

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5. DIFFERENTIATION OF LOGARITHMIC & EXPONENTIAL FUNCTION. **4 Hours**

- 5.1 Differentiation of ln x
- 5.2 Differentiation of log ax
- 5.3 Differentiation of ax
- 5.4 Differentiation of ex
- 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

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12.4 Radius & coordinate of the Centre
12.5 Problems

REFERENCE BOOKS

1. A Text Book of Applied Mathematics (Math-212) of TEVTA, published by National Book Foundation (NBF)

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MATH -212 **APPLIED MATHEMATICS –II**

INSTRUCTIONAL OBJECTIVES

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

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

2. **UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT**

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

3. **USE RULES OF DIFFERENTIAL TO SOLVE PROBLEMS OF ALGEBRAIC FUNCTIONS.**

3.1 Differentiate ab-initio Xn 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 by rationalization.
3.5 Solve problems using these formulas.

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

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

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

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

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

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

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7. **APPLY CONCEPT OF INTEGRATION IN SOLVING TECHNOLOGICAL PROBLEMS**
   - 7.1 Explain the concept of integration
   - 7.2 Write basic theorem of integration
   - 7.3 List some important rules of integration
   - 7.4 Derive fundamental formulas of integration
   - 7.5 Solve problems based on these formulas /rules.

8. **UNDERSTAND DIFFERENT METHODS OF INTEGRATION.**
   - 8.1 List standard formulas
   - 8.2 Integrate a function by substitution method
   - 8.3 Find integrals by the method of integration by parts
   - 8.4 Solve problems using these methods.

9. **UNDERSTAND THE METHOD OF SOLVING DEFENITE INTEGRALS.**
   - 9.1 Define definite integral
   - 9.2 List properties of definite integrals using definite integrals.
   - 9.3 Find areas under curves
   - 9.4 Solve problems of definite integrals.

10. **UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.**
   - 10.1 Explain the rectangular coordinate system
   - 10.2 Locate points in different quadrants
   - 10.3 Derive distance formula
   - 10.4 Prove section formula
   - 10.5 Derive slope formula
   - 10.6 Solve problems using the above formulas.

11. **USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.**
   - 11.1 Define a straight line
   - 11.2 State general form of equation of a straight line
   - 11.3 Derive slope intercept and intercept forms of equations.
   - 11.4 Derive expression for angle between two straight lines
   - 11.5 Derives conditions of perpendicularity and parallelism lines
   - 11.6 Solve problems involving these equations/formulas.

12. **SOLVE TECHNOLOGICAL PROBLEMS USING EQUATION OF CIRCLE.**
   - 12.1 Define a circle
   - 12.2 Describe standards, central and general forms of the equation of a circle.
   - 12.3 Convert general forms to the central forms of equation of a circle.
   - 12.4 Deduce formulas for the radius and the coordinates of the centre of a circle fromthe general form.
   - 12.5 Derive equation of the circle passing through three given points.
   - 12.6 Solve problems involving these equations

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Mgm-201 COMMUNICATION SKILLS & REPORT WRITING

T	P	C
1	0	1

Total contact hours

Theory 32 Hrs.

Prerequisites: The students shall already be familiar with the language concerned.

AIMS The course has been designed to enable the students to.

1. Develop communication skills.
2. Understand basic principles of good and effective business writing in commercial and industrial fields.
3. Develop knowledge and skill to write technical report with confidence and accuracy.

COURSE CONTENTS

1. COMMUNICATION PROCESS & ORAL COMMUNICATION SKILLS **8 Hours**

- 1.1 Purposes of communication
- 1.2 Communication process
- 1.3 Distortions in communication
- 1.4 Consolidation of communiqué
- 1.5 Communication flow
- 1.6 Communication for self-development
- 1.7 Significance of speaking.
- 1.8 Verbal and non-verbal messages.
- 1.9 Strategic steps of speaking.
- 1.10 Characteristics of effective oral messages.
- 1.11 Communication Trafficking.
- 1.12 Oral presentation.

2. QUESTIONING SKILLS. & INTERVIEWING SKILLS **7 Hours**

- 2.1 Nature of question.
- 2.2 Types of questions.
- 2.3 Characteristics of a good question.
- 2.4 Questioning strategy
- 2.5 Significance of interviews.
- 2.2 Characteristics of interviews.
- 2.3 Activities in an interviewing situation
- 2.4 Types of interviews.
- 2.5 Interviewing strategy.

3. LISTENING SKILLS & READING COMPREHENSION **6 Hours**

- 3.1 Principles of active listening.
- 3.2 Skills of active listening.
- 3.3 Barriers to listening.
- 3.4 Reasons of poor listening.
- 3.5 Giving Feedback.
- 3.6 Reading problems.
- 3.7 Four Reading skills.

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4. REPORT WRITING. **5 Hours**

- 4.1 Goals of report writing
- 4.2 Report format.
- 4.3 Types of reports.
- 4.4 Report writing strategy.
  - 4.4.1 Graphs/ Charts and their Analysis
- 4.5 Technical Reports:
  - 4.5.1Meaning & Classification.
  - 4.5.2Main Parts of the report.
  - 4.5.3Organizational & outline of the report.
  - 4.5.4 Sources of information
- 4.6 Business & Market Reports:
  - 4.6.1Definition.
  - 4.6.2Scope.
  - 4.6.3Importance.
  - 4.6.4 Contents.
  - 4.6.5 Market Terms

5. GROUP COMMUNICATION. **4 Hours**

- 5.1 Purposes of conducting meetings.
- 5.2 Planning a meeting.
- 5.3 Types of meetings.
- 5.4 Selection of a group for meeting.
- 5.5 Group leadership skills.
- 5.6 Running a successful meeting.
- 5.7 Active participation techniques.

6. INTERPERSONAL & INTRAPERSONAL SKILLS **2 Hours**

- 6.1 Interpersonal Skills
- 6.2 Intrapersonal Skills

RECOMMENDED BOOKS

1. Sh. Ata-ur-Rehman Effective Business Communication & Report Writing.
2. Ulman J.N. Could JR. Technical Reporting.

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Mgm-201 **COMMUNICATION SKILLS & REPORT WRITING.**

INSTRUCTIONAL OBJECTIVES

1. **UNDERSTAND THE COMMUNICATION PROCESS THE PROCESS OF ORAL**
   - 1.1 State the benefits of two way communication.
   - 1.2 Describe a model of communication process.
   - 1.3 Explain the major communication methods used in organization.
   - 1.4 Identify the barriers to communication and methods of overcoming these barriers.
   - 1.5 Identify misconceptions about communication.
   - 1.6 Identify speaking situations with other peoples.
   - 1.7 Identify the strategy steps of speaking.
   - 1.8 Identify the characteristics of effective speaking.
   - 1.9 State the principles of one-way communication.
   - 1.10 State the principles of two-way communication.
   - 1.11 Identify the elements of oral presentation skills.
   - 1.12 Determine the impact of non-verbal communication on oral communication.

2. **DETERMINE THE USES OF QUESTIONING SKILLS TO GATHER AND CLARIFY INFORMATION IN THE ORAL COMMUNICATION PROCESS AND DETERMINE THE APPROPRIATE INTERVIEW TYPE FOR THE SPECIFIC WORK-RELATED SITUATION AND CONDUCT A WORK-RELATED INTERVIEW.**
   - 2.1 Identify different types of questions.
   - 2.2 Determine the purpose of each type of question and its application.
   - 2.3 Identify the hazards to be avoided when asking questions.
   - 2.4 Demonstrate questioning skills.
   - 2.5 State the significance of interviews.
   - 2.6 State the characteristics of interviews.
   - 2.7 Explain the activities in an interviewing situation.
   - 2.8 Describe the types of interviews.
   - 2.9 Explain the interviewing strategy.
   - 2.10 Prepare instrument for a structured interview.

3. **DEMONSTRATE THE USE OF ACTIVE LISTENING SKILL IN THE ORAL COMMUNICATION PROCESS and DEMONSTRATE READING COMPREHENSION**
   - 3.1 State the principles of active listening.
   - 3.2 Identify skills of active listening.
   - 3.3 Identify barriers to active listening.
   - 3.4 State the benefits of active listening.
   - 3.5 Demonstrate listening skills.
   - 3.6 Explain the importance of giving and receiving feedback.
   - 3.7 Identify major reading problems.
   - 3.8 Identify basic reading skills.
   - 3.9 State methods of previewing written material.
   - 3.10 Identify methods of concentration when reading.
   - 3.11 Demonstrate reading comprehension.

4. **Understand REPORT WRITING**
   - 4.1 Interpret Goals of report writing

4.2 Explain Report format.
4.3 Enlist Types of reports.
4.4 Describe Report writing strategy.
4.4.1 Graphs/ Charts and their Analysis
4.5 Understanding Technical Reports:
4.5.1Meaning & Classification.
4.5.2Main Parts of the report.
4.5.3Organizational & outline of the report.
4.5.4 Sources of information
4.6 Understanding Business & Market Reports:
4.6.1Definition.
4.6.2Scope.
4.6.3Importance.
4.6.4 Contents.
4.6.5 Market Terms

5. **UNDERSTAND THE PRINCIPLES OF GROUP COMMUNICATIONS.**
5.1 State the purpose and characteristics of major types of meeting.
5.2 Explain responsibilities of a meeting/committee.
5.3 Identify problems likely to be faced at meeting and means to overcome these problems.
5.4 Distinguish between content and process at meetings.
5.5 Explain the key characteristics of a good group facilitator.

6. **UNDERSTAND INTERPERSONAL & INTRAPERSONAL SKILLS**
6.1 Explain Interpersonal Skills
6.2 Describe Intrapersonal Skills

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Mgm-221 BUSINESS MANAGEMENT AND INDUSTRIAL ECONOMICS

Total Contact Hours

		T	P	C
Theory	32			
Practical	0	1	0	1

AIMS The students will be able to develop management skills, get acquainted the learner with the principles of management and economic relations and develop commercial/economic approach to solve the problems in the industrial set-up.

COURSE CONTENTS

1. ECONOMICS — **2 Hours**

- 1.1 Definition: Adam Smith, Alfred Marshall, Prof. Robins.
- 1.2 Nature and scope
- 1.3 Importance for technicians.

2. BASIC CONCEPTS OF ECONOMICS — **1 Hour**

- 2.1 Utility
- 2.2 Income
- 2.3 Wealth
- 2.4 Saving
- 2.5 Investment
- 2.6 Value.

3. DEMAND AND SUPPLY. — **2 Hours**

- 3.1 Definition of demand.
- 3.2 Law of demand.
- 3.3 Definition of supply.
- 3.4 Law of supply.

4. FACTORS OF PRODUCTION. — **2 Hours**

- 4.1 Land
- 4.2 Labour
- 4.3 Capital
- 4.4 Organization.

5. BUSINESS ORGANIZATION. — **3 Hours**

- 5.1 Sole proprietorship.
- 5.2 Partnership
- 5.3 Joint stock company.

6. ENTREPRENEURIAL SKILLS — **4 Hours**

- 6.1 Preparing, planning, establishing, managing, operating and evaluating relevant resources in small business.
- 6.2 Business opportunities, goal setting.
- 6.3 Organizing, evaluating and analyzing opportunity and risk tasks.

7. SCALE OF PRODUCTION. — **2 Hours**

7.1 Meaning and its determination.
7.2 Large scale production.
7.3 Small scale production.

8. ECONOMIC SYSTEM **3 Hours**
8.1 Free economic system.
8.2 Centrally planned economy.
8.3 Mixed economic system.

9. MONEY. **1 Hour**
9.1 Barter system and its inconveniences.
9.2 Definition of money and its functions.

10. BANK. **1 Hour**
10.1 Definition
10.2 Functions of a commercial bank.
10.3 Central bank and its functions.

11. CHEQUE **1 Hour**
11.1 Definition
11.2 Characteristics and kinds of cheque.
11.3 Dishonor of cheque.

12. FINANCIAL INSTITUTIONS **2 Hours**
12.1 IMF
12.2 IDBP
12.3 PIDC

13. TRADE UNION **2 Hours**
13.1 Introduction and brief history.
13.2 Objectives, merits and demerits.
13.3 Problems of industrial labor.

14. INTERNATIONAL TRADE. **2 Hours**
14.1 Introduction
14.2 Advantages and disadvantages.

15. MANAGEMENT **1 Hour**
15.1 Meaning
15.2 Functions

16. ADVERTISEMENT **2 Hours**
16.1 The concept, benefits and draw-backs.
16.2 Principal media used in business world.

17. ECONOMY OF PAKISTAN **1 Hour**
17.1 Introduction
17.2 Economic problems and remedies.

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BOOKS RECOMMENDED

1. Nisar-ud-Din, Business Organization, Aziz Publisher, Lahore
2. M. Saeed Nasir, Introduction to Business, Ilmi Kitab Khana, Lahore.
3. S.M. Akhtar, An Introduction to Modern Economics, United Limited, Lahore.

Mgm-221 **BUSINESS MANAGEMENT AND INDUSTRIAL ECONOMICS.**

INSTRUCTIONAL OBJECTIVES

1. **UNDERSTAND THE IMPORTANCE OF ECONOMICS.**
   - 1.1 State definition of economics given by Adam Smith, Alfred Marshall and Professor Robins.
   - 1.2 Explain nature and scope of economics.
   - 1.3 Describe importance of study of economics for technicians.

2. **UNDERSTAND BASIC TERMS USED IN ECONOMICS.**
   - 2.1 Define basic terms, utility, income, wealth, saving, investment and value.
   - 2.2 Explain the basic terms with examples

3. **UNDERSTAND LAW OF DEMAND AND LAW OF SUPPLY.**
   - 3.1 Define Demand.
   - 3.2 Explain law of demand with the help of schedule and diagram.
   - 3.3 State assumptions and limitation of law of demand.
   - 3.4 Define Supply.
   - 3.5 Explain law of Supply with the help of schedule and diagram.
   - 3.6 State assumptions and limitation of law of supply.

4. **UNDERSTAND THE FACTORS OF PRODUCTION**
   - 4.1 Define the four factors of production.
   - 4.2 Explain labour and its features.
   - 4.3 Describe capital and its peculiarities.

5. **UNDERSTAND FORMS OF BUSINESS ORGANIZATION.**
   - 5.1 Describe sole proprietorship, its merits and demerits.
   - 5.2 Explain partnership, its advantages and disadvantages.
   - 5.3 Describe joint stock company, its merits and demerits.
   - 5.4 Distinguish public limited company and private limited company.

6. **UNDERSTAND ENTERPRENEURIAL SKILLS**
   - 6.1 Explain preparing, planning, establishing and managing small business set up
   - 6.2 Explain evaluating all relevant resources
   - 6.3 Describe organizing analyzing and innovation of risk of task

7. **UNDERSTAND SCALE OF PRODUCTION.**
   - 7.1 Explain scale of production and its determination.
   - 7.2 Describe large scale production and it merits.
   - 7.3 Explain small scale of production and its advantages and disadvantages.

8. **UNDERSTAND DIFFERENT ECONOMIC SYSTEMS.**
   - 8.1 Describe free economic system and its characteristics.
   - 8.2 Explain centrally planned economic system, its merits and demerits.
   - 8.3 State mixed economic system and its features.

9. **UNDERSTAND WHAT IS MONEY**
   - 9.1 Define money
   - 9.2 Explain barter system and its inconveniences.

9.3 Explain functions of money.

10. UNDERSTAND BANK AND ITS FUNCTIONS.

10.1 Define bank.
10.2 Describe commercial bank and its functions.
10.3 State central bank and its functions.

11. UNDERSTAND CHEQUE AND DISHONOR OF CHEQUE.

11.1 Define cheque.
11.2 Enlist the characteristics of cheque.
11.3 Identify the kinds of cheque.
11.4 Describe the causes of dishonor of a cheque.

12. UNDERSTAND FINANCIAL INSTITUTIONS.

12.1 Explain IMF and its objectives.
12.2 Explain organizational set up and objectives of IDBP.
12.3 Explain organizational set up and objectives of PIDC.

13. UNDERSTAND TRADE UNION, ITS BACKGROUND AND FUNCTIONS.

13.1 Describe brief history of trade union.
13.2 State functions of trade union.
13.3 Explain objectives, merits and demerits of trade unions.
13.4 Enlist problems of industrial labour.

14. UNDERSTAND INTERNATIONAL TRADE.

14.1 Explain international trade.
14.2 Enlist its merits and demerits.

15. UNDERSTAND MANAGEMENT

15.1 Explain meaning of management.
15.2 Describe functions of management.
15.3 Identify the problems of business management.

16. UNDERSTAND ADVERTISEMENT.

16.1 Explain the concept of advertisement.
16.2 Enlist benefits and drawbacks of advertisement.
16.3 Describe principal media of advertisement used in business world.

17. UNDERSTAND THE ECONOMIC PROBLEMS OF PAKISTAN.

17.1 Describe economy of Pakistan.
17.2 Explain economic problems of Pakistan
17.3 Explain remedial measures for economic problems of Pakistan.

Elect-212 APPLIED ELECTRICITY AND ELECTRONICS

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

Pre-requisites: Applied Physics (1st year)

AIMS: This course enables the students to understand the fundamental of electricity, know the devices used for control of industrial equipment, their properties and uses. The course provide the knowledge of working principles and operation of A.C. and D.C. motors, transformers and generators, Interpret connection diagrams of various electrical devices. Students will be able to observe safety rules and provide electric shock treatment.

Corse Contents:

1.	**FUNDAMENTALS OF ELECTRICITY**	**4Hrs**
2.	**PROTECTION DEVICES AND ELECTRICAL SAFETY**	**4Hrs**
3.	**MOTORS, GENERATORS AND TRANSFORMERS**	**5Hrs**
4.	**INSTRUMENTS AND WIRING**	**5Hrs**
5.	**FUNDAMENTALS OF ELECTRONICS**	**5Hrs**
6.	**TRANSISTORS/AND SPECIAL DIODES**	**4 Hrs**
7.	**PROGRAM LOGIC CONTROLLER (PLC) AND GATES**	**5 Hrs**

Detail of Contents:

1. **FUNDAMENTALS OF ELECTRICITY** **4 Hrs**
   - 1.1 Current, (AC and DC Supply) voltage and resistance, their units, single phase and three phase supply
   - 1.2 Ohms law, simple calculations
   - 1.3 Laws of resistance, simple calculations
   - 1.4 Combination of resistances, simple calculations, capacitors and their combinations
   - 1.5 Electrical and mechanical power, their conversion, units, horse power
   - 1.6 Heating effect of current, Joules law
   - 1.7 Electrical energy, units, energy bill
   - 1.8 Batteries and battery cells
2. **PROTECTION DEVICES AND ELECTRICAL SAFETY** **4 Hrs**
   - 2.1 Fuse and their types
   - 2.2 Circuit breaker and their types
   - 2.3 Relay and their types
   - 2.4 Starter and their types
3. **MOTORS, GENERATORS AND TRANSFORMERS** **5 Hrs**
   - 3.1 Faraday's law
   - 3.2 Construction and working of AC and DC generators
   - 3.3 Construction and working of transformers, emf and current equation types
   - 3.4 Welding transformers, ratings
   - 3.5 Types and working of motors
     - 3.5.1 AC MOTORS

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3.5.1.1 1- Phase induction motor
3.5.1.2 3- Phase induction motors

3.5.2 DC MOTORS

3.5.2.1 Stepper motors
3.5.2.2 Servo motors

4. (A) MEASURING INSTRUMENTS **5Hrs**

4.1 Basic Electrical measuring instruments
4.2 Ammeter, Voltmeter, Ohm meter, Multimeter, Watt meter Energy Meter and their connections
4.3 Use of multimeter
4.4 Use of megger

(B) DOMESTIC WIRING

4.5 Introduction to wiring and their types

5. FUNDAMENTALS OF ELECTRONICS **5 Hrs**

5.1 Semi-conductor theory, doping, P & N type materials
5.2 PN Junction diode, potential barrier, forward and reverse bias
5.3 Use of PN Diode as rectifier
5.4 Half-wave, full-wave and bridge rectifiers
5.5 Filtering, inverters and stabilizers
5.6 Power supply

6. TRANSISTORS/AND SPECIAL DIODES **4 Hrs**

6.1 PNP & NPN transistors, biasing, working
6.2 Use of transistors as amplifies, gains in CE, CB and CC amplifiers
6.3 Zener diode
6.4 Photo diode, photovoltaic cells, LED

7. PROGRAM LOGIC CONTROLER (PLC) and Logic Gates **5 Hrs**

7.1 PLC advantage and disadvantages and its types
7.2 Basic PLC programming
7.3 Gate and types, Relay logic
7.4 k. maps, binary system
7.5 Design a control circuit

Recommended Textbooks:

1. **Examples of Electrical Calculations, by Admiralty**
2. **Reed's Basic electro-technology for marine engineers, KRAAL**
3. **Electrical Technology, B.L. Theraja**
4. **AC & DC circuits B. Grob**
5. **Basic Electronics B. Grob**
6. **Digital Electronics by Moris Mayno**

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Elect-212 **APPLIED ELECTRICITY AND ELECTRONICS**

Instructional Objectives:

1. **UNDERSTAND BASIC CONCEPTS AND LAWS OF ELECTRICITY**
   - 1.1 Define units of current, voltage and resistance with respect to supply of single phase and three phase
   - 1.2 Explain Ohm's Law with simple calculations
   - 1.3 Solves simple problems on laws of resistance
   - 1.4 Substitute two of the three variables to find the third unknown in equation V=I x R
     - 1.4.1 Calculate the equivalent resistances for resistors joined in series, parallel and combination
     - 1.4.2 Calculate the total capacitance in series and parallel
   - 1.5 Calculate electrical and mechanical power and the inter relation between the two systems
   - 1.6 Heating effect of current, Jowls Law
   - 1.7 Calculate the electrical energy consumption in an installation and prepare the energy bill
   - 1.8 Define the inductors and its uses
   - 1.9 Define RLC circuit and its uses
   - 1.10 Define the batteries and battery cell
     - 1.10.1 Define primary and secondary battery
     - 1.10.2 State the types of primary and secondary batteries
2. **UNDERSTAND PROTECTION DEVICES AND ELECTRICAL SAFETY**
   - 2.1 Define Fuse and its current rating, fusing factor, Types of fuses, Re-wirable and HRC
   - 2.2 Explain working of circuit breaker, Types of C.B, High power circuit breaker and their types, Domestic Circuit breakers
     - 2.2.1 Difference between MCB and MCCB, Types of MCB w.r.t. poles
   - 2.3 Define relay and explain its working
     - 2.3.1 State types of relays w.r.t working
   - 2.4 Describe starter and its types
     - 2.4.1 Explain the working of following starter, 3Point, 4Point and star delta starter and soft starter)
     - 2.4.2 Understand personal safety while working on electricity)
3. **UNDERSTAND WORKING OF ELECTRIC MOTORS, AND GENERATORS AND TRANSFORMERS**
   - 3.1 Explain Faraday's law
   - 3.2 State the construction of alternator and D.C. generator with its parts and working
   - 3.3 Explain the working principal of transformers and emf equation
   - 3.4 State various parts of a welding transformer and setting
   - 3.5 Explain the working of single phase, three phase, and servo motors
   - 3.6 Explain the working of stepper motors
4. **INSTRUMENTS AND BASIC WIRING**
   - 4.1 Define instrument and their types, Use of instruments and their connections)
   - 4.2 Define secondary analog digital and working effect
   - 4.3 Explain types of meters, there uses and connection in a circuit , Ammeter, Voltmeter, Ohm meter, Multimeter, Watt meter and Energy Meter
   - 4.4 Define electric wiring and enlist the accessories used in Domestic wiring
     - 4.4.1 Describe batten wiring, conduit PVC, casing capping wiring, advantages and disadvantages of each
5. **UNDERSTAND THE FUNDAMENTALS OF ELECTRONICS**
   - 5.1 State the Semiconductor theory

5.1.1. State how P type and N type material is produced

5.2 State the action of potential barrier in a PN junction and the effect of forward and reverse bias on the junction

5.3 Describe the use of PN junction diode as rectifier

5.4 Draw and explain the circuit diagram for half wave and full wave rectifier

5.5 Draw and explain the Bridge Rectifier circuit with filter circuit, investors and stabilizer and its circuits

5.6 Explain Power supply

6. UNDERSTAND THE WORKING OF SPECIAL DIODES

6.1 State the biasing working of zener diodes

6.2 , State the construction working and uses of photo diodes, Photovoltaic cell and LED

7. PROGRAM LOGIC CONTROLER (PLC) AND GATES

7.1 Define PLC, working, advantages and disadvantages

7.2 Describe Basic PLC programming

7.3 Explain Gate and Types

7.3.1 Define symbols truth able logic diagram (AND, OR, NOT, NAND, NOR, XOR, NXOR)

7.4 Define binary system decimal to binary, Hexa, octal system, K maps SOP,POS,

7.5 Explain pneumatic cylinder control, basic operation, charging control operation, connection I/O devices

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Elect-212 APPLIED ELECTRICITY AND ELECTRONICS

List of Practical:

1. **FUNDAMENTALS OF ELECTRICITY**
   - 1.1 Study of electrical measuring instruments, handling precautions, methods of connection and identification of AC & DC Meter
   - 1.2 Verification of Ohm's law
   - 1.3 Verification laws of combination; of resistance
   - 1.4 Measurement of power by Volt-ammeter and wattmeter
   - 1.5 Measurement of electrical energy
   - 1.6 Use of primary and secondary batteries
2. **PROTECTION DEVICES AND ELECTRICAL SAFETY**
   - 2.1 Application of various fuses in wiring
   - 2.2 Study of connection circuit breaker 2 pole, 3 pole with time setting
3. **MOTORS, GENERATORS AND TRANSFORMERS**
   - 3.1 Verification of faraday's laws of electro-magnetic induction
   - 3.2 Connection of star delta starter and timer
   - 3.3 Study of AC and DC generators
   - 3.4 Study of welding transformers
   - 3.5 Starting single-phase induction motors, reversal and forward
   - 3.6 Starting 3-phase induction motors, reversal and forward
   - 3.7 Connections of magnetic starters with motors
4. **INSTRUMENTS AND WIRING**
   - 4.1 Current carrying capacity of cables
   - 4.2 Wiring, PVC, casing Capping and Batten
   - 4.3 Use of oscilloscope
   - 4.4 Study of calibration of instruments using bridge circuits
   - 4.5 Study of using AVO meter and meggar analog and digital
5. **FUNDAMENTALS OF ELECTRONICS**
   - 5.1 Study and connections of PN diodes as rectifiers
   - 5.2 Connecting PN Diode as half-wave and full-wave rectifier
   - 5.3 Connecting PN Diode as bridge Rectifiers with filter
   - 5.4 Study of Power Supply
6. **TRANSISTORS AND SPECIAL DIODES**
   - 6.1 Connections and biasing of PNP and NPN transistors
   - 6.2 Study and connections of zener diode as voltage regulator
   - 6.3 Study and connections of Photodiode as light sensing device
   - 6.4 Study and connections of DIAC's and TRIAC's as switch circuits
7. **PROGRAM LOGIC CONTROLER (PLC) AND GATES**
   - 7.1 Study of PLC system
   - 7.2 Study and connection of gate AND, OR, NOT, NAND, NOR, XOR, NXOR
   - 7.3 Study how to execute PLC
     - 7.3.1 Basic commands and how to design control circuit

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Mech-233 COMPUTER AIDED DESIGNING (CAD)

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

THEORY

DETAIL OF CONTENTS

1. **INTRODUCTION, INSTALLATION & ACTIVATION OF AUTO CAD** — 2 Hrs
   - 1.1. User Interface
   - 1.2. Templates
   - 1.3. Layers and Objects
   - 1.4. Installation & Activation
2. **TOOLS FOR CREATING AND MODIFYING 2D DRAWINGS** — 2 Hrs
   - 2.1 Draw Tool Bar
   - 2.2 Modify Tool Bar
3. **DRAWING AIDS & CO-ORDINATE SYSTEMS** — 2 Hrs
   - 3.1 Object Snap & Ortho
   - 3.2 Dynamic Input Settings
   - 3.3 Units and User Co-ordinate System
   - 3.4 Methods of Drawing Lines
4. **LAYERS** — 2 Hrs
   - 4.1 Introduction of Layers & Layer Toolbar
   - 4.2 Create Layers
   - 4.3 Working in Layers
5. **DIMENSION AND SYMBOLS** — 2 Hrs
   - 5.1 Create & Edit Dimensions
   - 5.2 Annotation and Symbols
6. **DRAWING LAYOUT** — 3 Hrs
   - 6.1 Make Layout
   - 6.2 Create Drawing Frame
   - 6.3 Create Contents and Template
   - 6.4 Drawing Sheet Settings (Limits, Title block etc.)
7. **APPLICATION OF AUTOCAD IN MECHANICAL TECHNOLOGY** — 4 Hrs
   - 7.1 Mechanical Structure
   - 7.2 Standard Parts
   - 7.3 Springs
   - 7.4 Chains / Belts
   - 7.5 Shafts
8. **BILL OF MATERIALS, PARTS LISTS** — 3 Hrs
   - 8.1 Bill of Materials
   - 8.2 Parts Lists
   - 8.3 Ballooning Parts
9. **SOLID MODELING** — 5 Hrs
   - 9.1 Extrude Solid, Revolve Solid

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9.2 Sweep Solid, Loft Solid
9.3 Boolean Operation

10. 3D -SURFACE MODELING **5 Hrs**

10.1 Plan Surface, Ruled Surface
10.2 Extrude Surface, Revolve Surface
10.3 Sweep Surface, Loft Surface
10.4 Surface Trim & Extend

11. MECHANICAL MODELS **2 Hrs**

11.1 Bench Vice
11.2 Pipe Vice
11.3 Radial Engine
11.4 Butterfly Valve
11.5 V Block

List of Reference Books:-

1. AutoCAD 2010 Tutorial First Level: 2D Fundamentals by Randy H. Shih
2. AutoCAD 2010 Tutorial Second Level: 3D Modeling by Randy H. Shih
3. Autodesk Official Training Courseware(AOTC) Volume-1
4. Autodesk Official Training Courseware(AOTC) Volume-2

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Mech-233 COMPUTER AIDED DESIGNING (CAD)

INSTRUCTIONAL OBJECTIVES

1. **INTRODUCTION, INSTALLATION & ACTIVATION OF AUTO CAD**
   a. Describe User Interface
   b. Describe different Templates used in Auto CAD
   c. State the use of Layers and Objects
   d. Understand & Perform Auto CAD Installation
   e. Understand & Perform Auto CAD Activation
2. **TOOLS FOR CREATING AND MODIFYING 2D DRAWINGS**
   a. Understand Draw Tool Bar
   b. Understand Modify Tool Bar
3. **DRAWING AIDS & CO-ORDINATE SYSTEMS**
   a. Define Object Snap & Ortho
   b. Understand Dynamic Input Settings
   c. Describe Units and User Co-ordinate System
   d. Describe the Methods of Drawing Lines
4. **LAYERS**
   a. Define Layers & understand Layer Toolbar
   b. Describe the method to Create Layers
   c. Explain Working in Layers
5. **DIMENSION AND SYMBOLS**
   a. Explain the method to Create & Edit Dimensions
   b. State the use of Annotation and Symbols
6. **DRAWING LAYOUT**
   a. Describe the method to Make Layout
   b. State the use of Drawing Frame
   c. Explain the method to Create Contents and Template
   d. Understand Drawing Sheet Settings (Limits, Title block etc.)
7. **APPLICATION OF AUTOCAD IN MECHANICAL TECHNOLOGY**
   a. Understand Mechanical Structure
   b. Identify Standard Parts
   c. Understand Springs
   d. Describe Chains / Belts
   e. Describe Shafts
8. **BILL OF MATERIALS, PARTS LISTS**
   a. Describe the Bill of Materials
   b. Define Parts Lists
   c. State the importance of Ballooning Parts
9. **SOLID MODELING**
   a. Explain Extrude Solid, Revolve Solid
   b. Explain Sweep Solid, Loft Solid
   c. Explain Boolean Operation
10. **3D SURFACE MODELING**
    a. Explain Plan Surface, Ruled Surface

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b. Explain Extrude Surface, Revolve Surface
c. Explain Sweep Surface, Loft Surface
d. Explain Surface Trim & Extend

11. MECHANICAL MODELS

a. Identify the parts of Bench Vice
b. Identify the parts of Pipe Vice
c. Identify the parts of Radial Engine
d. Identify the parts of Butterfly Valve
e. Identify the parts of V Block

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Mech-233 CAD

List of Practicals

1. Starting Auto cad
2. Title Bar, Tool Bar, Menu Bar, Browser, Status Bar, Command Bar
3. Options, O Snap, Units , Point
4. Zoom, Zoom And Extent, Pan, Orbit
5. Lines And The Methods Of Drawing Lines, Line Types
6. Dimensioning, Dimensioning Styles , Use Of Alternate Commands
7. Selections Of Objects And Unselecting Objects, Rotate Lines And Objects
8. Layers
9. Offset, Extend, Trim, Divide And Break
10. Use Of Function Keys
11. Use Of Ctrl + Keys
12. Copy, Move, Open Files, Save Files And Save As Files
13. Mirror, Rectangle, Explode , Lengthen And Use Of Grips
14. Circle
15. Array
16. Fillet And Chamfer
17. Match Properties And Change Properties
18. Construction Lines
19. Arc
20. Polygons, Ellipse
21. Hatch And Hatch Edit, Boundary
22. Join And Break Command
23. Grids, Limits, Snap On
24. Polar Tracking
25. Stretch, Scale
26. Area, Poly Line And Poly Line Edit
27. Text And Text Editing
28. S P Line/O G Curve, Reverse Curve, Threads,
29. Time, History, Copy Link, Scanning Of Objects To Work On
30. Views, Shades, Region, Extrude, Subtract And Union
31. Solid Editing
32. 3d Orbit, 3d Continuous Orbit
33. Revolve
34. Spring, Threads
35. Knurling
36. Text Extrude
37. Mass Properties
38. Basic 3d Shapes
39. Interfere, Intersect And Slice
40. Dynamic View
41. Render
42. Using Design Center

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Instructional Objectives of Practicals

1. **STARTING AUTOCAD**
    a. Understand starting AutoCAD, Selection of Units and Templates
    b. Installation and Activation

2. **TITLE BAR, TOOL BAR, MENU BAR, BROWSER, STATUS BAR, COMMAND BAR**
    a. Understand Title Bar and Tool Bar
    b. Understand Menu Bar and Browser
    c. Perform save & save as
    d. Perform Opening File

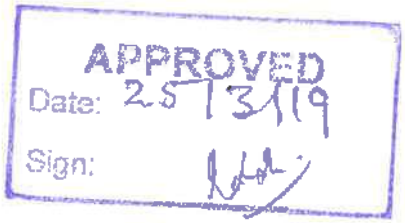
3. **OPTIONS, O SNAP, UNITS , POINT**
    a. Understand and Perform Options Setting
    b. Understand and Perform Units Setting
    c. Understand and Perform Point Setting

4. **ZOOM, ZOOM AND EXTENT, PAN, ORBIT**
    a. Understand and Perform Zoom
    b. Understand and Perform Pan
    c. Understand and Perform Orbit

5. **LINES AND THE METHODS OF DRAWING LINES, LINE TYPES**
    a. Draw Lines using Absolute Co- ordinate System
    b. Draw Lines using Relative Co- ordinate System
    c. Draw Lines using Direct Distance Method
    d. Draw Lines using Polar Co- ordinate System
    e. Perform Loading Line Types
    f. Draw 2D Figures using above said Methods

6. **DIMENSIONING, DIMENSIONING STYLES , USE OF ALTERNATE COMMANDS**
    a. Apply Linear Dimension on Figures
    b. Apply Align Dimension on Figures
    c. Apply Angular Dimension on Figures
    d. Apply Radius Dimension on Figures
    e. Apply Diameter Dimension on Figures
    f. Apply Center Point on Figures

7. **SELECTIONS OF OBJECTS AND UNSELECTING OBJECTS, ROTATE LINES AND OBJECTS**
    a. Apply Selection Techniques of Objects
    b. Apply Un-Selection Techniques of Objects
    c. Perform Rotation of Lines
    d. Perform Rotation of Objects



8. **LAYERS**
    a. Understand and Create Layers
    b. Apply Layers in 2D Drawings

9. **OFFSET, EXTEND, TRIM, DIVIDE AND BREAK**

a. Offset Lines and Objects,
b. Extend the Lines
c. Trim the Lines
d. Divide the Lines and Objects
e. Break the Lines

10. UNDERSTAND AND USE OF FUNCTION KEYS; F1 TO F9

11. UNDERSTAND AND USE OF CTRL + 1 TO CTRL + 0 KEYS

12. COPY, MOVE

a. Perform Copy Command
b. Perform Move Command

13. MIRROR, RECTANGLE, EXPLODE , LENGTHEN AND USE OF GRIPS

a. Perform Mirror Command
b. Perform Rectangle Command
c. Perform Explode Command
d. Perform lengthen Command
e. Perform Grips Options (Extend, Move, Mirror and Lengthen)

14. CIRCLE

a. Draw Circle (with Radius, Diameter, 2 Ponits, 3 Points, Tan Tan Radius and Tan Tan Tan Methods)

15. ARRAY

a. Perform Polar Array
b. Perform Rectangular Array

16. FILLET AND CHAMFER

a. Create Fillets
b. Create Chamfers

17. MATCH PROPERTIES AND CHANGE PROPERTIES

a. Perform Change Properties
b. Perform Match Properties

18. CONSTRUCTION LINES

a. Create Construction Lines

19. Create ARCs using following Methods

1. 3 POINTS
2. START CENTER END
3. START CENTER ANGLE
4. START CENTER LENGTH
5. START END ANGLE
6. START END DIRECTION
7. START END RADIUS
8. START END CENTER
9. CENTER START END

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10. CENTER START ANGLE
11. CENTER START LENGTH
12. CONTINUE

20. POLYGONS, ELLIPSE

a. Draw Polygons (Inscribed and Circumscribed)
b. Draw Ellipse (with Half of Major Axis and Half of Minor Axis)

21. HATCH AND HATCH EDIT, BOUNDARY

a. Perform Hatch and Gradient Hatch
b. Create Boundary of Objects

22. JOIN AND BREAK COMMAND

a. Perform Join and Break Command on objects

23. GRIDS, LIMITS, SNAP ON

a. Perform on Grids with the help of Snap on
b. Perform on Limits

24. POLAR TRACKING

a. Perform with Polar Tracking on

25. STRETCH, SCALE

a. Perform Stretching
b. Perform Scale (Big and Small)

26. AREA, POLY LINE AND POLY LINE EDIT

a. Perform Calculating Area (Area, Perimeter and Circumference)
b. Create Poly Lines
c. Perform Poly Line Editing

27. TEXT AND TEXT EDITING

a. Perform Text Writing
b. Perform Text Editing
c. Create Leader Line
d. Perform Text Styles
e. Insert Symbols Φ , ± , °
f. Perform Spell Check
g. Perform Arc Align Text Writing
h. Perform Rotate Text and Dimensions

28. SPLINE/OG CURVE, REVERSE CURVE, THREADS,

a. Create Splines
b. Create Thread Drawings

29. TIME, HISTORY, COPY LINK, SCANNING OF OBJECTS TO WORK ON

a. Check Time and History
b. Copy Auto Cad Files with Word/ Corel Draw

30. VIEWS, SHADES, REGION, EXTRUDE, SUBTRACT AND UNION

a. Understand and use Top, Bottom, Left, Right, Front, Back Views
b. Understand and Use Isometric SW View

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c. Understand and Use Isometric SE View
d. Understand and Use Isometric NE View
e. Understand and Use Isometric NW View
f. Understand and Use 2D Wire Frame, 3D Wire Frame, Hidden, Flat Shaded, **Gouraud Shaded Views**
g. Perform Region Command
h. Perform Extrude Command
i. Perform Subtract Command
j. Perform Union Command

31. SOLID EDITING

a. Perform Color Edge, Copy Edge, Color Face, Copy Face
b. Perform Taper Face, Extrude Face, Delete Face
c. Perform 3D Fillets, 3D Chamfer, 3D Mirror

32. 3D ORBIT, 3D CONTINUOUS ORBIT

33. REVOLVE

a. Apply Revolve Command
b. Apply Taper Command
c. Apply Extrude on Paths Command
d. Apply Extrude on P Lines

34. SPRING, THREADS

a. Perform Spring Command
b. Create 3D Threads

35. KNURLING

a. Perform Diamond Knurling
b. Perform Straight Knurling

36. TEXT EXTRUDE

a. Perform Text Explode
b. Perform Text Region
c. Perform Text Extrude
d. Perform Engraving Text
e. Perform Embossing Text

37. MASS PROPERTIES

a. Apply Mass Properties

38. BASIC 3D SHAPES

a. Create Box
b. Create Cone
c. Create Dish
d. Create Dome
e. Create Mesh
f. Create Pyramid
g. Create Sphere
h. Create Wedge
i. Create Torus

39. INTERFERE, INTERSECT AND SLICE

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a. Perform Interfere
b. Perform Intersect
c. Perform Slice

40. DYNAMIC VIEW

a. Understand and use Camera, Target, Distance, Pan, Point, Zoom, Twist, Clip

41. RENDER

a. Understand and Perform Rendering

42. USING DESIGN CENTER

a. Practice the use of Design Center

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Mech-246 WORKSHOP PRACTICE-II

Total Contact Hours	T	P	C
Theory: 64 Hrs	2	12	6
Practical: 384 Hrs			

Pre-requisites: WORKSHOP PRACTICE-I

AIMS: At the end of this course, the student will be able to know and practice following:-

A) Basic Machine Shop-II:

1) Operate lathe, drill press, shaper, planner , tool grinder
2) Perform different operations on these machines
3) Prepare different jobs using these machines
4) Observe safety to operate machines

B) Foundry & Pattern Making:

1) Use different molding Techniques
2) Prepare core
3) Operate Cupola furnace
4) Detect the different casting defects
5) Prepare the pattern

C) Advance Welding:

1) Perform the Arc welding and oxyacetylene welding
2) Observe different welding defects and their remedies
3) Perform TIG and MIG welding on different metals
4) Reworking
5) Non destructive testing

Mech-246 WORKSHOP PRACTICE-II

A) Machine Shop:

Course Contents:

1.	TYPES OF LATHE AND USES	3Hrs
2.	LATHE CUTTING TOOL GEOMETRY	1Hr
3.	MACHINING TIME	2Hrs
4.	LATHE OPERATIONS	5Hrs
5.	DRILL MACHINES AND OPERATIONS	6Hrs
6.	TOOL GRINDERS AND OPERATIONS	2Hrs
7.	GRINDING WHEELS	4Hrs
8.	SHAPER MACHINES	4Hrs
9.	PLANNER MACHINES	5Hrs

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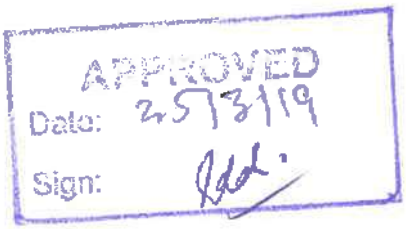
Detail of Contents:

1. **LATHE MACHINES** — **3 Hrs**
   - 1.1 Types of Lathe and their uses
     - 1.1.1 Centre lathe
     - 1.1.2 Bench lathe
     - 1.1.3 Capstan lathe
     - 1.1.4 Turret lathe
     - 1.1.5 Tool room lathe
     - 1.1.6 Special purpose lathe
     - 1.1.7 CNC lathe
   - 1.2 LATHE ATTACHMENTS
     - 1.2.1 Taper turning attachment
     - 1.2.2 Cylindrical grinding attachment
     - 1.2.3 Milling attachment

2. **LATHE CUTTING TOOL GEOMETRY** — **1 Hr**
   - 2.1 Single point cutting tool terms
   - 2.2 Tool angles
     - 2.2.1 Front clearance angle
     - 2.2.2 Side clearance angle
     - 2.2.3 Top rake angle
     - 2.2.4 Side rake angle
     - 2.2.5 Wedge angle

3. **MACHINING TIME** — **2 Hrs**
   - 3.1 Machining time (turning and facing)
   - 3.2 Total machining time
   - 3.3 Factors involved in total machining time
   - 3.4 Formulae for calculation of actual machining time and total machining time
   - 3.5 Coolants and Lubricants
     - 3.5.1 Types of coolants and lubricants
     - 3.5.2 Applications and uses of each

4. **LATHE OPERATIONS** — **5Hrs**
   - 4.1 Drilling for reaming
     - 4.1.1 Drill calculation for reaming
     - 4.1.2 Reaming
     - 4.1.3 Purpose and importance of reaming
   - 4.2 Boring
     - 4.2.1 Straight Boring
     - 4.2.2 Counter Boring
     - 4.2.3 Taper Boring
   - 4.3 Methods of Taper Turning
     - 4.3.1 Compound rest method
     - 4.3.2 Tail stock offset method
     - 4.3.3 Taper turning attachment method
   - 4.4 Threading Operations
     - 4.4.1 Types of threads
     - 4.4.2 Methods of thread cutting
     - 4.4.3 Procedure of cutting threads (external & internal)
     - 4.4.4 Thread rolling



5. **DRILL MACHINES** — **6 Hrs**

5.1 Parts of drill machines
- 5.1.1 Major parts and their functions

5.2 Types of drill machines
- 5.2.1 Sensitive drill machine and uses
- 5.2.2 Bench drill machine and uses
- 5.2.3 Gang drill machine and uses
- 5.2.4 Multi-spindle drill machine & uses
- 5.2.5 Radial drill machine & uses

5.3 Drill Machine Operations
- 5.3.1 Drilling
- 5.3.2 Counter sinking
- 5.3.3 Counter boring
- 5.3.4 Reaming
- 5.3.5 Spot facing
- 5.3.6 Tapping

5.4 Tool and Job holding devices used on drill machines

5.5 Procedure of drills grinding

5.6 Safety precautions during drilling operation and drill grinding

6. TOOL GRINDER — 2 Hrs

6.1 Types of tool grinder
- 6.1.1 Pedestal grinder
- 6.1.2 Bench grinder
- 6.1.3 Wet grinder

7. GRINDER WHEELS AND STANDARD MARKING SYSTEM — 4 Hrs

7.1 Grinding wheel elements
- 7.1.1 Abrasive
- 7.1.2 Grain
- 7.1.3 Grade
- 7.1.4 Bond
- 7.1.5 Structure
- 7.1.6 Selection of grinding wheel

7.2 Grinding Wheels
- 7.2.1 Standard wheels shapes and their applications
- 7.2.2 Loading and glazing of grinding wheels
- 7.2.3 Truing and dressing method of grinding wheels
- 7.2.4 Inspection of grinding wheels
- 7.2.5 Safety precautions for tool grinding

8. SHAPER MACHINE — 4 Hrs

8.1 Types of Shaper & Description.

8.2 Shaper stroke adjustment
- 8.2.1 Length of stroke
- 8.2.2 Position of stroke
- 8.2.3 No. of strokes per minute

8.3 Forward and backward Stroke of Shaper

8.4 Lubrication of shaper

8.5 Shaper Operations
- 8.5.1 Vertical shaping
- 8.5.2 Horizontal shaping
- 8.5.3 Angular shaping

9. PLANNER MACHINE — 5Hrs

9.1 Parts of planner and functions

9.2 Forward and backward stroke
9.3 Lubrication
9.4 Difference between shaper and planner
9.5 Planner operations
    9.5.1 Plain flat surface
    9.5.2 Cutting dove-tail slides
    9.5.3 Cutting simple slots
    9.5.4 Cutting T –slots
    9.5.5 Cutting tools used on the planner

Recommended Textbooks:

1. **Technology of Machine Tools by Steve F. Krar, Albert F. Check**
2. **Shop Theory by James Anderson, Earil E. Tatro**
3. **Production Machine Shop by John E. Neely**
4. **Machine Tool Technology by Willard J. McCarthy, Dr. Victor E. Reff**
5. **Machine Tool Metal Working by John L. Feirer**
6. **Technical Metal**
7. **Machine Tool Practices**

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A) Machine Shop:

Instructional Objectives:

1. **LATHE MACHINE**
   - 1.1 Understand the types of Lathe machine and their uses
     - 1.1.1 Describe center lathe with its uses
     - 1.1.2 Describe bench lathe with its uses
     - 1.1.3 Describe capstan lathe with its uses
     - 1.1.4 Describe turret lathe with its uses
     - 1.1.5 Describe tool room lathe with its uses
     - 1.1.6 Describe special purpose lathes with its uses
     - 1.1.7 Describe CNC lathe with its uses
   - 1.2 Understand the types of Lathe attachments
     - 1.2.1 Explain taper turning attachment
     - 1.2.2 Explain cylindrical grinding attachment
     - 1.2.3 Explain milling attachment

2. **LATHE CUTTING TOOL ANGLES**
   - 2.1 Describe single point cutting tool terms
   - 2.2 Understand the lathe tool angles
     - 2.2.1 Describe the front clearance angle
     - 2.2.2 Describe side clearance angle
     - 2.2.3 Describe top rake angle
     - 2.2.4 Describe side/back rake angle
     - 2.2.5 Describe wedge angle

3. **MACHINING TIME**
   - 3.1 Understand total machining time
     - 3.1.1 Describe the factors involved in total machining time, i.e. setup time, actual machining time, auxiliary time and delay time
     - 3.1.2 Explain the formulae for calculating actual machining and total machining time
   - 3.2 Understand coolants and lubricants
     - 3.2.1 List types of coolants and lubricants
     - 3.2.2 Describe the applications and uses of each

4. **LATHE OPERATIONS**
   - 4.1 Understand drilling for reaming
     - 4.1.1 Explain drill calculating for reaming
     - 4.1.2 Define reaming
     - 4.1.3 Describe purpose and importance of reaming
     - 4.1.4 Enlist types of reamers
   - 4.2 Understand Boring
     - 4.2.1 Describe straight boring
     - 4.2.2 Describe counter boring
     - 4.2.3 Describe taper boring
     - 4.2.4 State types of boring tools
   - 4.3 Understand methods of taper turning
     - 4.3.1 List the methods of taper turning i.e. compound rest method, tail stock offset method and taper turning attachment method
     - 4.3.2 Explain each method

4.3.3 Explain merits and demerits of each method

4.4 Understand threads and use of threads

4.4.1 Describe types of threads

4.4.2 Describe methods of thread cutting

4.4.3 Describe the procedure of cutting external and internal threads of different forms on lathe machine

4.4.4 Describe thread rolling process

5. DRILL MACHINES

5.1 Understand parts of drill machine

5.1.1 Explain major parts and their functions

5.2 Understand types of drill machine

5.2.1 Describe sensitive drill machine and its uses

5.2.2 Describe bench drill machine and its uses

5.2.3 Describe gang drill machine and its uses

5.2.4 Describe multi-spindle drill machine and its uses

5.2.5 Describe radial drill machine and its uses

5.3 Understand drill machine operations

5.3.1 Explain drilling

5.3.2 Explain counter sinking

5.3.3 Explain counter boring

5.3.4 Explain reaming

5.3.5 Explain spot facing

5.3.6 Explain tapping

5.4 Understand tool and job holding devices used on drill machine

5.4.1 Describe tool and job holding devices

5.5 Describe procedure for drill grinding

5.6 Describe safety precautions adopted during drilling operation and drill grinding

6. TOOL GRINDER

6.1 Understand types of tool grinders

6.1.1 Describe pedestal grinder

6.1.2 Describe bench grinder

6.1.3 Describe wet grinder

7. ELEMENTS OF GRINDING WHEEL AND STANDARD MARKING SYSTEM

7.1 Understand grinding wheel elements

7.1.1 Explain abrasive materials used for grinding wheels

7.1.2 Explain grain size

7.1.3 Explain grade of grinding wheel

7.1.4 Explain bonding material used for grinding wheel

7.1.5 Explain structure of grinding wheel

7.1.6 Describe selection of grinding wheel

7.1.7 Describe standard marking system for grinding wheel

7.2 Understand grinding wheels

7.2.1 Describe standard wheel shapes and their applications

7.2.2 Describe loading and glazing of grinding wheel

7.2.3 Describe truing and dressing methods of grinding wheel

7.2.4 Describe inspection of grinding wheel

7.2.5 Describe safety precautions to be observed during tool grinding

8. SHAPER

8.1 Understand shaper types

8.1.1 List types of shaper

8.1.2 Explain each

8.2 Understand shaper stroke adjustment
- 8.2.1 Explain the procedure for setting length of stroke
- 8.2.2 Explain the procedure for setting position of stroke
- 8.2.3 Explain No. of strokes per minute and its calculations

8.3 Explain forward and backward stroke of shaper

8.4 Explain lubrication of shaper

8.5 Understand shaper operations
- 8.5.1 Explain Vertical shaping
- 8.5.2 Explain Horizontal shaping
- 8.5.3 Explain angular shaping

9 PLANNER MACHINE

9.1 Understand planner parts and functions
- 9.1.1 Explain major parts of Planner and their functions

9.2 Explain forward and backward stroke

9.3 Explain lubrication of planner

9.4 Explain the difference between shaper and planner

9.5 Understand planner operations
- 9.5.1 Describe the procedure for planning flat surfaces on planner
- 9.5.2 Describe the procedure for cutting dovetail slides on planner
- 9.5.3 Describe the procedure for cutting simple slots on planner
- 9.5.4 Describe the procedure for cutting T-slots on planner
- 9.5.5 Enlist cutting tools used on planner

Mech-246 **WORKSHOP PRACTICE-II**

A) Machine Shop:

List of Practical:

1.	Centering the job by dial indicator method	6 Hours
2.	Taper turning by tail stock off-set method	12Hours
3.	Taper turning by taper turning attachment	12Hours
4.	Eccentric turning practice	12Hours
5.	Practice of reaming	6 Hours
6.	Practice of boring	3 Hours
7.	Practice of counter boring	3 Hours
8.	Practice of taper boring	6 Hours
9.	Practice of grinding tool for thread cutting	6 Hours
10.	Practice of cutting metric v-thread	9 Hours
11.	Practice of cutting square thread	12Hours
12.	Practice of cutting acme thread	12Hours
13.	Practice of cutting worm thread 9 Hours	
14.	Practice of cutting multi-start v-thread	12Hours
15.	Practice of cutting internal metric v-thread	12Hours
16.	Practice of preparing milling arbor	12Hours
17.	Practice of drill grinding	12Hours
18.	Practice of shaping V-Block	36Hours

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B) Foundry and Pattern Making:

Course Contents:

(Part A: Foundry)

1.	MOLDING AND MOLDING TECHNIQUES	2Hrs
2.	CORE AND CORE MAKING	2Hr
3.	CUPOLA OPERATION	4Hrs
4.	CASTING DEFECTS	2Hrs

(Part B: Pattern Making)

5.	PATTERN MAKING	4Hrs
6.	PATTERN ALLOWANCES	2Hrs

Detail of Contents:

(Part A: Foundry)

1. Molding and molding techniques — 2Hrs
- 1.1 Bedding in molding
- 1.2 Use of two parting surfaces
- 1.3 Molding of loose piece pattern
- 1.4 Use of draw back
- 1.5 Molding with three piece molding box

2. Core and Core making — 2Hrs
- 2.1 Cores and its type
- 2.2 Core sand and its properties
- 2.3 Core baking
- 2.4 Solid and hollow core

3. Cupola Operation — 4Hrs
- 3.1 Cupola's charge and its Properties
- 3.2 Charging of cupola
- 3.3 Tapping and botting
- 3.4 Melting and pouring

4. Casting Defects — 2Hrs
- 4.1 Blow holes, its causes and remedies
- 4.2 Shrinkage cavity or crack its causes and remedies
- 4.3 Miss-run, its causes and remedies
- 4.4 Mismatch, its causes and remedies
- 4.5 Fins, its causes and remedies

(Part B: Pattern Making)

5. PATTERN MAKING — 4Hrs
- 5.1 Principle of pattern making

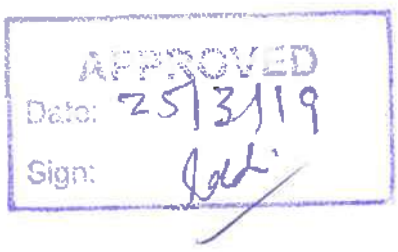
5.2 Selection of pattern material with respect to their properties
5.3 Pattern Construction and its techniques
5.4 Preparation of pattern layout
5.5 Preservation and storage of pattern
5.6 Master Pattern
5.7 Modern Trends in Pattern Making
5.7.1 Using CNC router
5.7.2 Using Rapid Prototyping Machine
5.7.2.1 Stereo lithography (SLA) Machine
5.7.2.2 Selective Laser Sintering (SLS) Machine
5.7.2.3 Fused Deposition Modeling

6. PATTERN ALLOWANCES **2Hrs**

6.1 Shrinkage allowance
6.2 Machining allowance
6.3 Draft allowance
6.4 Rapping allowance
6.5 Distortion allowance

Recommended Textbooks:

1. **Foundry practice By William H Salmon**
2. **Foundry Technology By K.P.Sinha & D.B.Goel**
3. **Foundry Technology By Dr. Fazal Kareem**
4. **Exploring Pattern making and foundry By Harvey D. Minar and John G.Millar**



B) Foundry and Pattern Making:

Instructional Objectives:

(Part a: Foundry)

1. **Explain Molding and molding techniques**
   - 1.1 Explain bedding in molding techniques
   - 1.2 Explain use of two parting surfaces
   - 1.3 Describe molding of loose piece pattern
   - 1.4 Describe use of draw back
   - 1.5 Describe molding with three piece molding box (Cope drag & Cheek)
2. **Explain core and core making**
   - 2.1 Explain core and its type
   - 2.2 Explain different core sand composition and its properties
     - 2.1.1. Green sand core
     - 2.1.2. Dry sand core
   - 2.3 Describe core baking
   - 2.4 Describe solid and hollow core
3. **Explain cupola operations**
   - 3.1 Explain cupola charge and its properties
   - 3.2 Explain charging process of cupola
   - 3.3 Explain tapping and botting of cupola furnace
     - 3.3.1 Tapping bar
     - 3.3.2 Bott stick
     - 3.3.3 Botting clay
     - 3.3.4 Slag hole tapping
     - 3.3.5 Melting zones
   - 3.4 Explain melting and pouring process
4. **Explain Casting Defects**
   - 4.1 Explain blow holes, its causes and remedies
   - 4.2 Explain shrinkage cavity and crack, its causes and remedies
   - 4.3 Describe miss run, its causes and remedies
   - 4.4 Describe mismatch, its causes and remedies
   - 4.5 Describe fins, its causes and remedies

(Part-b: Pattern Making)

5. **Explain pattern making**
   - 5.1 Introduction to pattern making and its importance
   - 5.2 Explain principles of pattern making
   - 5.3 Explain selection of pattern material with respects to material properties
   - 5.4 Explain techniques of pattern constructions
     - 5.4.1 Explain preparation of pattern layout
     - 5.4.2 Explain construction of pattern
   - 5.5 Describe preservation and storage of pattern
   - 5.6 Describe master pattern
   - 5.7 Explain Modern Trends in Pattern Making
     - 5.7.1 Describe working and operation of CNC router

5.7.2 Describe working and operation of Rapid Prototyping Machine
- 5.7.2.1 Stereo lithography (SLA) Machine
- 5.7.2.2 Selective Laser Sintering (SLS) Machine

6. Explain pattern allowances
- 6.1 Explain shrinkage allowance
- 6.2 Explain machining allowance
- 6.3 Explain draft allowance
- 6.4 Describe rapping allowance
- 6.5 Explain distortion allowance

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B) Foundry and Pattern Making:

Practical List:

(Part a: Foundry)

1. **MOLDING** — **12 Hrs**
   - 1.1 Practice of bedding in molding method
   - 1.2 Practice of molding with irregular pattern by CO2 Molding process
   - 1.3 Practice of molding with three piece pattern by CO2 Molding process
2. **CORE MAKING** — **9 Hrs**
   - 2.1 Practice of making round core
   - 2.2 Practice of making half core
   - 2.3 Practice of baking cores and assembling of half cores
3. **CASTING** — **12 Hrs**
   - 3.1 Practice use of pyrometer
   - 3.2 Practice of complete operation of cupola furnace (charging, melting, pouring, casting etc.)
   - 3.3 Practice of Casting of non ferrous metals (Aluminum, Brass, Lead)
4. **CLEANING AND FINISHING OF CASTING** — **6Hrs**
   - 4.1 By hand with the help of
     - 4.1.1 Hammer and chisel
     - 4.1.2 Steel wire brush
     - 4.1.3 Hand Hacksaw
   - 4.2 By Machines
     - 4.2.1 Sand blasting
     - 4.2.2 Hand grinding
     - 4.2.3 Tumbling barrel machine
     - 4.2.4 Surface Roughness Meters
5. **SAND TESTING** — **15 Hrs**
   - 5.1 Moisture contents test
   - 5.2 Clay contents test
   - 5.3 Permeability number test
   - 5.4 Green compressive strength test
   - 5.5 Fineness number of various sand samples
6. **TESTING OF CASTING** — **6 Hrs**
   - 6.1 Practice of detecting the casting defects, like Mismatch, Blow holes, Miss-run, Fins etc.

(Part b:Pattern Making)

7. **Practice of making a pattern for casting a pipe 50mm, 25mm and length 100 mm providing core prints** — **6Hrs**
8. **Practice of making a pattern, on CNC Router Machine, of surface plate 250mmx300mm providing supporting ribs 35mm projected with draft allowance. Also provide shrinkage,**

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Machining and distortion allowances. Ribs must be provided at periphery and diagonally 6 Hrs

9. Practice of making a single piece pattern of any English word from a wood plate 1 x 4 x 7cm providing draft and machining allowances 6 Hrs
10. Application of CNC Router for complex shaped pattern 6 Hrs
11. Preparation of a pattern of Bell or Vase on Rapid Prototyping Machine 6 Hrs
12. Preparation of a pattern of Mobile Case on Rapid Prototyping Machine (3D Printers) 6 Hrs

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C) Advanced Welding:

Course Contents:

1.	TYPES OF WELDING JOINTS	1Hrs
2.	WELDING SYMBOLS / AMERICAN WELDING SOCIETY	1Hr
3.	WELDING POSITIONS	1 Hrs
4.	WELDING TESTS	2Hrs
5.	OXY ACETYLENE GAS WELDING TECHNIQUES	1Hrs
6.	ALUMINUM WELDING	1Hr
7.	COPPER WELDING	1 Hrs
8.	CAST IRON WELDING	1Hrs
9.	OXY ACETYLENE GAS CUTTING	1Hr
10.	TIG WELDING (TUNGSTEN INERT GAS WELDING/ARGON WELDING)	2Hrs
11.	MIG WELDING (METAL INERT GAS WELDING/CO2 WELDING)	2 Hrs
12.	PLASMA ARC CUTTING	1Hr
13.	SAFETY PRACTICE AND PROCEDURE	1 Hrs

Detail of Contents:

1. **TYPES OF WELDING JOINTS** — 1Hr
   - 1.1 Butt Joint
   - 1.2 Lap Joint
   - 1.3 Corner Joint
   - 1.4 T - Joint
2. **WELDING SYMBOLS / AMERICAN WELDING SOCIETY** — 1Hr
   - 2.1 Methods to specify welding information
   - 2.2 Size of Arrow, near side and fore side
   - 2.3 Weld size
   - 2.4 Welding Process/Specifications
3. **WELDING POSITIONS** — 1Hr
   - 3.1 Four positions of welding(Flat, Horizontal, vertical &over head)
   - 3.2 Current Adjustment for each position
   - 3.3 Welding techniques for each position
4. **WELDING TESTS** — 2 Hrs
   - 4.1 Visual examination
   - 4.2 Non-Destructive Test (NDT & DPTs)and its types
   - 4.1 Destructive Test (DT)and its types
5. **OXY ACETYLENE GAS WELDING TECHNIQUES** — 1Hr
   - 5.1 Fore Hand welding Techniques (Right to Left)

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5.2 Back Hand welding Technique (Left to Right)
5.3 Preheating of base metal

6. ALUMINUM WELDING **1Hr**

6.1 Preparation of base metal (cutting, straightening, and cleaning)
6.2 Preheating of base metal
6.3 Application of Flux
6.4 Proper plane for Aluminium welding
6.5 Welding Technique for Aluminum

7. COPPER WELDING **1Hr**

7.1 Weld ability of copper
7.2 Preparation of the base metal
7.3 Preheating of base metal
7.4 Filler material
7.5 Welding technique for copper

8. CAST IRON WELDING **2Hrs**

8.1 Weld ability of cast iron
8.2 Difficulties during welding of cast iron
8.3 Preparation of base metal
8.4 Preheating of base metal
8.5 Application of Flux
8.6 Welding techniques of cast iron

9. OXY ACETYLENE GAS CUTTING **1Hr**

9.1 Gas cutting blow pipes
9.2 Function of the gas cutting torch
9.3 Flame use for gas cutting
9.4 Oxidation process

10. TIG WELDING (TUNGSTUN INERT GAS WELDING/ARGON WELDING) **2Hrs**

10.1 Introduction of TIG welding Machine
10.2 Function of argon Gas
10.3 Arc of Tungsten Electrode
10.4 Current Adjustment for welding process
10.5 Function of the Tungsten Electrode

11. MIG WELDING (METAL INERT GAS WELDING/CO_2 WELDING) **2 Hrs**

11.1 Introduction of MIG welding Machine
11.2 ARC of MIG welding
11.3 Filler metal of MIG welding
11.4 Current adjustment according to size of filler metal
11.5 Function of CO_2 gas

12. PLASMA CUTTING **1 Hr**

12.1 Introduction of Plasma Cutting
12.2 Cut-ability of metals
12.3 Operation of laser cutting techniques

13. SAFETY PRACTICE AND PROCEDURE **1 Hr**

13.1 Electric Arc Welding
13.2 Gas Welding
13.3 Flashback and backfire

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Recommended Textbooks:

1. Arc Welding (Basic Fundamentals) by Johan R. Walkar
2. Welding Technology by O. P. Khanna
3. Oxyacetylene Welding (Basic Fundamentals) by R. B. Gupta, Ronald J. Barid
4. Pipe Welding Techniques by I. Wan H. Edward
5. Fundamentals of Welding Skills by Peter F. Woo

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C) Advanced Welding:

Instructional Objectives:

After study this topic learner will be able to:

1. **TYPES OF WELDING JOINTS**
   - 1.1 Describe the types of joint (Butt, Lap, Corner & Tee Joint)
     - 1.1.1 Open Square Butt Joint
     - 1.1.2 "V" Groove Butt Joint
     - 1.1.3 Half "V" Groove Butt Joint
     - 1.1.4 Double "V" Groove Butt Joint
     - 1.1.5 "U" Groove Butt Joint
     - 1.1.6 "J" Groove Butt Joint
     - 1.1.7 Double "J" Groove Butt Joint
   - 1.2 Describe the position of Lap Joint
   - 1.3 State the position of corner Joint
     - 1.3.1 Inside Corner Joint
     - 1.3.2 Outside Corner Joint/Square Corner Joint
   - 1.4 Define the position "T" Joint for inside / Outside fillet Joint
2. **WELDING SYMBOLS / AMERICAN WELDING SOCIETY**
   - 2.1 Explain the methods specify the welding information
     - 2.1.1 Type of Weld
     - 2.1.2 Size of Weld
     - 2.1.3 Place of Weld
   - 2.2 Explain Basic Welding Symbols
     - 2.2.1 Open Square Butt Joint
     - 2.2.2 "V" Groove Butt Joint
     - 2.2.3 Half "V" Groove Butt Joint
     - 2.2.4 Double "V" Groove Butt Joint
     - 2.2.5 "U" Groove Butt Joint
     - 2.2.6 "J" Groove Butt Joint
     - 2.2.7 Double "J" Groove Butt Joint
   - 2.3 Describe location of Arrow
   - 2.4 Explain Welding Process and their specification
3. **WELDING POSITIONS**
   - 3.1 Explain four positions for welding
     - 3.1.1 Flat Position
     - 3.1.2 Over Head position
     - 3.1.3 Vertical Position (Down to up & Up to Down)
     - 3.1.4 Horizontal Position
   - 3.2 State the current adjustment for above each position
   - 3.3 Describe the welding technique for different position
4. **WELDING TESTS**
   - 4.1 Describe the types of test and visual examination
   - 4.2 Explain the non-destructive Test (NDT) & DPTs
     - 4.2.1 X-rays Test

4.2.2 Gama rays Test
4.2.3 Magna Flux Test
4.2.4 Stethoscope Test

4.3 Explain Destructive Test
4.3.1 Tensile Test
4.3.2 Fatigue Test
4.3.3 Shear Test

5. OXY ACETYLENE GAS WELDING TECHNIQUES

5.1 Describe the Fore hand welding techniques (Right to Left hand)
5.2 Describe Back hand welding techniques (Right to Left hand)
5.3 State the preheating and post weld heat treatment of following base metals
5.3.1 Aluminum
5.3.2 Copper
5.3.3 Cast Iron
5.4 Preheating of welding electrode

6. ALUMINIUM WELDING

6.1 Describe preparation of Base Metal
6.1.1 Straightening of Base Metal pieces
6.1.2 Cleaning of the Base Metal with sand paper
6.1.3 Cleaning of the filler Rod with sand paper
6.2 Describe preheating of base metal
6.2.1 Preheating with carburizing flame
6.2.2 Check the proper preheating of Base Metal
6.3 State the application of flux
6.3.1 Making of paste with water
6.3.2 Application of flux paste on Base Metal and Filler Rod
6.4 Describe the carburizing flame
6.5 Explain the fore hand welding Techniques

7. COPPER WELDING

7.1 Describe weld ability of copper
7.2 State pre heating of base metal
7.3 State filler material
7.4 Describe the welding technique use for copper

8. CAST IRON WELDING

8.1 Describe weld ability of Cast Iron
8.2 Explain the difficulties of welding process raised due to heavy quantity of carbon
8.3 State preheating of base metal
8.4 Describe the applications of flux
8.5 State the welding technique used for casting iron welding

9 OXY ACETYLENE GAS CUTTING

9.1 Explain the construction of gas cutting torch
9.2 State the types of flame
9.2.1 Neutral Flame
9.2.2 Oxidizing Flame
9.3 Explain the process of oxidation of metal / cutting process

10 TIG WELDING (TUNGSTEN INERT GAS WELDING/ORGAN WELDING)

10.1 Describe construction/operation of TIG welding machine
10.2 Describe the Arc of Tungsten Electrode
10.3 State the function of organ gas
10.4 Describe the current adjustment

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10.5 State the function of Tungsten electrode

11 MIG WELDING (METAL INERT GAS WELDING/CO_2 WELDING)

11.1 Describe the construction and operation of the MIG welding machine
11.2 Describe the Arc of MIG welding machine
11.3 Describe the filler metal use for MIG welding
11.4 State the current adjustment
11.5 Explain the function of CO_2 gas

12. PLASMA CUTTING

12.1 Describe the introduction of Plasma cutting
12.2 Describe the function of plasma cutting machine
12.3 Describe the cut-ability of different metals, like aluminum, mild steel, stainless steel
12.4 Explain the operations of plasma cutting techniques

13. UNDERSTAND SAFETY PRACTICE AND PROCEDURE

13.1 Observe Safety Practice and Procedures in Electric Arc Welding Shop
13.2 Observe Safety Practice and Procedures in Oxy Acetylene Gas Welding Shop

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Mech-246 WORKSHOP PRACTICE-II

C) Advanced Welding:

List of Practical:

1.	Double "V" Butt Joint by Arc welding	10 Hours
2.	Fillet joint inside corner by Arc welding	9 Hour
3.	"T" Fillet joint	9 Hour
4.	Pipe welding having Nominal size ø 3 inch Sch. 40	12 Hours
5.	Visual examination of pipe welded joint	8 Hour
6.	Aluminum Butt joint (oxyacetylene gas welding)	9 Hours
7.	Cast Iron Butt Joint by Oxyacetylene gas welding	9 Hours
8.	Oxy-acetylene Gas cutting of mild steel(Ferrous metals)	6 Hour
9.	TIG Welding	6 Hours
10.	MIG Welding	6 Hours
11.	PLASMA ARC CUTTING(Ferrous & Non- ferrous metals)	8 Hour

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Mech-262 METALLURGY

Total Contact Hours
Theory: 32Hrs
Practical: 96 Hrs

T	P	C
2	0	2

Pre-requisites : None

AIMS: This subject deals with the Metallurgy concepts that influence Mechanical and physical properties of Metals and Alloys. The student acquire knowledge of ores and the methods of dressing them which enhances his knowledge regarding different operations carried out in the recovery of ferrous and non-ferrous metals from their ores. The students gains also knowledge of different steel making processes. The student will also acquire knowledge of various shaping, farming, rolling methods. It will also enhance the knowledge Die-casting process of metals and powder metallurgy.

Course Contents:

1.	INTRODUCTION TO METALLURGY	2 Hrs
2.	ORES	2 Hrs
3.	PRODUCTION PROCESS	2 Hrs
4.	REFRACTORY MATERIALS	4 Hrs
5.	TREATMENT OF IRON ORES	3 Hrs
6.	PRE-SMELTING TREATMENT OF ORES	4 Hrs
7.	BLAST FURNACE	5 Hrs
8.	MANUFACTURING OF WROUGHT IRON	4 Hrs
9.	STEEL MANUFACTURING PROCESSES	9 Hrs
10.	TYPES OF STEEL	4 Hrs
11.	NON FERROUS METALS	5 Hrs
12.	INDUSTRIAL SHAPING OF METALS	10 Hrs
13.	DIE-CASTING	4 Hrs
14.	POWDER METALLURGY	6 Hrs

Detail of Contents:

1. **INTRODUCTION TO METALLURGY** — **2 Hrs**
   - 1.1 Definition and Classification
   - 1.2 Scope of Metallurgy
2. **ORES** — **2 Hrs**
   - 2.1 Definition of ore
   - 2.2 Iron ores and its occurrence in nature
   - 2.3 Natural resources of iron ores in Pakistan

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2.4 Classification and evaluation of iron ores

3. PRODUCTION PROCESS — **2 Hrs**

3.1 Reduction and oxidation
3.2 Acid and Base in Metallurgical terminology

4. REFRACTORY MATERIALS — **4 Hrs**

4.1 Definition and classification
4.2 Acid refractory materials
4.3 Basic refractory materials
4.4 Neutral refractory materials

5. TREATMENT OF IRON ORES — **3 Hrs**

5.1 Hand picking
5.2 Magnetic separation
5.3 Gravity separation
5.4 Roasting and calcinations
5.5 Froth floatation

6. PRE-SMELTING TREATMENT OF ORES — **4 Hrs**

6.1 Concentration
6.2 Agglomeration
- 6.2.1 Sintering
- 6.2.2 Pelletizing
- 6.2.3 Nodulizing

7. BLAST FURNACE — **5 Hrs**

7.1 Construction of blast furnace
7.2 Composition of the charge
7.3 Charging and working operations of the Blast Furnace
7.4 Chemical Reaction
7.5 Zones of Blast Furnace
7.6 Taping of molten metal
7.7 Preheating plant for Blast Furnace
7.8 Pig iron properties and uses

8. MANUFACTURING OF WROUGHT IRON — **4 Hrs**

8.1 Classification of Puddling furnace
8.2 Charge of Puddling furnace
8.3 Simple operation of Puddling furnace
8.4 Construction of Puddling furnace
8.5 Uses of wrought iron

9. STEEL MANUFACTURING PROCESSES — **9 Hrs**

9.1 Chemistry of steel refining
- 9.1.1 Raw Material
- 9.1.2 Constituents of each raw material
- 9.1.3 Chemical Reactions

9.2 Open Hearth Furnace.
- 9.2.1 Construction and working of an Open Hearth Furnace
- 9.2.2 Acid process
- 9.2.3 Basic Process

9.3 Bessemer Convertor
- 9.3.1 Construction of convertor
- 9.3.2 Charge of the convertor
- 9.3.3 Operation of Bessemer convertor

9.4 Electric Arc Furnace
- 9.4.1 Types of Electric Furnaces

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9.4.2 Construction of Electric Furnaces
9.4.3 Charging of Electric Arc Furnaces
9.4.4 Operation of Electric Arc Furnaces
9.4.5 Oxidation period
9.4.6 Addition of Alloying elements and tapping.
9.4.7 Duplex operation.

9.5 Quality and Capacity of Steel

10. TYPES OF STEEL **4 Hrs**

10.1 Carbon steels.
10.2 Types of plain Carbon Steel
10.3 International Designations for Steel(SAE, DIN, JIS, AISI)
10.4 Alloy steels
10.5 Alloying elements of steel and their effects
10.6 Application of carbon and alloy steels.
10.7 Eutectoid steel.
10.8 Inter-metallic compound

11. NON FERROUS METALS **5 Hrs**

11.1 Properties and uses of non ferrous metals
11.2 Ores of non ferrous metals
11.3 Extraction of non ferrous metals

12. INDUSTRIAL SHAPING OF METALS& ALLOYS **10 Hrs**

12.1 Hot working processes.
12.1.1 Rolling
12.1.2 Forging
12.1.3 Drop forging
12.1.4 Heading
12.1.5 Hot pressing
12.1.6 Extrusion

12.2 Cold working process.
12.2.1 Rolling
12.2.2 Drawing
12.2.3 Pressing
12.2.4 Deep drawing
12.2.5 Coining
12.2.6 Spinning
12.2.7 Thread forming
12.2.8 Piercing

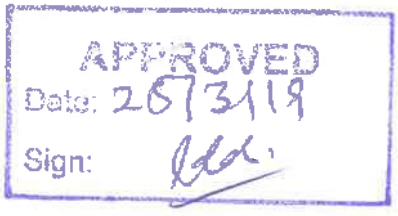
12.3 Production of pipes
12.3.1 Methods of pipe manufacturing
12.3.2 Casting and forming methods

13. DIE-CASTING **4 Hrs**

13.1 Die casting and its uses
13.2 Materials of dies
13.3 Die casting machines and their functions

14. POWDER METALLURGY **6 Hrs**

14.1 Introduction to powder Metallurgy
14.2 Powder manufacturing methods
14.3 Properties of Powder
14.4 Fabricating procedure and Secondary operations
14.5 Application o f Powder Metallurgy



Recommended Textbooks:

1. Engineering Metallurgy by Higgins Part I & II
2. Physical and Chemical Metallurgy by JE GARSIDE
3. Physical metallurgy by AVNER
4. Elementary Metallurgy by Frier
5. Metallurgy of Iron and Steel by Bradley
6. Elementary Metallurgy and Metallography by Sharager

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Mech-262 METALLURGY

Instructional Objectives:

1. **INTRODUCTION TO METALLURGY**
   - 1.1 Know definition and classification
     - 1.1.1 Define Metallurgy
     - 1.1.2 State relationship of metallurgy with chemistry
     - 1.1.3 State classification of metallurgy
   - 1.2 Know scope of metallurgy
     - 1.2.1 Describe importance of metallurgy in engineering field
     - 1.2.3 Describe specific importance w.r.t. steel industry

2. **ORES**
   - 2.1 Know fundamentals
     - 2.1.1 Define ore and its types
     - 2.1.2 Describe Quality of good ore
     - 2.1.3 Select proper ore for extraction of metal
   - 2.2 Know Iron ores and their occurrence in nature
     - 2.2.1 List types of iron ore
     - 2.2.2 Describe each type
     - 2.2.3 List the world ore deposits along with its Quality
   - 2.3 Know the natural ore deposits in Pakistan
     - 2.3.1 Enlist the Pakistan ore deposits along with its quantity and quality
   - 2.4 Classification and evaluation of iron ores
     - 2.4.1 Describe economic use of ores in Pakistan for making of steel
     - 2.4.2 Describe iron ore needs for Pakistan steel Karachi

3. **PRODUCTION PROCESSES**
   - 3.1 Understand Reduction and Oxidation
     - 3.1.1 Define Reduction and Oxidation
     - 3.1.2 Enlist different methods
     - 3.1.3 Explain each method
   - 3.2 Understand Acid and Basic process in Metallurgical Terminology
     - 3.2.1 Define acid and base in metallurgy
     - 3.2.2 Describe the effects of acid and basic process in metallurgy
     - 3.2.3 Explain how to control the negative effects

4. **REFRACTORY MATERIAL**
   - 4.1 Understand classification of refractory materials
     - 4.1.1 Define refractory material
     - 4.1.2 Enlist the types of refractory material
     - 4.1.3 Explain the Quality of a refractory material
   - 4.2 Understand acidic refractory materials
     - 4.2.1 Define acidic refractory material
     - 4.2.2 Explain its importance and use
   - 4.3 Understand basic refractory materials
     - 4.3.1 Define basic refractory materials
     - 4.3.2 Explain its use and importance
   - 4.4 Understand neutral Refractory materials
     - 4.4.1 Define neutral refractory material
     - 4.4.2 Explain its use and importance

5. **TREATMENT OF IRON ORE**
   - 5.1 Understand hand picking

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5.1.1 Define Hand picking
5.1.2 Explain Hand picking process

5.2 Understand Magnetic Separation
5.2.1 Define magnetic Separation
5.2.2 Explain magnetic separation process

5.3 Understand Gravity separation
5.3.1 Define gravity separation
5.3.2 Explain gravity separation process

5.4 Understand roasting and calcination
5.4.1 Define roasting and calcination
5.4.2 Explain roasting and calcinations process

5.5 Understand froth floatation
5.5.1 Define froth floatation
5.5.2 Explain froth floatation process

6. PRESMELTING TREATMENT OF IRON ORES

6.1 Understand pre-smelting treatment of ores
6.1.1 Explain concentration

6.2 Explain agglomeration
6.2.1 Explain Sintering
6.2.2 Explain Pelletizing
6.2.3 Explain Nodulizing

7. BLAST FURNACE

7.1 Understand Blast Furnace
7.1.1 Explain the construction of a Blast Furnace

7.2 Understand the composition of the charge in Blast Furnace
7.2.1 Describe the composition of the Charge of the Blast Furnace
7.2.2 Describe the quantity of ore required to be fed
7.2.3 Explain the escape of hot gases through chimney

7.3 Understand the charging and operation of Blast Furnace
7.3.1 Explain the charging procedure of Blast Furnace
7.3.2 Explain the working operation of Blast Furnace

7.4 Understand the Chemical reactions in Blast Furnace
7.4.1 Describe different chemical reactions in the Blast Furnace

7.5 Understand the zones of Blast Furnace
7.5.1 Explain the different zones of Blast Furnace

7.6 Understand the tapping of molten metal
7.6.1 Describe the tapping of PIG iron through Blast Furnace

7.7 Understand the preheating plant for Blast Furnace
7.7.1 Describe the use of preheating of air for Blast Furnace
7.7.2 Explain the plant for preheating the air ancillary plant
7.7.3 Explain the refractory bricks used in ancillary plant
7.7.4 Explain flow of hot gases from Blast Furnace to ancillary plant
7.7.5 Explain flow of hot air from ancillary plant to Blast Furnace

7.8 Understand PIG Iron properties and its uses
7.8.1 Define PIG Iron
7.8.2 Explain properties of pig iron
7.8.3 Explain uses of pig iron
7.8.4 Describe types of pig iron obtained from Blast Furnace

8. MANUFACTURING OF WROUGHT IRON

8.1 Understand the classification of Puddling Furnace
8.1.1 Enlist the types of Puddling Furnace

8.2 Understand the charge of Puddling Furnace

8.2.1 Describe the raw materials used for wrought iron in puddling furnace
8.2.2 Describe the capacity of Puddling furnace
8.3 Understand the Charging and Working Operation of Puddling Furnace
8.3.1 Explain the Charging and Working Operation of Puddling Furnace
8.4 Understand the construction of Puddling Furnace
8.4.1 Explain the construction of Puddling Furnace
8.5 Understand the uses of Wrought Iron
8.5.1 Define Wrought Iron
8.5.2 Describe its properties
8.5.3 Explain uses of Wrought Iron

9. STEEL MANUFACTURING PROCESSES

9.1 Know basic chemistry of steel manufacturing
9.1.1 List the raw material used for steel manufacturing.
9.1.2 Describe the constituents of each raw material.
9.1.3 Describe chemical reactions taking place in steel manufacturing furnace
9.2 Understand open hearth process
9.2.1 Describe the construction of Open Hearth Furnace
9.2.2 Describe the operation inside Open Hearth Furnace
9.2.3 Describe charging/discharging of Open Hearth Furnace
9.2.4 Describe fuel supply/heating of Open Hearth Furnace
9.2.5 Explain refractory lining of Open Hearth Furnace
9.2.5.1 Describe refractory lining of Open Hearth Furnace for Acid Process
9.2.5.2 Describe refractory lining of Open Hearth Furnace for Basic Process
9.2.6 Describe quality of steel obtained through Open Hearth Furnace
9.2.7 Estimate the quantity of steel produced by O.H. Furnace in Pakistan and the world
9.3 Understand Bessemer converter
9.3.1 Describe the construction of Bessemer converter
9.3.2 Describe charging of converter
9.3.3 Describe oxidation process in convertor
9.3.3.1 Explain alloying of steel in the converter
9.3.3.2 Describe discharging of the convertor
9.3.3.3 Describe the converter used in Pakistan Steel (L.D. converter)
9.3.3.4 Explain the difference between L.D. convertor and Bessemer convertor
9.4 Understand Electric Arc Furnaces
9.4.1 Describe the types of electric arc furnaces (Direct Arc Furnace & Indirect Arc Furnace)
9.4.2 Describe the parts of electric arc furnaces
9.4.3 Explain the charging of electric arc furnaces
9.4.4 Explain the working operation of electric arc furnaces
9.4.5 Describe the oxidation period during steel making
9.4.6 (i)Describe the alloying elements added during steel making
(ii)Describe the tapping of steel
9.4.7 Describe the Duplex Operation

10. TYPES OF STEEL

10.1 Know difference between steel and iron
10.1.1 Define steel
10.1.2 Define iron
10.1.3 Difference between steel and iron
10.2 Understand Types of Plain Carbon Steel

10.2.1 List the types of plain carbon steel
10.2.2 Define each type
10.2.3 Describe the properties of each
10.2.4 Explain the uses of each carbon steel

10.3 Understand alloy steel
10.3.1 Describe alloy steel
10.3.2 Explain the types of alloy steel
10.3.3 Describe the uses of different alloy steels
10.3.4 Describe tool steel
10.3.5 Define stainless steel
10.3.6 Explain the properties of stainless steel

10.4 Know alloying elements and their effects on steel
10.4.1 Describe the effects of alloying elements on steel (Ni, Cr, C, Va, W, Mn, Co, Mb etc.)

10.5 Understand applications of carbon and alloy steels
10.5.1 Explain the uses of each carbon steel
10.5.2 Describe the uses of different alloy steel

10.6 Understand the Eutectoid Steel
10.6.1 Describe the Eutectoid steel and its types

10.7 Understand the inter metallic compound
10.7.1 Describe the inter metallic compound

11. NON FERROUS METALS.

11.1 Know non ferrous metals
11.1.1 Define a non ferrous metal
11.1.2 List common non ferrous metals
11.1.3 Describe the properties and uses of non-ferrous metal

11.2 Understand Ores of non ferrous metals
11.2.1 Enlist various non-ferrous ores
11.2.2 Describe the use of different non-ferrous ores and their importance

11.3 Understand Extraction of Non ferrous metals
11.3.1 Enlist ores of Cu, Al and Zn.
11.3.2 Explain methods of extraction of Cu, Al and Zn.

11.4 Describe the Cu, Al and Zn based alloys and their uses

12. INDUSTRIAL SHAPING OF METALS& ALLOYS

12.1 Know hot working processes
12.1.1 Define Hot working processes (hot rolling)
12.1.2 Describe Hot forging
12.1.3 Describe Drop forging
12.1.4 Explain Heading
12.1.5 Describe Hot Pressing
12.1.6 Explain Extrusion

12.2 Understand cold working processes
12.2.1 Define cold working processes and describe cold rolling, cold forging processes
12.2.2 Describe Drawing
12.2.3 Describe Cold pressing
12.2.4 Explain the Deep drawing
12.2.5 Explain Coining
12.2.6 Explain Spinning
12.2.7 Describe thread forming
12.2.8 Describe Piercing

12.3 Understand production of pipes
12.3.1 State methods of manufacturing of pipes
12.3.2 Explain pipe manufacturing by casting and forming methods

13. DIE CASTING

13.1 Understand Die-casting and its uses

- 13.1.1 State Die-casting
- 13.1.2 Explain uses of Die-casting

13.2 Understand the materials of Dies

- 13.2.1 Name the materials of dies used in Die Casting and their properties

13.3 Understand Die Casting Machine

- 13.3.1 Describe the die casting machines (hot chamber, cold chamber and goose neck die casting machines)
- 13.3.2 Explain Die casting process step by step

14. POWDER METALLURGY

14.1 Understand Powder metallurgy

- 14.1.1 Define powder metallurgy and uses

14.2 Understand powder manufacturing methods

- 14.2.1 Explain the methods of making powder and their properties

14.3 Understand properties of powder

- 14.3.1 Describe the properties of metal powders

14.4 Understand fabricating procedure and secondary operation

- 14.4.1 Explain the fabricating procedures (Compacting, Sintering)
- 14.4.2 Explain secondary operations

14.5 Understand powder metallurgy applications

- 14.5.1 Explain the uses of powder metallurgy products Differentiate powder metallurgy methods from other production methods

Mech-272 **METROLOGY**

Total Contact Hours
Theory: 32Hrs
Practical: 96 Hrs

T	P	C
1	3	2

Pre-requisites:MT-117 (Workshop Practice I)

AIMS: The subject is connected with the methods of measurements based on agreed International Standards and units. The practice in the subject requires the use of apparatus and equipment which include measuring instruments, laying-out Tools, Supporting Tools, necessary to adjust at the degree of accuracy required.

Course Contents:

1.	INTRODUCTION TO MEASUREMENT AND QUALITY CONTROL	4Hrs
2.	LINEAR MEASUREMENTS SUPPORTING TOOLS	2Hrs
3.	GAUGES	2 Hrs
4.	ADJUSTABLE MEASURING TOOLS	3 Hrs
5.	ANGLE MEASURING TOOLS	3 Hrs
6.	PRECISION MEASURING INSTRUMENTS	3 Hrs
7.	ACCURACY IN MEASUREMENTS	2 Hrs
8.	DIAL INSTRUMENTS	2 Hrs
9.	TAPER MEASUREMENTS	1 Hr
10.	OPTICAL MEASUREMENTS	2 Hrs
11.	COMPARATORS	2 Hrs
12.	DIGITAL INSTRUMENTS	1 Hr
13.	COORDINATE MEASURING MACHINE	3Hrs
14.	GEAR MEASUREMENTS	2 Hrs

Detail of Contents:

1. INTRODUCTION TO MEASUREMENT AND QUALITY CONTROL **4Hrs**

- 1.1 History of measurements
- 1.1 Importance and purpose of measurements
- 1.2 Quality control and its importance in metrology
- 1.3 S.I Units
- 1.4 ISO Standards
- 1.5 Fits, Tolerance & Allowance
- 1.6 Geometric Tolerance

2. LINEAR MEASUREMENTS SUPPORTING TOOLS **2Hrs**

- 2.1 Cast iron surface plate
- 2.2 Granite Surface plate

2.3 Glass surface plate
2.4 Straight edges
2.5 Spirit levels
2.6 Engineer's parallels
2.7 Universal Surface Gauge

3. GAUGES — **2 Hrs**

3.1 Ring gauge
3.2 Plug gauge
3.3 Snap gauge
3.4 Radius gauge
3.5 Angle gauge
3.6 Screw-pitch Gauge
3.7 Standard wire gauge
3.8 Feeler Gauge

4. ADJUSTABLE MEASURING TOOLS — **3 Hrs**

4.2 Vernier Caliper
4.3 Micro meter
4.4 Dial Indicator

5. ANGLE MEASURING TOOLS — **3 Hrs**

5.1 Fixed angle measuring tool
5.2 Angle gauges
5.3 Adjustable angle measuring tools
- 5.3.1 With out graduations
- 5.3.2 With graduations

6. PRECISION MEASURING INSTRUMENTS — **3 Hrs**

6.1 Vernier height gauge
6.2 Vernier depth gauge
6.3 Inside Micrometer
6.4 Depth Micrometer
6.5 Thread Micrometer
6.6 Hot gauge Micrometer
6.7 Vernier Micrometer

7. ACCURACY IN MEASUREMENTS — **2 Hrs**

7.1 Elements of Metrology
7.2 Classification of Errors
- 7.2.1 Controllable errors
- 7.2.2 Random errors

7.3 Calibration
7.4 Repeatability

8. DIAL INSTRUMENTS — **2 Hrs**

8.1 Dial Caliper
8.2 Dial thickness gauge
8.3 Dial bore gauge

9. TAPER MEASUREMENTS — **1 Hr**

9.1. Gauge Block
9.2. Sine Bar

10. OPTICAL MEASUREMENT — **2 Hrs**

10.1 Tool Makers Micro Scope

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10.2 Profile Projector/Shadow Graph (50 X)
10.3 Optical Flats

11. COMPARATORS — **2 Hrs**
- 11.1 Mechanical Comparator
- 11.2 Electrical Comparator
- 11.3 Electronic Comparator

12. DIGITAL INSTRUMENTS — **1 Hr**
- 12.1 Digital Micrometer
- 12.2 Digital Caliper
- 12.3 Digital Indicator
- 12.4 Digital Depth Gauge
- 12.5 Digital Height Gauge
- 12.6 Digital Read Out (DRO)
- 12.7 Digital Roughness Tester

13. COORDINATE MEASURING MACHINE — **3Hrs**
- 13.1 Working principle of CMM and its coordinates
- 13.2 Part and Accessories
- 13.3 Use of CMM
- 13.4 Digital 3D Scanner

14. GEAR MEASUREMENT — **2 Hrs**
- 14.1 Gear Testing machine
- 14.2 Backlash Measurement

Recommended Textbooks:

1. **Shop Theory by Anderson**
2. **Engineering Metrology by R.K Jane**
3. **Production Technology by R.B Gupta**
4. **Dimensional Metrology by Ted. Busch, Roger Horlow**

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Mech-272 METROLOGY

Instructional Objectives:

1. **INTRODUCTION TO MEASUREMENTS**
   - 1.1 State history of measurements
   - 1.2 Describe importance and purpose of measurements
   - 1.3 Describe quality control and its importance in metrology
   - 1.4 Describe S.I units
   - 1.5 Describe ISO standard
   - 1.6 Describe fits , tolerance, allowances
   - 1.7 Describe geometric tolerance
2. **UNDERSTAND LINEAR MEASUREMENT SUPPORTING TOOL**
   - 2.1 Describe Cast-iron Surface plate
   - 2.2 Describe Granite Surface plate
   - 2.3 Describe Glass Surface plate
   - 2.4 Describe Straight edges
   - 2.5 Describe Spirit levels
   - 2.6 Describe Engineers parallels
   - 2.7 Explain Universal Surface Gauge
3. **KNOW ABOUT GAUGES**
   - 3.1 Describe the ring gauge and its uses
   - 3.2 Describe the plug gauge and its uses
   - 3.3 Describe the snap gauge and its uses
   - 3.4 Describe the radius gauge and its uses
   - 3.5 Describe the angle gauge and its uses
   - 3.6 Describe screw pitch gauge
   - 3.7 Describe the use of standard wire gauge
   - 3.8 Describe the use of feeler gauge
4. **UNDERSTAND ADJUSTABLE MEASURING TOOLS**
   - 4.1 Explain the construction and use of vernier Caliper
   - 4.2 Explain the construction and use of Micrometer
   - 4.3 Explain the construction and use of Dial Indicator
5. **UNDERSTAND ANGLE MEASURING TOOLS**
   - 5.1 Describe the use of following fixed angle Measuring Tools
     - 5.1.1 Centre Square
     - 5.1.2 Combination square
     - 5.1.3 Try Square
     - 5.1.4 Double Square
     - 5.1.5 Die maker Square
     - 5.1.6 Engineer Square
   - 5.2 Describe the use of following angle gauges
     - 5.2.1 Thread gauges
     - 5.2.2 Grinding gauges
     - 5.2.3 Tool angle Gauge
     - 5.2.4 Drill gauges
     - 5.2.5 Drill point Gauge
   - 5.3 Discuss adjustable angle measuring tools
     - 5.3.1 Without graduations
       - 5.3.1.1 Sine bar

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5.3.1.2 Universal bevel
5.3.1.3 Combination bevel

5.3.2 With Graduations

5.3.2.1 Bevel protractor
5.3.2.2 Vernier bevel protractor
5.3.2.3 Steel protractor
5.3.2.4 Dial protractor

6. EXPLAIN FOLLOWING PRECISION MEASURING INSTRUMENTS

6.1 Explain Vernier Height gauge
6.2 ExplainVernier depth gauge
6.3 Explain Inside Micrometer
6.4 Explain Micrometer depth gauge
6.5 Thread Micrometer
6.6 Explain Hot gauge Micrometer
6.7 ExplainVernier Micrometer

7. ACCURACY IN MEASUREMENT

7.1 State five basis Metrology Elements
7.2 Explain classification of Errors
7.2.1 Controllable Errors
7.2.2 Random Errors
7.3 Explain Calibration and its need
7.4 Explain Repeatability

8. UNDERSTAND THE DIAL INSTRUMENTS

8.1 Describe the use of Dial Caliper
8.2 Describe the use of Dial thickness gauge
8.3 Describe the use of Dial bore gauge

8. TAPER MEASUREMENTS

1.1 Describe the use of Gauge Blocks
1.2 Describe the use of Sine Bar

9. OPTICAL MEASUREMENTS

10.1 Discuss the use of Tool Makers Microscope
10.2 Discuss the use of Optical flats
10.3 Discuss the use of Profile projector

10. DESCRIBE THE USE OF FOLLOWING COMPARATORS

11.1 Mechanical comparator
11.2 Electronic comparator
11.3 Electrical comparator

11. DESCRIBE THE USE OF FOLLOWING DIGITAL INSTRUMENTS

12.1 Digital Micrometer
12.2 Digital Caliper
12.3 Digital indicator
12.4 Digital Depth Gauge
12.5 Digital height Gauge
12.6 Digital Readout
12.7 Digital Roughness Meter

12. COORDINATE MEASURING MACHINE

13.1 Describe the coordinates of CMM
13.2 Describe the accessories of CMM
13.3 Describe the use of CMM

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13.4 Describe the use of 3-D scanner

13. GEAR MEASUREMENT

14.1 Describe about gear testing machine

14.2 Describe about backlash measurement

Mech-272 **METROLOGY**

List of Practical:

1. **PRACTICE OF FOLLOWING GRADUATED TOOLS** — 3Hrs
   - 1.1 Steel Rule
   - 1.2 Hook Rule
   - 1.3 Folding Rule
   - 1.4 Trammels
2. **PRACTICE OF COMBINATION SET** — 3Hrs
3. **PRACTICE OF FOLLOWING SUPPORTING TOOLS** — 3Hrs
   - 3.1 Cast Iron, Granite, and Glass Surface Plates
   - 3.2 Straight Edge
   - 3.3 Spirit level
   - 3.4 Engineer's level
   - 3.5 Engineer's parallel
4. **PRACTICE OF FOLLOWING GAUGES** — 6 Hrs
   - 4.1 Fixed gauges
   - 4.2 Adjustable gauges
   - 4.3 Small hole gauges
   - 4.4 Telescope gauges
5. **PRACTICE AND USE OF FOLLOWING PRECISION INSTRUMENTS** — 12 Hrs
   - 5.1 Outside Micrometer
   - 5.2 Inside Micrometer
   - 5.3 Depth Micrometer
   - 5.4 Thread Micrometer
   - 5.5 Vernier Micrometer
6. **PRACTICE AND USE OF VERNIER TOOLS** — 9Hrs
   - 6.1 Vernier caliper
   - 6.2 Vernier Height gauge
   - 6.3 Vernier depth gauge
7. **PRACTICE AND USE OF FOLLOWING ANGLE MEASURING TOOLS** — 6 Hrs
   - 7.1 Bevel protractor
   - 7.2 VernierBevel protractor
   - 7.3 Dial protractor
   - 7.4 Steel protractor
   - 7.5 Sine bar
8. **CALCULATION RELATING TO TOLERANCE AND ALLOWANCE** — 3 Hrs
9. **PRACTICE AND USE OF FOLLOWING DIAL INSTRUMENTS** — 3 Hrs
   - 9.1 Dial Caliper
   - 9.2 Dial Thickness gauge
   - 9.3 Dial Indicator
10. **PRACTICE AND USE OF GAUGE BLOCKS** — 6 Hrs
11. **PRACTICE OF TOOL MAKERS MICROSCOPE** — 6 Hrs
12. **PRACTICE OF PROFILE PROJECTOR** — 3 Hrs

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13. PRACTICE AND USE OF FOLLOWING COMPARATORS **9Hrs**

13.1 Mechanical comparator
13.2 Electronic comparator
13.3 Electrical comparator

14. PRACTICE AND USE OF DIGITAL INSTRUMENTS **6 Hrs**

14.1 Digital Micrometer
14.2 Digital Caliper
14.3 Digital Indicator
14.4 Digital Depth Gauge
14.5 Digital Height Gauge

15. PRACTICE OF MEASUREMENT ON CMM **9 Hrs**

15.1 Point to point/linear measurement
15.2 Profile measurement (2D, 3D)

16. PRACTICE OF THREAD AND GEAR MEASUREMENT **9 Hrs**

16.1 Thread gauges
16.2 Gear Tooth Caliper
16.3 Gear Testing Machine

Note:-Quarterly Industrial visit must be arranged for observing physically, the use of above inspection tools/instruments in quality control lab.

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REVISED CURRICULUM

OF

DIPLOMA OF ASSOCIATE ENGINEER

IN

MECHANICAL TECHNOLOGY

(THIRD YEAR)

REVISED, 2019

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Revised Scheme of Studies D.A.E. 3RD Year Mechanical

Code		Subject	Hrs	T	P	C
Gen	311	Islamiat and Pak Studies	32	1	0	1
IMH	301	Industrial Management and Human Relations	32	1	0	1
Mech.	302	Fluid Mechanics & Hydraulics Machines	128	1	3	2
Mech.	313	Applied Thermodynamics	128	2	3	3
Mech.	321	Industrial Planning and Production Methods	32	1	0	1
Mech.	333	Machine Design & Analysis	160	2	3	3
Mech.	363	Tool& Mould Design	160	2	3	3
Mech.	332	Materials Testing and Heat Treatment	128	1	3	2
Mech.	354	Workshop Practice – III	256	2	6	4
Mech.	352	CAD/CAM	128	1	3	2
Mech.	372	CNC Machines	128	1	3	2
TOTAL				15	27	24

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Gen-311

ISLAMIAT AND PAK-STUDY

APPROVED
Date: 25/8/19
Sign:

اسلامیات/مطالعہ پاکستان

نصاب (سال سوم)

			ٹی	پی	سی
حصہ اول	اسلامیات	Gen 311	1	0	1
حصہ دوم	مطالعہ پاکستان				

کل وقت 20 گھنٹے

موضوعات

1 قرآن مجید

سورۃ الفاتحہ۔ آیۃ الکرسی۔ سورۃ البقرہ کی آخری آیات از امن الرسول تا آخر اور سورہ اخلاص معہ ترجمہ و تشریح

2 دس منتخب احادیث معہ ترجمہ و تشریح

- بنی الاسلام علیٰ خمس شہادۃ ان لا الہ الا اللہ و اقام الصلوۃ و ایتاء الزکوۃ و حج البیت وصوم رمضان
- الدین النصیحہ
- المستشار المؤتمن
- للمومن علی المومن ست خصال یعودہ اذا مرض و یشمتہ اذا مات ویجیبہ اذا دعاہ ویسلم علیہ اذا لقیہ و یشمت اذا عطس و ینصح لہ اذا غاب او شہد لا تخن من خانک
- لا یدخل الجنۃ قاطع
- ان اللہ حرم علیکم عقوق الامہات و اضاعۃ المال
- یسرا ولا تعسرا بشرا ولا تنفرا
- ذاق طعم الایمان من رضی باللہ و بالاسلام دینا و بمحمد نبیاً
- افضل الذکر لا الہ الا اللہ

3 حقوق و فرائض

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

4 اسلام کی اخلاقی اقدار

صبر و استقلال۔ عفو و درگزر۔ ایفائے عہد۔ اخوت۔ ایثار و قربانی

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نصاب اخلاقیات (غیر مسلم طلباء کے لئے)

ٹی	پی	سی
1	0	1

سال سوم Gen-311

کل وقت 20 گھنٹے

موضوعات

- احساس ذمہ داری
- مثبت ذہن
- عدل وانصاف
- قومی خدمت کا جذبہ
- فکر ونظر کی پاکیزگی
- احترام آدمیت
- شائستگی
- عفو ودرگذر
- بردباری
- خود انحصاری
- ایثر ونفوذ
- جامعیت
- اپنی ذات کی معرفت (بذریعہ ہم عصر طلباء۔ اساتذہ۔ اہم شخصیات، ادارہ)

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منتخب احادیث

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

خصوصی مقاصد

- احادیث کا ترجمہ بیان کر سکے۔
- احادیث کی تشریح کر سکے۔
- معاشرتی اور انفرادی زندگی میں احادیث سے 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۔
- ہمسائیوں کے حقوق بیان کر سکے۔
- اسلام میں حقوق و فرائض کی اہمیت بیان کر سکے۔
- حقوق و فرائض کی آگاہی 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 ہوتا 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 درگذر کی اہمیت بیان کر سکے۔
- ایفائے عہد کی اہمیت بیان کر سکے۔
- اخوت کے معنی و مفہوم کو بیان کر سکے۔
- اخوت اسلامی کی اہمیت بیان کر سکے۔
- اسلام کی اعلیٰ اقدار کو اپنا کر مثالی معاشرہ پیدا کر سکے۔

نصاب (سال سوم)

مطالعہ پاکستان	Gen-311	ئی	پی .	سی
		1	0	1

حصہ دوم

کل وقت 12 گھنٹے

قیام پاکستان

موضوعات

- باؤنڈری کمیشن
- ریڈکلف ایوارڈ
- تقسیم بنگال وکلکتہ
- تقسیم پنجاب
- مسئلہ مہاجرین
- ریاستوں کا الحاق
- ریاست جموں وکشمیر
- نہری پانی کا تنازعہ
- قرارداد مقاصد
- علماء کے بائیس نکات
- 1956 - 1962 اور 1973 کے دساتیر کی اسلامی دفعات
- پاکستان کا محل وقوع اور اس کی جغرافیائی اہمیت
- قدرتی وسائل (تیل، گیس، کوئلہ)

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مطالعہ پاکستان

حصہ دوم

قیام پاکستان

تدریسی مقاصد

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

خصوصی مقاصد:

- باؤنڈری کمیشن کی تشکیل اور اس کے فرائض بیان کر سکے۔
- ریڈکلف اور اس کے ایوارڈ کے بارے میں بیان کر سکے۔
- بنگال اور کلکتہ کی تقسیم کی وجوہات بیان کر سکے۔
- پنجاب کی تقسیم کی تفصیل بیان کر سکے۔
- مہاجرین کی آمد سے جو مسائل پیدا ہوئے انہیں بیان کر سکے۔
- ریاستوں کے الحاق کے بارے میں تفصیل بیان کر سکے۔
- ریاست جموں کشمیر کے بارے میں بیان کر سکے۔
- نہری پانی کے تنازعہ کو بیان کر سکے۔
- قرارداد مقاصد کی تفصیلات بیان کر سکے۔
- 22 علماء کے متفقہ اسلامی نکات بیان کر سکے۔
- 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۔

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IMH-301 **INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS**

Total Contact Hours	T	P	C
Theory 32	1	0	1

AIMS The study of this subject will enable the student to develop the management skill, acquaint him with the principles of management and human relations and develop psychological approach to solve the labor problems

Course Contents:

1.	**Industrial Psychology**	**2 Hrs**
2.	**Industrial Management**	**2 Hrs**
3.	**Labour Laws**	**3 Hrs**
4.	**Human Resource Management**	**2 Hrs**
5.	**Industrial Fatigue and Boredom**	**2 Hrs**
6.	**Industrial Prejudice**	**2 Hrs**
7.	**Human Relations**	**3Hrs**
8.	**Job Evaluation**	**3 Hrs**
9.	**Leadership**	**2Hrs**
10.	**Motivation**	**2 Hrs**
11.	**Guidance and Counseling**	**2Hrs**
12.	**Working Conditions**	**2 Hrs**
13.	**Budget as Controlling Technique**	**3Hrs**
14.	**Role of foreman in Management**	**2 Hrs**

Detail of Contents:

1. **Industrial Psychology** 2 Hrs
   - 1.1 History and definition
   - 1.2 Application and Importance
2. **Industrial Management** 2 Hrs
   - 2.1 Introduction
   - 2.2 Functions of management
   - 2.3 Subdivisions of management
   - 2.4 Objectives of industrial management.
   - 2.5 General principles of management
   - **2.6 Management Styles (Theories)**
3. **Labour Laws** **3Hrs**
   - 3.1 EOBI (Labour policy 2010)
   - 3.2 Minimum Wage
   - 3.3 Working Hours & Overtime Pay rates
   - 3.4 Labour Inspection Systems

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3.5 Labour Union & Labour Courts
3.6 Occupational Health & Safety Laws in Pakistan
3.7 Child Labour
3.8 Women empowerment & Gender Equality

4. Human Resource Management — **2 Hrs**
- 4.1 Recruitment and orientation of employees
- 4.2 Training
- 4.3 Effects of training on production and product cost

5. Industrial Fatigue and Boredom — **2 Hrs**
- 5.1 Definition and distinction
- 5.2 Psychological causes
- 5.3 Objective causes
- 5.4 Prevention

6. Industrial Prejudice — **2 Hrs**
- 6.1 Causes and Effects
- 6.2 Remedies

7. Human Relations — **3 Hrs**
- 7.1 Importance and Roles
- 7.2 Functions

8. Job Evaluation — **3 Hrs**
- 8.1 Importance
- 8.2 Job description and specification
- 8.3 Performance evaluation and job satisfaction
- 8.4 Work simplification
- **8.5 Key Performance indicators (KPI's)**

9. Leadership — **2Hrs**
- 9.1 Definition and types
- 9.2 Qualities of a good leader

10. Motivation — **2 Hrs**
- 10.1 Definition
- 10.2 Types
- 10.3 Conflict of motives
- 10.4 Effects of motivation on morale

11. Guidance and Counseling — **2 Hrs**
- 11.1 Importance
- 11.2 Choice of job
- 11.3 During service

12. Working Conditions — **2 Hrs**
- 12.1 Importance and consideration
- 12.2 Effects on efficiency and per unit cost

13. Budget as Controlling Technique — **3Hrs**
- 13.1 Definition
- 13.2 Types
- 13.3 Importance

14. Role of Foreman in Management — **2 Hrs**
- 14.1 Foreman's abilities
- 14.2 Duties and functions

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Recommended Reference books:

1 Industrial Psychology by C.S. Meyers (Publisher:Oxford University Press, London)

2. Psychology of Industrial Behaviors by Smith Wakley(Publisher: Mc-Graw Hill, New York)

3. The Process of Management by Andrew R. Megill (Publisher:William M New Man)

4. Management of Industrial Enterprises by Richard N Omen

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IMH-301 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS

Instructional Objectives:

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

1. **Know Industrial Psychology**
   - 1.1 Describe brief history of industrial psychology
   - 1.2 Describe in detail definition of industrial psychology
   - 1.3 State application and important of industrial psychology
2. **Understand Industrial Management**
   - 2.1 Define management
   - 2.2 State functions of management
   - 2.3 Enlist subdivision of management
   - 2.4 Explain objectives of industrial management
   - 2.5 Explain general principles of management
   - 2.6 Describe various Management Styles Theories
3. **Understand the Labour Laws**
   - 3.1 Interpret EOBI (Labour policy 2010)
   - 3.2 Describe the Minimum Wage
   - 3.3 Enlist Working Hours & Overtime Pay rates
   - 3.4 Explain Labour Inspection Systems
   - 3.5 Conceptualize Labour Union & Labour Courts
   - 3.6 Describe Occupational Health & Safety Laws in Pakistan
   - 3.7 Explain Child Labour
   - 3.8 State Women empowerment & Gender Equality
4. **Understand Human Resource Management**
   - 4.1 Describe the recruitment procedure of employees in an industrial concern
   - 4.2 Explain training
   - 4.3 Identify the kinds of training
   - 4.4 Explain the effects of training on production and product cost
5. **Understand Industrial Fatigue and Boredom**
   - 5.1 Define fatigue and boredom
   - 5.2 Describe psychological causes of fatigue and boredom
   - 5.3 Describe objective causes of fatigue and boredom
   - 5.4 Explain measures to prevent fatigue and boredom
6. **Understand Industrial Prejudice**
   - 6.1 Define prejudice
   - 6.2 Explain causes and effects of industrial prejudice
   - 6.3 Explain remedies of industrial prejudice
7. **Understand the Human Relations**
   - 7.1 Explain importance and role of public/human relations

7.2 Explain functions of public/human relations

8. Understand Job Evaluation

8.1 Explain importance of job evaluation
8.2 Explain job description and job specification
8.3 Explain performance evaluation and job satisfaction
8.4 Explain work simplification

9. Know Leadership

9.1 Define leadership
9.2 Describe types of leadership
9.3 State qualities of a good leader

10. Understand Motivation

10.1 Define motivation
10.2 Describe financial and non- financial motives
10.3 Explain conflict of motives
10.4 Explain effects of motivation on moral

11. Understand the Need for Guidance and Counseling

11.1 State importance of guidance and counseling
11.2 Explain the role of guidance and counseling in choosing the job
11.3 Describe help of guidance and counseling during service

12. Understand the Effects of Working Conditions on Efficiency

12.1 Explain importance of working conditions
12.2 Describe air-conditioning, ventilation, lighting and noise
12.3 State the effects of good working conditions on efficiency and per unit cost

13. Understand Budget as Controlling Techniques

13.1 Explain budget as controlling techniques
13.2 Explain types of budgets
13.3 Explain the importance of budget as controlling technique

14. Understand the Role of Foreman in Management

14.1 Explain abilities of a foreman
14.2 Enlist duties of foreman
14.3 Describe functions of foreman as middle management

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Mech-302 FLUID MECHANICS AND HYDRAULIC MACHINES

Total Contact Hrs.		T	P	C
Theory	32	1	3	2
Practical	96			

AIMS: At the end of the course the students will able to understand properties of incompressible fluids, pressure and flow of fluids, able to apply problems of total head of water for losses of heads etc. The student will be able to know the Introduction to water wheels, hydraulic turbines, pumps and, hydraulics machines. Knowledge of essential parts of hydraulic circuits, types of Actuators, their applications & maintenance, Knowledge of different types of directional control valves used in hydraulic control / circuits. The student will also be able to study hydraulic circuits of different machines & can rectify their basic faults.

Course Contents:

1.	**Introduction to fluid mechanics**	**3 Hrs**
2.	**Hydro kinetics**	**3Hrs**
3.	**Flow Through Pipes**	**3 Hrs**
4.	**Impact of Jet**	**1 Hr**
5.	**Water Turbines**	**2 Hrs**
6.	**Pumps**	**4Hrs**
7.	**Hydraulic Valves and Seals**	**3Hrs**
8.	**Hydraulic machines**	**4Hrs**
9.	**Hydraulic Actuators**	**3Hrs**
10.	**Hydraulic Circuits and Accessories**	**4Hrs**
11.	**Pneumatic Simple Machines**	**2 Hrs**

Detail of Contents:

1. **Introduction to fluid mechanics** **4 Hrs**
   - 1.1 Introduction and basic concepts
   - 1.2 Introduction to different properties of liquids(Water &oils)
     - 1.2.1 Care of Hydraulic liquids
   - 1.3 Density of liquids
     - 1.3.1 Specific weight of liquids

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1.3.2 Specific gravity of liquids

1.4 Viscosity of liquids, S.I. Units of Viscosity, Relation of change of viscosity with the change of temperature

1.4.1 Difference between Hydraulic & Lubricating oils

1.4.2 Effects of viscosity on flow of liquids

1.5 Pressure head of liquids, Conversion of intensity of pressure in head of liquid

1.6 Pascal's law

1.7 Pressure and its Types, Atmospheric pressure, Gauge pressure, Absolute pressure,

1.8 Measurement of pressure with,

1.8.1 Manometers

1.8.2 Piezo-meter tube

1.8.3 Pressure gauges(Bourdon tube pressure gauge, Diaphragm pressure gauge)

1.8.4 Dead weight pressure gauge calibrator

1.8.5 Calibration of pressure Gauges with Dead Weight pressure& master Gauge calibrator

1.9 Solution of simple problems on above topics

2. Hydro- Kinetics — 3 Hrs

2.1 Introduction

2.2 Rate of discharge

2.2.1 Equation of discharge(volume, weight, mass)

2.3 Equation of continuity of flow

2.4 Total energy/head of liquid particles in motion

2.5 Bernoulli's Equation

2.5.1 Limitations of Bernoulli's Equation

2.5.2 Application of Bernoulli's Equation

2.6 Types of flow

2.7 Use of Pitot-tube gauge for measurement of velocity and discharge of flowing fluids

2.8 Solution of simple problems of discharge, Velocity head, pressure head, Datum head intensity of pressure in flowing liquid when all parameter are given

2.9 Flow meter (Venturi meter and orifice meter)

3. Flow through pipes — 3 Hrs

3.1 Introduction to losses of head in pipes

3.1.1 Reynold's Number for internal flow

3.2 Loss of head of liquid flowing in pipe (major & minor losses)

3.2.1 Losses of head due to friction

3.2.2 Loss of head due to sudden enlargement

3.2.3 Loss of head due to sudden contraction

3.2.4 Loss of head at entrance in a pipe

3.2.5 Loss of head in bends, elbows, valves & other pipe fittings

3.3 Solution of simple problems by direct application of formulae

4. Impact of Jet — 1 Hrs

4.1 Introduction

4.2 Force of Jet normally on fixed plate

4.3 Force of Jet normally on inclined plate

4.4 Force of Jet normally on moving plate

4.5 Force of Jet in series of vanes

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4.6 Calculate force of jet in all above cases by application of simple formulae

5. Water Turbines **2 Hrs**

5.1 Introduction to Development of water Wheels & water turbines

5.2 Advantages of water turbines over water Wheels

5.3 Classification of water turbines

5.4 Impulse Turbines (Pelton wheel) & its main parts

5.4.1 Working of Pelton wheel water Turbine

5.4.2 Sketch a Pelton wheel turbine and state main parts

5.5 Reaction turbine and main parts

5.6 Differentiate between Impulse & reaction turbine

5.7 State different types of low head, high discharge water (Reaction) Turbines

Advantages of hydraulics turbines

6. Pumps **4 Hrs**

6.1 Introduction to pump

6.2 Types of pumps

6.3 Detailed Construction and working of Centrifugal Pumps

6.4 Detailed Construction and working of reciprocating pump

6.4.1 Discharge of a single acting reciprocating pump

6.4.2 Slip of a reciprocating pump

6.4.3 Positive Displacement (e.g. Reciprocating, Vane, Gear etc) pumps

6.5 Comparison of centrifugal and reciprocating pump

6.6 Cavitation's in pumps, their causes and remedy

6.7 Solution of simple problems by using above formulae

7. Hydraulic valves and Seals **3 Hrs**

7.1 Types of Directional control valves, their study, symbols and function

7.2 Pressure relief valves and their types

7.3 Flow control/ Speed control valves & their types

7.4 Study of Pilot operated directional control valves construction, uses and symbols

7.5 Study of Check valves

7.6 Study of Seals used in hydraulics circuits

7.7 Study of Safety Devices necessary in a hydraulic circuits

8. Hydraulic Simple Machines **4Hrs**

8.1 Types of simple hydraulic machines

8.2 Hydraulic press

8.3 Mechanical advantage of hydraulic press

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8.4 Accumulators Their Types and uses in Hydraulic Circuits
8.5 Hydraulic Intensifiers
8.6 Solve simple problems on mechanical advantage of hydraulic press, Accumulators, and Intensifier

9. Hydraulics Actuators **4Hrs**

9.1 Classification of Rotary Actuators & their method of actuation
9.1.1 Uses of Hydraulic motors
9.1.2 Difference between hydraulic motors & pumps
9.2 Classifications of reciprocating Actuators their construction and working

10. Hydraulic Circuits and Accessories **4 Hrs**

10.1 The parts/ components of hydraulic circuits
10.2 Uses of proximity switches
10.3 Uses of different hydraulic filters, chillers, different types of rubber hoses, pipe fittings, and couplings

11 Pneumatic Simple Machines

11.1 Introduction of Pneumatic Systems
11.2 History of Pneumatic Systems
11.3 Advantages & Disadvantages of Pneumatic Systems
11.4 Gases used in Pneumatic Systems
11.5 Working Principle of Pneumatic Systems
11.6 Study of Simple Pneumatic Machines (Tools)
11.6.1 Jack Hammer
11.6.2 Pneumatic Nail Gun
11.6.3 Air Brakes

Recommended Textbooks:

1. Fluid Mechanics by John F. Douglas (Fifth Edition)
2. Fluid Mechanics with Engineering Applications by Robert L. Daugherty, Joseph B. Fanzine
3. Hydraulics and Hydraulics Machines by E.H.LEWITT (Sir ISAAC Pitman & Sons Ltd London)
4. Fluid and power with applications by Anthony Esposito
5. Basic applied fluid power by Oster Jon

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Mech-302 FLUID MECHANICS AND HYDRAULIC MACHINES

Instructional Objectives:

1. **Introduction and basic concepts**
   - 1.1 Understand basic terms of fluid mechanics
     - 1.1.1 State difference between liquid and fluid
     - 1.1.2 Enlist properties of liquid (hydraulic oil, lubricating oil etc.)
     - 1.1.3 Define following terms, unit weight of liquids,, viscosity, pressure density, specific gravity
     - 1.1.4 Describe SI units of viscosity, effects of change of viscosity on change of temperature
     - 1.1.5 Define hydraulics
     - 1.1.5.1 Difference between hydraulic & lubricating oils
     - 1.1.5.2 Effect of viscosity on flow , compression of hydraulic oil and its leakage from hydraulic components (valves & cylinders)
     - 1.1.6 Explain pressure head conversion of hydraulic pressure/ Intensity of Pressure in terms of pressure head
     - 1.1.7 Explain Pascal's law
     - 1.1.8 Describe types of pressure
   - 1.2 Understand Pressure Management Techniques
     - 1.2.1 Explain measurement of pressure by manometer, simple piezometer tube and conversion of pressure head in terms of intensity of pressure
     - 1.2.2 Explain diaphragm pressure gauge and bourdon tube pressure gauge
     - 1.2.3 Explain dead weight pressure gauge and calibration procedure of gauges
   - 1.3 Solve simple problems of pressure head & intensity of pressure

2. **Hydro Kinetics**
   - 2.1 Understand basic terms of Hydro Kinematics
   - 2.2 Describe rate of discharge
   - 2.3 Explain equation of continuity of flow
   - 2.4 Explain energy/head / total head of a liquid in motion
   - 2.5 Explain Bernoulli's Theorem and its applications
   - 2.6 Understand types of flow
     - 2.6.1 Describe the types of flow
   - 2.7 Describe use of pitot tube in determination of velocity of flowing liquid
   - 2.8 Solution of simple problems of discharge, velocity head, pressure head datum head, intensity of pressure in flowing fluid when all parameters are given

3. **Flow through pipes**
   - 3.1 Introduction to loss of head in pipes
   - 3.2 Understand Remolds' Number for internal flows
   - 3.3 Identify various losses of head of a liquid flowing in pipes (major & minor) and their formula
   - 3.4 Explain methods of calculation of Losses of head due to friction
     a) Chaz's formula (b) Darcy's formula
   - 3.5 Explain methods of calculation of loss of head due to sudden enlargement
   - 3.6 Explain methods of calculation of loss of head due to sudden contraction
   - 3.7 Explain methods of calculation of loss of head at entrance to a pipe

3.8 Explain methods of calculation of loss of head in bends elbow valves & other pipe fittings

3.9 Solve simple problems for calculation of various losses of head by direct application of formula, when all parameters are given

4. Impact of Jet

4.1 Describe Jet of water through noses

4.2 Describe force of jet impinging normally on fixed plate

4.3 Describe force of jet impinging on inclined fixed plate

4.4 Describe force of jet impinging on moving plate

4.5 Solve simple problems based on all above cases

5. Water Turbines

5.1 Understand development of water Wheels & water turbines

5.2 State advantages and disadvantages of water turbines over water Wheels

5.3 State classification of water turbines

5.4 Impulse Turbines (Pelton wheel)

- 5.4.1 Explain working of Pelton wheel water turbine
- 5.4.2 Sketch Pelton wheel turbine and state its various parts
- 5.4.3 Explain Nozzle
- 5.4.4 Describe Runner and buckets
- 5.4.5 Describe Casing
- 5.4.6 Describe Breaking jet mechanism

5.5 Understand reaction turbine and its parts

- 5.5.1 Describe spiral casing
- 5.5.2 Describe guide vane mechanism
- 5.5.3 Describe turbine runner
- 5.5.4 Describe Draft tube
- 5.5.5 Differentiate between reaction turbine and impulse turbine

5.6 State different types of low head, high discharge water Reaction Turbines (Francis Turbine, Propeller Turbine, Kaplan Turbine) and their main parts

- 5.6.1 Spiral casing
- 5.6.2 Guide Vane mechanism
- 5.6.3 Turbine runner
- 5.6.4 Draft tube

5.7 Sketch and study of reaction turbine and label its parts

6. Pumps

6.1 State functions of pumps

6.2 Describe classifications of pumps

6.3 Centrifugal pump

- 6.3.1 Explain construction of Centrifugal pump

6.4 Explain construction and working of reciprocating pump

- 6.4.1 State simple formula for calculation of discharge of a single acting reciprocating pump (Q=LAN / 60)
- 6.4.2 Explain Slip of a pump
- 6.4.3 Explain construction of Following Positive Displacement pumps, Reciprocating, Vane, Gear etc.

6.5 Compare the centrifugal and reciprocating pump

6.6 Cavitation's in pumps and their remedy

6.7 Solve simple problems by using above formulas

7. Hydraulic valves and Seals

7.1 Describe types of hydraulic valves and their symbols

7.2 Describe different directional control valves, their construction, types of spools and their symbols

7.3 Describe types of pressure relief valves and their symbols

7.4 Describe speed control valves/ flow control valve, their construction, uses and symbols

7.5 Describe pilot operated directional valves construction, uses and symbols

7.6 Describe check valves their types, construction and their symbols

7.7 Describe seals used in hydraulic circuits

7.8 Describe safety devices used in hydraulic circuits

8. Hydraulic Simple Machines

8.1 Describe types of simple hydraulic machines

8.2 Explain construction of Hydraulic press

8.3 Explain Mechanical advantage of hydraulic press

8.4 Explain Hydraulic Intensifiers

8.5 Accumulators Their Types and uses in Hydraulic Circuits

8.6 Solve simple problems on mechanical advantages of hydraulic press, Hydraulic Intensifier, Hydraulic accumulator

9. Hydraulics Actuators

9.1 Describe classification of Rotary Actuators

- 9.1.1 Explain Use and Construction of different Hydraulic motors
- 9.1.2 Differentiate between hydraulic motors & pumps
- 9.1.3 Explain different types of seals used in Hydraulic motors

9.2 Describe classifications of reciprocating Actuators

- 9.2.1 Describe Use of single acting spring return hydraulic cylinder
- 9.2.2 Describe Use & construction of double acting reciprocating hydraulic cylinder
- 9.2.3 Describe Use and construction of different hydraulic cylinder & their seals

10. Hydraulic Circuits and Accessories

10.1 Parts/ components of hydraulic circuits (Actuator, Control valve, Reservoir, Filter, Pump, pressure control valve, Directional control valve, Hydraulic pipes and couplings, Flow control Valve)

10.2 Describe Use of proximity switches

10.3 Describe Use of hydraulic filters, chillers, different types of rubber hoses, pipe fittings, and couplings

10.4 Describe different hydraulic circuits of hydraulic control machines

11. Pneumatic Simple Machines

11.1. Describe the History of Pneumatic Systems

11.2. Describe Advantages & Disadvantages of Pneumatic Systems

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11.3. State the Gases used in Pneumatic Systems

11.4. Describe the Working Principle of Pneumatic Systems

11.5. Explain Simple Pneumatic Machines (Tools)

- 11.5.1. Jack Hammer
- 11.5.2. Pneumatic Nail Gun
- 11.5.3. Air Brakes

Mech-302 **FLUID MECHANICS AND HYDRAULIC MACHINES**

List of Practical:

1. Observe hydraulic bench and its function
2. Practice of Calibration of Bourdon tube and diaphragm pressure gauge with dead weight and master gauge calibrator
3. Operate hydraulic press and observe power required to derive it
4. Practice on hydraulic bench for verification of conversion of velocity head, pressure head and datum head
5. Performance test on friction pipe apparatus
6. Performance test for loss of head due to sudden enlargement, contraction and entrance in a pipe using friction in a pipe apparatus
7. Performance test on Impulse turbine /Pelton turbine
8. Performance test on Reaction Turbine /Francis turbine
9. Performance of centrifugal pump at different speed
10. Performance test on reciprocating pump and observe the operation of reciprocating pump
11. Practice of Measurement of pressure at various connections in hydraulic circuits using different instruments including manometers.
12. Actuation of double acting hydraulic cylinder at push of a switch , develop speed regulation through throttle and flow control valves also draw its circuit diagram
13. Actuation of double acting hydraulic cylinder at a Rapid Traverse By using one way Throttle Valve
14. Setup a pressure device on a double acting cylinder by using pressure reducing valve.
15. Practice to hold a specific load by using Double Acting Cylinder & pilot operated Check Valve
16. Construct a circuit for double acting hydraulic(differential cylinder) for mechanical interlocking with switch also draw its Hydraulic & Electric circuit diagram
17. Construct a circuit to control a double acting Hydraulic cylinder, by using 02, push button, and canceling with limit switch/Proximity switch also draw its Hydraulic & Electric circuit diagram
18. Practice to set a Hydraulic motor R.P.M. & direction by using Flow Control & directional Valve
19. To construct a Hydraulic circuit in which Accumulator stored energy can be utilized by double acting cylinder, when required
20. Visit to related industry plant for topics including pneumatics machines

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Mech-313 APPLIED THERMODYNAMICS

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

AIMS: To transfer the knowledge of fundamentals of thermodynamics, laws and properties of gases, thermodynamic processes and cycles, formation and properties of steam, steam boilers and their performance , steam and Gas turbines , I.C. Engines, Air compressors and their performance, refrigeration and air conditioning etc.

Course Contents:

1.	**Fundamentals of Thermodynamics**	**08 Hrs**
2.	**Laws and properties of perfect gases**	**06 Hrs**
3.	**Thermodynamic processes and cycles**	**10 Hrs**
4.	**Formation and properties of Steam**	**04 Hrs**
5.	**Steam Boilers and their performance**	**08 Hrs**
6.	**Steam and Gas turbines**	**08 Hrs**
7.	**Internal Combustion Engines**	**08 Hrs**
8.	**Air Compressors and their performance**	**06 Hrs**
9.	**Refrigeration and Air Conditioning**	**06 Hrs**

Details of Contents:

1. **Fundamentals of Thermodynamics** **8 Hrs**
   - 1.1 Introduction to thermodynamics
   - 1.2 Units, Systems of units, Thermodynamic systems, its classification and properties
   - 1.3 Heat, Mass and weight, Force, Work and power
   - 1.4 Temperature, Absolute Temperature and Temperature Scales, Normal / Standard Temperature and Pressure
   - 1.5 Pressure, Absolute pressure, Gauge pressure and Vacuum pressure
   - 1.6 Energy, Potential energy, Kinetic energy and Internal energy of gas
   - 1.7 Laws of thermodynamics, Laws of conservation of energy and matter, limitations of 1'st law of thermodynamics
   - 1.8 Solution of problems by direct application of formulae for above topics

1.9 Mode of heat transfer

2. Laws and properties of perfect gases **6 Hrs**

2.1 Introduction

2.2 Boyle's law, Charles law, Gay-Lussac's law, Joule's law, Avogadro's law, Regnault's law and Dalton's law

2.3 General gas equation, Characteristic Gas equation, Universal Gas equation

2.4 Specific heats of a gas, Molar specific heats of a gas and its mathematical relations

2.5 Enthalpy, and Entropy of a gas, importance of Entropy and relation between Heat & Entropy

2.6 Solution of problems by direct application of formulae for above topics

3. Thermodynamic processes and cycles **10 Hrs**

3.1 Introduction of thermodynamic process

3.2 Classification/types of thermodynamic processes

3.3 Application of 1st law of thermodynamics for work done during a non-flow-reversible process

3.4 Heating and Expansion of gases in Non flow-Reversible & Irreversible processes

3.5 Solution of problems by direct-application of formulae

3.6 Introduction and classification/types of thermodynamic cycles

3.7 Assumptions in thermodynamic cycles

3.8 Reversible and Irreversible cycles

3.9 Working of an ideal engine

3.10 CARNOT's Cycle, OTTO Cycle, DIESEL Cycle and Dual Combustion Cycle

3.11 Solution of problems for air standard efficiency of thermodynamics cycles

4. Formation and properties of Steam **4 Hrs**

4.1 Introduction of steam, its formation, properties and classification

4.2 Important terms used for steam

4.3 Temperature-Enthalpy and Temperature- Entropy diagrams for steam formation

4.4 Use of steam tables

4.5 Calculation of total heat of Wet ,dry and super-heated steam (Solution of Problems)

5. Steam Boilers and Their performance **8 Hrs**

5.1 Introduction of boiler

5.2 Classification of boilers

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5.3 Selection of a steam boiler

5.4 Important terms used for steam boilers

5.5 Constructions and Working of:

- 5.5.1 Simple vertical boiler (Single tube boiler)
- 5.5.2 COCHRAN boiler (Multi tubular boiler)
- 5.5.3 Locomotive Boiler
- 5.5.4 Marine boiler (scotch type)
- 5.5.5 Babcock and Wilcox Boiler

5.6 Boiler mountings and accessories

5.7 Comparison between Water Tube and Fire Tube boilers

5.8 Performance of steam boilers, Equivalent evaporation and boiler efficiency

5.9 Boiler Emissions

5.9.1 Sox, Nox, etc.

6. Steam and Gas Turbines — 8 Hrs

6.1 Introduction and classification of turbines

6.2 Steam Turbine (Impulse type)

- 6.2.1 Introduction
- 6.2.2 De-Laval impulse turbine
- 6.2.3 Advantages of steam turbine

6.3 Steam turbine (Reaction type)

- 6.3.1 Introduction.
- 6.3.2 PARSON's Reaction turbine.
- 6.3.3 Comparison between Impulse & Reaction Turbines

6.4 Gas Turbines

- 6.4.1 Introduction
- 6.4.2 Classification
- 6.4.3 Cycles of Gas turbines
- 6.4.4 Uses of Gas turbines
- 6.4.5 Comparison of closed cycle and open cycle turbines
- 6.4.6 Comparison of Gas turbine & Steam turbine

7. Internal Combustion Engines — 8Hrs

7.1 Introduction of Internal & External Combustion Engines

7.2 Classification of I.C. Engines

7.3 Cycle of operations & important terms used

7.4 Comparison of Two Strokes Cycle and Four Strokes Cycle Engines

7.5 Petrol Engine

7.5.1 Construction and working with the help of P-V , T-S diagrams & neat sketch

7.5.2 Valve Timing Diagrams for two strokes and four strokes cycle petrol engine

7.6 Diesel Engine

7.6.1 Construction and working with its P-V, T-S diagrams and neat sketch

7.6.2 Valve Timing Diagrams for two strokes cycle and four strokes cycle Diesel engine

7.7 Indicated power, Brake power, Friction power and efficiencies of I.C. Engines

7.8 Comparison of I.C. engine and E.C. engine

7.9 Comparison of Petrol and Diesel engines

7.10 Solution of Problems regarding I.P, B.P, Friction Power and efficiencies of I.C. engines

8. Air Compressors and their performance (Reciprocating & Rotary) 6 Hrs

8.1 Introduction

8.2 Classification of air compressors(Reciprocating & Rotary)

8.3 Technical terms used

8.4 Construction and working of single stage reciprocating Air Compressor with help of PV-diagram and neat sketch

8.4.1 Work done per cycle by a single stage reciprocating air compressor without and with clearance volume.

8.5 Multistage compression and its advantages

8.6 Two stage reciprocating air compressor with intercooler, work done

Per cycle with polytrophic law of compression

8.7 Power required to drive a single stage and two stage reciprocating air compressors

8.8 Comparison of reciprocating and rotary air compressors

8.9 Work done per cycle and power required to drive a rotary compressor

8.10 Solution of Problems regarding work done power required for single stage & multistage rotary air compressors

9. Refrigeration and Air Conditioning 6 Hrs

9.1 Introduction

9.2 Classification of refrigeration systems / cycles

9.3 Units, terms used

9.4 Refrigerants and its properties

9.5 Introduction to vapor compression, vapor absorption in refrigeration system

9.6 Fundamentals of air conditioning system

9.7 Classification of air conditioning systems

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Recommended Textbooks:

1. Principle of Refrigeration by Royj. Dossat
2. Air conditioning principles and system an energy approach by Edward. G. Pita
3. Applied Thermodynamics T.D Eastop, A. Mcconkey
4. Thermodynamics by Rayner Joel
5. Thermodynamics Applied to Heat Engines by E.H.LEWITT (Published by; Sir ISAAC Pitman & Sons Ltd London)
6. Heat Engines by D.A Low (McGraw Hill Book Company , New York)
7. Thermal Engg. By Khurmi

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Mech-313 APPLIED THERMODYNAMICS

Instructional Objectives:

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

1. **Know the Fundamentals of Thermodynamics**

1.1 State the following:

1.1.1 Fundamentals of thermodynamics

1.1.2 Units and Systems of units

1.2 Describe the Thermodynamic systems, its classification and properties

1.3 State the following:

1.3.1 Heat

1.3.2 Mass and weight

1.3.3 Force

1.3.4 Work and power

1.4 Describe the following:

1.4.1 Temperature, Absolute Temperature and Temperature Scales

1.4.2 Normal Temperature and Pressure

1.4.3 Standard Temperature and Pressure

1.5 Describe the following:

1.5.1 Pressure and Absolute pressure.

1.5.2 Gauge pressure and Vacuum pressure

1.6 State the following:

1.6.1 Energy, Potential energy and Kinetic energy

1.6.2 Internal energy of a gas

1.7 Describe the following:

1.7.1 Laws of thermodynamics

1.7.2 Laws of conservation of energy and matter

1.7.3 Limitations of 1st law of thermodynamics

1.8 Describe mode of heat transfer

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1.8.1 Describe Conduction

1.8.2 Describe Convection

1.8.3 Describe Radiation

1.9 Solve the problems by direct application of formulae for the above topics

2. Understand the laws and properties of perfect gases

2.1 State the perfect gas and its properties

2.2 Describe the following; also derive its mathematical relations:

2.2.1 Boyle's law

2.2.2 Charles's law

2.2.3 Gay-Lussac's law

2.2.4 Joule's law

2.2.5 Avogadro's law

2.2.6 Regnault's law

2.2.7 Dalton's law

2.3 Describe the following; also derive its mathematical relations:

2.3.1 General gas equation

2.3.2 Characteristic Gas equation

2.3.3 Universal Gas equation

2.4 Describe the following:

2.4.1 The two specific heats of a gas and derive its mathematical relations

2.4.2 The molar specific heats of a gas and derive its mathematical relations

2.5 State the following:

2.5.1 Enthalpy of a Gas

2.5.2 Entropy of a gas

2.5.3 Importance of Entropy

2.5.4 Relation between Heat & Entropy

2.6 Solve the problems by direct application of formulae for the above topics

3. Understand the Thermodynamics Processes and Cycles

3.1 State the thermodynamic process

3.2 State Classification /Types of thermodynamic processes

3.3 State the application of 1st law of thermodynamics for work done during a non-flow-reversible process

3.4 Describe the following

3.4.1 The Non flow-Reversible & Irreversible processes with the help of P-V & T-S diagrams

3.4.2 The constant pressure process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.4.3 The constant volume process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.4.4 The constant temperature process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.4.5 The adiabatic process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.4.6 The polytrophic process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.5 Solve the problems by direct application of formulae for the above topics

3.6 Describe the following:

3.6.1 Thermodynamic cycle with the help of P-V diagram

3.6.2 Classification / Types of thermodynamic cycles

3.7 Describe the assumptions in thermodynamic cycles

3.8 Describe the Reversible & Irreversible cycles with help of PV diagram

3.9 Explain the construction and working of an ideal engine with the help of neat sketch

3.10 Explain the following

3.10.1 CARNOT'S CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.10.2 OTTO CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.10.3 DIESEL CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.10.4 DUAL COMBUSTION CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.11 Solve the problems by direct application of formulae for the above topics

4. Understand the Formation and properties of Steam

4.1 Describe the steam formation, its properties and classification

4.2 State the important terms used for steam

4.3 Describe the Temperature-Enthalpy and Temperature- Entropy diagrams for steam formation

4.4 Describe the use of steam tables with help of examples

4.5 Describe the following:

4.5.1 Derive the formulae for the calculation of total heat of wet, Dry, and super-heated steam

4.5.2 Solve the problems by direct application of formulae for the above topics

5. Understand the Steam Boilers & its performance

5.1 Describe the working and general construction of a boiler

5.2 Describe the classification of boilers

5.3 State the selection factors of a good steam boiler

5.4 Describe the important terms used for steam boilers

5.5 Explain the Following:

5.5.1 The construction and working of Simple Vertical Boiler with the help of neat sketch

5.5.2 The construction and working of COCHRAN Boiler (Multi tubular boiler) with the help of neat sketch

5.5.3 The construction and working of MARINE Boiler (Scotch type) with the help of neat sketch

5.5.4 The construction and working of Locomotive Boiler with the help of neat sketch

5.5.5 The construction and working of Babcock and Wilcox Boiler with the help of neat sketch

5.6 State the List of boiler mountings & accessories:

5.7 Make a Comparison between Water tube and Fire tube boilers

5.8 Describe the following with the help of mathematical expressions

5.8.1 Performance of boiler

5.8.2 Equivalent evaporation of boiler

5.8.3 Efficiency of boiler

5.9 Describe the Following :

5.9.1 The formulae for the calculation of power /H.P and efficiency of boiler

5.9.2 Solve the problems by direct application of formulae for above topics

5.9.3 Boiler Emissions

5.9.3 Sox, Nox, etc.

6. Understand the Steam and Gas Turbines

6.1 State the introduction and classification of turbines

6.2 Explain the following:

6.2.1 The construction and working of De-Level Impulse turbine with the help of neat sketch

6.2.2 State the advantages of steam turbine over reciprocating steam engine

6.3 Explain the following:

6.3.1 The Construction and working of PARSON'S Reaction turbine with the helping neat sketch

6.3.2 Make a comparison between Impulse and Reaction turbine

6.4 Describe the following

6.4.1 The introduction of Gas Turbines

6.4.2 The classification/types of Gas turbines

6.4.3 The cycles of Gas turbine with help of diagram

6.4.4 State the uses of gas turbines

6.4.5 Make a Comparison of closed cycle and open cycle turbines

6.4.6 Make a Comparison of Gas turbine and steam turbine

7. Understand the Internal Combustion Engines

7.1 State the introduction of I.C and E.C Engines(Internal and External combustion engines)

7.2 Describe the classification of I.C Engines

7.3 Describe the cycle of operations with the help of P-V diagram and important terms used for I.C Engines

7.4 Make a comparison of two strokes cycle and four strokes cycle engines

7.5 Explain the following:

7.5.1 The Construction and working of PETROL Engine with the help of PV- diagram & neat sketch

7.5.2 The valve timing diagrams for two strokes and four strokes cycle PETROL Engine

7.6 Explain the following:

7.6.1 The Construction and working of DIESEL Engine with the help of PV- diagram & neat sketch

7.6.2 The valve timing diagrams for two strokes and four strokes cycle DIESEL Engine

7.7 Describe the following also derive its mathematical formulae:

7.7.1 Indicated power

7.7.2 Brake power

7.7.3 Friction power

7.7.4 Efficiencies of I.C. engines

7.8 Make a Comparison of I.C. and E.C. engines

7.9 Make a Comparison of PETROL and DIESEL engines

7.10 Solve problems for calculation of I.P, B.P, Friction Power and efficiencies of I.C. engines

8. Understand the Air Compressors and their performance (Reciprocating & Rotary)

8.1 State the introduction of Air Compressors

8.2 Describe the classification / types of Air Compressors(Reciprocating & Rotary)

8.3 State the terms used for Air Compressors

8.4 Explain the following:

8.4.1 The Construction and working single cylinder- single stage double acting reciprocating air compressor with the help of P-V diagram and neat sketch

8.4.2 The work done single stage. Single cylinder reciprocating air compressor without and with clearance volume; also drive its Mathematical Expression.

8.5 Describe the Multistage compression with the help of P-V diagram and its advantages

8.6 Describe the two stage reciprocating air compressor with intercooler; also derive its mathematical Expression for the work done per cycle considering polytropic law of compression

8.7 Describe the power required to drive a single stage and two stages reciprocating Air compressors; also derive its formulae

8.8 Make a comparison of reciprocating and rotary air compressors

8.9 Describe the work done and power required to drive a rotary air compressor; also derive its formulae

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8.10 Solution of the problems regarding work done and power required to drive the rotary and reciprocating air compressors

9. Understand the Refrigeration and Air Conditioning

9.1 State the concept of Refrigeration and Air conditioning

9.2 Describe the Classification/types of Refrigeration systems

9.3 State the Units and terms used for Refrigeration and Air Conditioning

9.4 State the names and Properties of refrigerants

9.5 Describe the simple mechanism of a vapor compression vapour absorption in refrigeration system with the help of neat schematic diagram

9.6 State the fundamentals of Air Conditioning Systems

9.7 Describe the Classification/types Air Conditioning Systems

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Mech-313 APPLIED THERMODYNAMICS

List of Practical:

1. **Pressure measurement by Barometer**
2. **Introduction of Thermometers and Thermocouples**
3. **Sketch and study of Steam Boilers**
   - 3.1 Simple vertical boiler
   - 3.2 Cochran (Multi tubular) boiler
   - 3.3 Marine boiler(Scotch type)
   - 3.4 Locomotive boiler
4. **Sketch and study of Boiler Mountings and Accessories**
   - 4.1 Pressure gauge (Bourdon type)
   - 4.2 Water level indicator
   - 4.3 Safety valve (Spring loaded)
   - 4.4 Feed water pump
5. Study of fault diagnosis of steam boiler apparatus
6. Study & practice on petrol engine
7. Study & practice on diesel engine
8. Study and Practice on Ignition point Testing Machine
9. Study and problem solution on Steam Turbine
10. Study of Gas Turbine
11. Performance Test of Reciprocating Air Compressor
12. Performance Test of Heating and Cooling system (Compression type A/C system)
13. Performance Test of Refrigeration system (Compression type)

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Mech-321 **INDUSTRIAL PLANNING AND PRODUCTION METHODS**

Total contact Hrs:		**T**	**P**	**C**
Theory	32	**1**	**0**	**1**

AIMS: At the end of this course, the student will be able to:

i) Understand the fundamental functions of industrial concerns.
ii) Understand the methods generally employed in various manufacturing organizations

Course Contents:

1.	**Industrial planning**	**3 Hrs**
2.	**Site selection for industry**	**2 Hrs**
3.	**Plant layout**	**4 Hrs**
4.	**Production methods**	**3 Hrs**
5.	**Job analysis**	**2 Hrs**
6.	**Production planning and control**	**4 Hrs**
7.	**Quality Management**	**4 Hrs**
8.	**Maintenance activities**	**4 Hrs**
9.	**Cost determination and control**	**2 Hrs**
10.	**Types of Cost**	**2 Hrs.**
11.	**Ware house operations in industry**	**2 Hrs**

Detail of Contents:

1. Industrial Planning **3 Hrs**
- 1.1 Need of industrial planning
- 1.2 Phases of industrial planning

2. Site selection for Industry **2 Hrs**
- 2.1 Economical and technical factors considered while selecting factory site

3. Plant layout **4 Hrs**
- 3.1 Definition
- 3.2 Objectives
- 3.3 Types
- 3.4 Criteria for a good lay out
- 3.5 Advantages of a good lay out
- 3.6 Preparing a lay out
- 3.7 Production Routing sheets
- 3.8 Identification & concept of :-

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3.8.1 bottlenecks,

3.8.2 Buffers

3.8.3 Throughput

3.8.4 Line balancing

3.8.5 Capacity Utilization

4. Production Methods **3Hrs**

4.1 Introduction to production

4.2 Important types of production

4.3 Lean Manufacturing (waste identification & removal)

5. Job Analysis **2Hrs**

5.1 Motion study

5.2 Time study

5.3 Overall Equipment Efficiency (OEE)

5.4 Single Minute Die Exchange

6. Production planning and control **4Hrs**

6.1 Production planning

6.2 Production control

7. Quality Management **4Hrs**

7.1 Inspection

7.2 Quality control

7.3 Quality Policy

7.4 Control Charts

7.5 Quality Plan

7.6 Documentation/ (SOPs)

7.7 Process capability & capability Index (Cp & Cpk)

7.8 Standard deviation & variance

7.9 Sigma capabilities

8. Maintenance activities **4Hrs**

8.1 Responsibilities of maintenance department

8.2 Types of maintenance

8.3 Comparison of different types of maintenance

8.4 Replacement studies

9. Cost determination and control **2Hrs**

9.1 Cost calculation of industrial product.

9.2 Cost control

10. Types of Cost **2 Hrs**

10.1 Fixed

10.2 Variable

10.3 Opportunity cost

10.4 Cost of quality

11. Warehouse operations in industry **2 Hrs**

11.1 Inventory Management

11.2 LIFO & FIFO

11.3 ABC Classification

11.4 Material Handling Equipment

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Recommended Textbooks:

1. Motion and time study by RALPH M. BARNES (Publisher: Wiley, 1980)
2. Industrial Engineering and Management System by Dr. Mansor Ali (Publisher: Urban Resource Center,2001)
3. Factory and Production Management by Lockyer(Publisher: Pitman, 1974)
4. Industrial Management by Prof. M.H. Zubairy

Mech-321 INDUSTRIAL PLANNING AND PRODUCTION METHODS

Instructional Objectives:

1. **Industrial planning**
   - 1.1 Explain the need of industrial planning
     - 1.1.1 Define industrial planning
     - 1.1.2 Explain need and importance of industrial planning
   - 1.2 Explain different phases of industrial planning
     - 1.2.1 Explain financial planning
     - 1.2.2 Explain product planning and selection of material
     - 1.2.3 Explain selection of process and equipment

2. **Know the Economical and technical factors considered during site selection Procedure**
   - 2.1 Explain economical and technical factors in site selection
     - 2.1.1 Define site (location of industry)
     - 2.1.2 Describe factors for site selection
     - 2.1.3 Economical factors (cost of site, rebate in taxes, special grants)
     - 2.1.4 Technical factor(availability of labor, raw material, market of Product, services , transportation etc.)

3. **Understand plant lay out**
   - 3.1 Define plant lay out and its importance
   - 3.2 Describe the objectives of lay out
   - 3.3 Describe the types of lay out (product/process) with its advantages and limitations
   - 3.4 Explain criteria for a good lay out
   - 3.5 Describe advantages of a good lay out
   - 3.6 Explain different factors / procedures followed in preparing layout
     - 3.6.1 Explain factors considered while preparing a lay out (man. Material, machine, Movement etc.)
     - 3.6.2 Describe procedure and various steps followed in developing a lay out
   - 3.7 Describe Production Routing sheets
   - 3.8 Identification & concept of :-
     - 3.8.1 bottlenecks,
     - 3.8.2 Buffers
     - 3.8.3 Throughput
     - 3.8.4 Line balancing
     - 3.8.5 Capacity Utilization

4. **Understand Production Methods**
   - 4.1 Define Production.
   - 4.2 Explain different types of production
     - 4.2.1 Explain Mass Production, Job order Production, Batch Production
     - 4.2.2 Explain flow Production
     - 4.2.3 Describe requirements of flow production
   - 4.3 Describe Lean Manufacturing (waste identification & removal)

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5. **Understand Job Analysis**

5.1 Explain motion study

5.1.1 Define motion study

5.1.2 Explain techniques developed by the gilbreth, like therbligs, process charts etc.

5.1.3 Describe micro motion study

5.2 Explain time study

5.2.1 Define time study

5.2.2 Describe uses of time study

5.2.3 Describe instruments used in motion and time study

5.2.4 Describe time study procedure

5.2.5 Explain observation sheet (Time study tool)

5.3 Explain Overall Equipment Efficiency (OEE)

5.4 Interpret Single Minute Die Exchange

6. **Understand Production Planning and Control (PPC)**

6.1 Define PPC

6.2 Describe the objectives of PPC

6.3 Explain functions of production control

6.4 Explain routing, scheduling and loading

6.5 Explain Packaging and Dispatching

7. **Understand Quality Management**

7.1. Inspection

7.2. Quality control

7.3. Quality Policy

7.4. Control Charts

7.5. Quality Plan

7.6. Documentation/ (SOPs)

7.7. Process capability & capability index (Cp & Cpk)

7.8. Standard deviation & variance

7.9. Sigma capabilities

8. **Understand Maintenance Activities**

8.1 Explain duties of maintenance department.

8.2 Explain types of maintenance

8.2.1 Explain Preventive maintenance and Break-down maintenance

8.2.2 Describe maintenance schedules

8.3 Explain replacement studies

8.3.1 Explain replacement of parts in machines and equipment

8.3.2 Explain replacement policy

9. **Understand Cost Determination and Control**

9.1 Explain cost calculation of industrial products

9.1.1 Explain procedure of cost calculation

9.1.2 Describe elements of cost

9.1.3 Explain factory overhead

9.2 Describe cost control

10. **Understand Types of Cost**

10.1. Fixed

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10.2. Variable
10.3. Opportunity cost
10.4. Cost of quality

11. Understand Ware house Operation

11.1. Inventory Management
11.2. LIFO & FIFO
11.3. ABC Classification
11.4. Material Handling Equipment

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Mech-333 MACHINE DESIGN & ANALYSIS

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

AIMS: At the end of the course the students will be able to:

i) Calculate and analyze stresses induced in different machine parts
ii) Design Simple machine parts, welded joints, Screwed joints, pressure vessels, shafts and Couplings, Keys, Belt Drives, helical springs, Bearings and CAMS & Followers.

Course Contents:

1.	**Design Methodology**	**2Hrs.**
2.	**Simple Stresses in Machine Parts**	**6Hrs**
3.	**Pressure Vessels**	**6Hrs**
4.	**Welded Joints**	**6Hrs**
5.	**Screwed Joints**	**6Hrs**
6.	**Design of Keys**	**5Hrs**
7.	**Shafts and Couplings**	**8Hrs**
8.	**Belt Drives**	**6 Hrs**
9.	**Springs**	**6Hrs**
10.	**Bearings**	**6 Hrs**
11.	**Cam and Followers**	**7 Hr**

Details of Contents:

1. Design Methodology **2 Hrs.**

1.1 Fundamental designing

1.2 Type of designing

1.3 Design product concept

1.4 Design methods

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2. Simple Stresses in Machine Parts — 6 Hrs

2.1 Load and its types

2.2 Stress and strain

- 2.2.1 Tensile stress and strain
- 2.2.2 Compressive stress and strain
- 2.2.3 Shear stress and strain
- 2.2.4 Young's Modulus of elasticity; Hook's Law
- 2.2.5 Modulus of rigidity or Shear Modulus
- 2.2.6 Stress strain diagram
- 2.2.7 Working stress
- 2.2.8 Factor of safety
- 2.2.9 Selection of Factor of Safety
- 2.2.10 Poisson's Ratio
- 2.2.11 Temperature stress
- 2.2.12 Volumetric strain and bulk modulus
- 2.2.13 Resilience and Toughness
- 2.2.14 Solution of problems of the above topics by direct application of formulae

3. Pressure Vessels — 6 Hrs

3.1 Introduction

3.2 Classification of pressure vessels

- 3.2.1 According to dimensions.
- 3.2.2 According to end – construction

3.3 Stresses in a thin cylindrical shell due to internal pressure

- 3.3.1 Hoop stress
- 3.3.2 Longitudinal stress

3.4 Calculation of thickness of cylinder by direct application of formula, while all parameters are provided (e.g.), Pressure. Internal Dia, hoop or longitudinal stress and efficiency of joint are given)

- 3.5 Calculation of hoop or longitudinal stress by direct application of formula, while P. d, t and efficiency of joint are given
- 3.6 Thin spherical shell subjected to internal pressure
- 3.7 Calculation of thickness of spherical shell when all other parameters are provided by direct application of formula
- 3.8 Thick cylindrical shell subjected to internal pressure
- 3.9 Calculation of thickness of thick vessel made of brittle material by LAME,S equation, while all other parameters are given

4. Welded Joints — 6Hrs

4.1 Types of various welding joints

4.2 Strength of transverse and parallel fillet welded joint under static and fatigue loading

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4.3 Calculation of length of weld under static loading, when load, plate thickness & width, tensile & shears stress are given

5. Screwed Joints **6Hrs**

5.1 Introduction
5.2 Advantages and disadvantages
5.3 Thread terminology
5.4 Stress in screwed fastening due to external forces under static loading
5.5 Initial stress due to screwing up forces
5.6 Solution of simple problem by direct formula application

6. Design of Keys **5 Hrs**

6.1 Introduction
6.2 Types of keys
6.3 Forces acting on a sunk key
6.4 Strength of a sunk key
6.5 Calculate length of sunk key by direct application of formula, while all parameters are directly provided

7. Shafts and Couplings **8Hrs**

7.1 Introduction to shaft

7.2 Materials used for shaft and its properties

7.3 Types of shafts

7.4 Standard sizes

7.5 Stresses in shafts

7.6 Shafts subjected to twisting moment

6.6.1 Solid shaft

6.6.2 Hallow shaft

7.7 Calculate diameter of solid and hollow shafts by direct application of formula

7.8 Shafts subjected to bending moment

6.8.1 Solid shaft

6.8.2 Hollow shaft

7.9 Calculate diameter of solid and hollow shaft (bending only) by direct application of formula

7.10 Calculation of dia. of shaft subjected to bending and twisting moments

7.11 Introduction of shaft coupling

7.12 Types of couplings

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7.13 Design of flange coupling

7.14 Solve problems on calculation of sizes of different components in flange coupling by direct application of formula

8. Belt Drives — 6 Hrs

8.1 Introduction to Belt and pulley drives
8.2 Selection of Belt drive
8.3 Types of Belt drive
8.4 Type of Belts and pullies
8.5 Type of Flat Belts drive
8.6 Velocity ratio of Belt drive
8.7 Slip / creep of Belt
8.8 Length of open Belt drive
8.9 Solve problem to find out the speed of shaft considering the diameters of flat pulleys and slip between belt and flat pulleys

9. Springs — 6Hrs

9.1 Introduction
9.2 Types and uses of springs
9.3 Materials used for helical springs
9.4 Terms used in helical springs
9.5 Stresses in helical springs of circular wire
9.6 Deflection of helical springs of circular wire
9.7 Solution of simple problem on helical springs of circular wire regarding finding out stresses, deflection and diameter of wire by direct application of formulae

10. Bearings — 6 Hrs

10.1 Functions of bearings
10.2 Classification of bearing
10.3 Depending upon the direction of load to be supported
10.4 Depending upon the nature of contact
10.5 Uses of bearings
10.6 Terms used in journal bearings
10.7 Lubrication of bearings
10.8 Solution of simple problems on journal bearings when all parameter of journal bearing are directly provided

11. Cam and Follower Design — 7Hrs

11.1 Cam and its Types
11.2 Followers and its Types
11.3 Terminology of Cam and Follower
11.4 Cam profile design

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Recommended Textbooks:

1. Machine Design by: Paul H. Black (Published by McGraw Hill Book Company , New York)
2. Machine Design by Stanton. E. Wiston (Published by McGraw Hill Book Company , New York)
3. Machine Design by: Lafayette. Ind. (Purdue University of California)
4. Machine Design by Khurmi & Gupta

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Mech-333 MACHINE DESIGN & ANALYSIS

Instructional Objectives:

1. **Design Methodology**

   1.1 Interpret Fundamental designing

   1.2 Enlist Type of designing

   1.3 Describe Design product concept

   1.4 Explain Design methods

2. **Simple Stresses in Machine Parts**

   2.1 Describe Load and its types

      2.1.1 Dead load

      2.1.2 Live load

      2.1.3 Suddenly applied load

      2.1.4 Impact load

   2.2 Describe Stress and strain

   2.3 Describe Tensile stress and strain

   2.4 Describe Compressive stress and strain

   2.5 Describe Shear stress and strain

   2.6 Describe Modulus of elasticity

   2.7 Describe Modulus of rigidity

   2.8 Explain Stress strain diagram

      2.8.1 Proportional limit
      2.8.2 Elastic limit
      2.8.3 Yield points
      2.8.4 Ultimate stress
      2.8.5 Breaking stress
      2.8.6 Percentage reduction in area
      2.8.7 Percentage elongation
      2.8.8 Describe Working stress

   2.9 Describe Factor of safety

   2.10 Describe selection of factor of safety

2.11 Describe Poisson's ratio

2.12 Describe temperature stress

2.13 Describe volumetric strain and bulk modulus

2.14 Describe Resilience and Toughness

2.15 Solve of simple problems of the above topics by direct application of formula

3. Pressure Vessels

3.1 Describe pressure vessels

3.2 Explain Classification of pressure vessels

- 3.2.1 According to dimensions
- 3.2.2 According to end – construction

3.3 Explain Stresses in a thin cylindrical shell due to internal pressure

- 3.3.1Hoop stress
- 3.3.2Longitudinal stress

3.4 Calculate thickness of cylinder by direct application of formula, while all parameters are provided (e.g., Pressure. Internal Dia, hoop or longitudinal stress and efficiency of joint are given)

3.5 Calculate hoop or longitudinal stress by direct application of formula, while P. d, t and efficiency of joint are given

3.6 Explain thin spherical shell subjected to internal pressure

3.7 Calculate thickness of spherical shell when all other parameters are provided by direct application of formula

3.8 Explain Thick cylindrical shell subjected to internal pressure

3.9 Solve simple problem to Calculate of thickness of thick vessel made of brittle material by LAME, S equation, while all other parameters (e.g., Pressure. Internal Dia, tensile stress) are given

4. Welded Joints

4.1 Describe list of types of various welding joints

4.2 Explain strength of transverse and parallel fillet welded joint under static and fatigue loading

4.3 Calculation of length of weld under static loading and fatigue loading, when load, plate thickness, plate width, tensile and shears stress are given

5. Screwed Joints

5.1 Describe Screwed Joints

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5.2 Describe Advantages and disadvantages of Screwed Joints

5.3 Explain Thread terminology

5.3.1 Major diameter

5.3.2 Minor diameter

5.3.3 Pitch diameter

5.3.4 Pitch

5.3.5 Lead

5.3.6 Helix and Helix angle

5.3.7 Thread angle

5.3.8 Root

5.3.9 Crest and Apex

5.4 Explain Stresses in screwed fastening due to external forces under static loading

5.5 Describe Initial stress due to screwing up forces

5.6 Solve simple problem on screwed fastening by direct application of formula

6. Design of Keys

6.1 Describe Keys and its use

6.2 Describe Types of keys

6.2.1 Sunk keys

6.2.1.1 Rectangular (Parallel & Taper) Sunk key

6.2.1.2 Square (Parallel & Taper) Sunk key

6.2.1.3 Gib-Head key

6.2.1.4 Feather key

6.2.1.5 Wood ruff key

6.2.2 Saddle keys

6.2.2.1 Flat Saddle Key

6.2.2.2 Hollow Saddle Key

6.2.3 Tangent keys

6.2.4 Round keys

6.2.5 Splines

6.3 Describe Forces acting on a sunk key

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6.4 Explain strength of a sunk key

6.5 Solve simple problem to Calculate length of sunk key (Square & Rectangular) by direct application of formula, while all parameters are directly provided

7 Shafts and Couplings

7.1 Describe Shafts

7.2 Describe Materials used for shaft and its properties

7.3 Describe Types of shafts

7.4 Describe Standard sizes of shafts

7.5 Describe Stresses in shafts

7.6 Explain shafts subjected to twisting moment

6.6.1 Solid shaft

6.6.2 Hollow shaft

7.7 Solve simple problem to Calculate diameter of solid and hollow shafts by direct application of formula

7.8 Explain shafts subjected to bending moment

7.8.1 Solid shaft

7.8.2 Hollow shaft

7.9 Solve simple problem to Calculate diameter of solid and hollow shaft (under bending only) by direct application of formula

7.10 Solve simple problem to calculate dia. of shaft subjected to combined bending and twisting moments

7.11 Describe Shafts coupling

7.12 Describe Types of couplings

7.13 Explain design of flange coupling

7.14 Solve problems on calculation of sizes of different components in flange coupling by direct application of formula

8 Belt Drives

8.1 Introduction to Belt and pulley drives

8.2 Describe Selection of Belt drive

8.3 Describe Types of Belt drive

8.3.1 Light drives

8.3.2 Medium drives

8.3.3 Heavy drives

8.4 Describe Types of Belts and pullies

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8.4.1 Flat belt and pullies

8.4.2 V-belt and pullies

8.4.3 Circular belt and pullies

8.5 Describe Types of Flat Belts drive

- Open belt drive
- Crossed or Twist belt drive
- Quarter Turn belt drive
- Belt drive with idler pulley
- Compound belt drive

8.6 Explain Velocity ratio of Belt drive

8.7 Explain Slip of Belt

8.8 Describe Length of open Belt drive

8.9 Solve problem to find out the speed of shaft considering the diameters of flat pulleys and slip between belt and flat pulleys

9. Springs

9.1 Describe function of springs

9.1.1 Explain Types and uses of springs

9.1.1.1 Helical spring

9.1.2 Conical and volute spring

11.1.1 Torsion spring

11.1.2 Leaf spring

11.1.3 Disc spring

9.2 Describe Materials used for springs

9.3 Explain Terms used in helical springs of circular wire along with formulae for each term

9.4 Derive formula for torsional and direct shear stress induced in helical springs of circular wire. Maximum shear stress should also be found out by considering the effect of wire curvature

9.5 Derive formula for deflection of spring

9.6 Solve problems on stresses, deflection and diameters for helical springs of circular wire by direct application of formulae

10. Bearings

10.1 Describe function of bearings

10.2 Explain classification of bearing

10.2.1 Depending upon the direction of load to be supported

10.2.1 Radial bearing

10.2.1.2 Thrust bearing

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10.2.2 Depending upon nature of contact

10.2.2.1 Friction bearing or sliding contact bearing

10.2.2.2 Anti friction or rolling contact bearing

10.3 Describe uses of bearings

10.4 Describe terms used in hydrodynamic journal bearing

10.5 Explain lubrications of bearings

10.6 Solve simple problems on journal bearing when load on shaft, speed of shaft, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus are provided.

11. Cam and Follower Design

11.1 Explain Cam and its Types
- 11.1.1 Cylindrical Cam
- 11.1.2 Radial Cam
- 11.1.3 Wedge type Cam
- 11.1.4 Face Cam

11.2 Describe Followers and its Types
- 11.2.1 Roller Follower
- 11.2.2 Knife Edge Follower
- 11.2.3 Flat face Follower
- 11.2.4 Spherical face Follower

11.3 Define Terminology of Cam and Follower
- 11.3.1 Base circle
- 11.3.2 Trace Point
- 11.3.3 Pressure angle
- 11.3.4 Pitch point
- 11.3.5 Pitch circle
- 11.3.6 Prime circle
- 11.3.7 Lift or Stroke
- 11.3.8 Dwell

11.4 Explain Cam profile design
- 11.4.1 Draw/ Sketch displacement diagram, velocity and acceleration diagram when knife edge follower moves with uniform velocity
- 11.4.2 Draw/ Sketch displacement diagram, velocity and acceleration diagram when knife edge follower moves with Simple Harmonic Motion(S.H.M)

Mech-333 MACHINE DESIGN & ANALYSIS

List of Practical:

1. Calculate (tensile, compressive and shear), stress and strain, modulus of elasticity, %age elongation, %age reduction in area, factor of safety for simple machine parts
2. Calculate force required to punch a hole
3. Calculate thickness and diameter of thin cylinders for hoop and longitudinal stresses
4. Calculate thickness of thick cylinders by LAME 'S Equation
5. Calculate thickness and diameter of spherical shell.
6. Design welded joints for transverse and parallel fillet weld under static loading only
7. Calculate stresses setup due to initial tightening and external load on screws.
8. Check dimensions of square and rectangular keys due to failure in shearing and crushing.
9. Design solid shaft subjected to twisting moment only.
10. Design hollow shaft subjected to twisting moment only.
11. Design Solid & Hollow shafts subjected to combined bending & twisting moment.
12. Design un-protected flange coupling for specific torque.
13. Check the speed of shaft when diameters of flat pulleys (Driver or Driven) and slip between belt and flat pulley is given.
14. Design the dimensions of closely coiled helical spring of circular wire subjected to tensile load.
15. Suggest suitable journal bearing, considering the load on shaft, speed, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus.
16. Design and draw the CAM profile with knife edge follower for uniform velocity

(a) Out Stroke during 60°of Cam rotation (b) Dwell for next 30°of Cam rotation (c) return Stroke during next 60°of Cam rotation (d) Dwell of remaining 210°of Cam rotation (e) Stroke of follower is 22 mm (f) Minimum Radius of Cam is 50 mm (g) Axis of Follower is passing through axis of Cam shaft (h) Follower moves with uniform velocity during both out Stroke and return Stroke.

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Mech-363 **TOOL AND MOULD DESIGN**

Total Contact Hours		**T**	**P**	**C**
Theory	**64 Hrs**	**2**	**3**	**3**
Practical	**96 Hrs**			

AIMS: At the end of this course, the student will be able to;

i) Know the importance of tool design and mould design
ii) Principles of designing jigs and fixtures with their types
iii) Design dies and punches, cutting tools
iv) Describe Injection Moulding and Design of Moulds
v) Describe the Die Casting Die Design

Course Contents:

1.	**Jigs and Fixture Design**	**10 Hrs**
2.	**Form Tools**	**4 Hrs**
3.	**Press and Press Work**	**6 Hrs**
4.	**Punches and Dies Design**	**10Hrs**
5.	**Sheet Metal Dies(Blanking, Piercing, Progressive, and Drawing Dies)**	**8Hrs**
6.	**Die Casting**	**6 Hrs**
7.	**Steel Standards used in Tool Making**	**4 Hrs**
8.	**Injection Mould**	**4Hrs**
9.	**Mould Design**	**12Hrs**

Detail of Contents:

1. **Jigs and Fixture Design** **10Hrs**
   - 1.1 Introduction and importance of Production Tools
   - 1.2 Detail of Jigs and fixtures
   - 1.3 Material for jigs and fixtures
   - 1.4 Principles of location
   - 1.5 Design procedure
   - 1.6 Element of jigs and fixtures
2. **Form Tool** **4 Hrs**
   - 2.1 Introduction of form tools
   - 2.2 Types of form tools
   - 2.3 Design of form tools
3. **Press and Press Work** **6 Hrs**
   - 3.1 Introduction to Press Working
   - 3.2 Fundamentals of Press working operations
   - 3.3 Types of presses

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- 3.4 Classification of presses
- 3.5 General press information
  - 3.5.1 Press tonnage
  - 3.5.2 Stroke
  - 3.5.3 Shut height
- 3.6 Material Handling equipment in press shop
- 3.7 Different terms used in press working

4. Punches and dies Design **10 Hrs**

- 4.1 Introduction of punches
- 4.2 Types of punches with respect to operations
- 4.3 Introduction of Dies
- 4.4 Types of dies
- 4.5 Punch and die design procedure
- 4.6 Material used for punches and dies

5. Sheet metal Dies **8 Hrs**

- 5.1 Designed of Blanking , piercing , progressive and drawing dies
- 5.2 Introduction of compound , inverted, Bending and Forming dies

6. Die Casting **6 Hrs**

- 6.1 Introduction to Die Casting Machine
- 6.2 Design of simple Die Casting Mould

7. Steel Standards used in Tool making **4 Hrs**

- 7.1 Introduction to Steel Standards

8. Injection Mould & Blow Moulding **08 Hrs**

- 8.1 Introduction of Injection Moulding Machine
- 8.2 Mould and its Types
- 8.3 Types of Plastic
- 8.4 Process of injection moulding
- 8.5 Introduction to Blow Moulding Machine
- 8.6 Control Parameter for Blow Moulding Machine

9. Mould Design **08Hrs**

- 9.1 Outline the design of injection mould
- 9.2 Types of Moulds
- 9.3 Alignments of Moulds
- 9.4 Clamping of Moulds
- 9.5 Injection Pressure & temperature management
- 9.6 Surface finishing of moulds
- 9.7 Coatings on mould cavities
- 9.8 Shrinkage allowance in mould design

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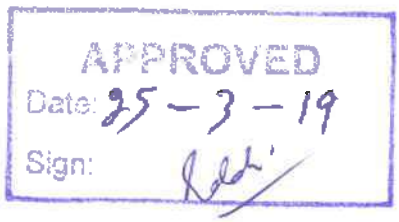
Mech-363 TOOL AND MOULD DESIGN

Instructional Objectives:

1. **Jigs and Fixture Design**
   - 1.1 Understand production tool
     - 1.1.1 Define Jigs and fixture
     - 1.1.2 Explain jigs and fixtures
     - 1.1.3 Distinguish between jig and fixture
   - 1.2 Understand different parts and types of jig sand fixture
     - 1.2.1 Describe different types of standard parts i.e, nuts, bolts, screws, studs, washers of jig and fixture
     - 1.2.2 Explain the function of each part
     - 1.2.3 Enlist the types of jig and fixture
       - 1.2.3.1 Explain template plate type drill jig
       - 1.2.3.2 Explain plate type drill jig
       - 1.2.3.3 Explain Angle drill jig
       - 1.2.3.4 Explain swinging leaf drill jig
       - 1.2.3.5 Explain channel jig
       - 1.2.3.6 Explain Box and tumble jig
       - 1.2.3.7 Explain indexing jig
       - 1.2.3.8 Vise fixtures with series of special jaws
         - a) Simple pair of jaw for holding round work piece
         - b) Pair of jaw for holding thin sheet
         - c) Extended jaws for large work pieces
         - d) Tongue and groove jaws for accurate alignment
         - e) Wedge type jaws to hold the work piece against pressure
         - f) Link jaw to safe the work tilt upward
       - 1.2.3.9 Angle Milling fixture
       - 1.2.3.10 Turning fixture
       - 1.2.3.11 Broaching fixture
   - 1.3 Understand different material used in jig and fixture
     - 1.3.1 Enlist different materials used in jig and fixture
       - 1.3.1.1 H.S.S., Die steel, Carbon steels, Nickel chrome Steel, High Tensile steel, Mild steel, Cast iron, Nylon , Fiber , Bronze ,etc.



1.3.2 Describe the composition of material w .r .t. jig and fixture

1.4 Understand principle of location

1.4.1 Explain 3.2.1 location

1.5 Understand design procedure

1.5.1 Enlist the point to be consider while designing the jig and fixture

1.5.2 (a)Rigidity (b) Location and clamping (d) Chip control (e) Jig feet and legs (f) safety in design.(g) Safety in designing (h) Weight of jig (i) Method of construction (j) Fool proofing

1.5.3 Explain the point to be consider in detail

1.6 Understand tool guiding , tool supporting element tool clamping element, tool locating element

1.6.1 Explain tool guiding elements

1.6.1.1 Headed drill bush

1.6.1.2 Headless drill bush

1.6.1.3 Renewable drill bush

1.6.1.4 Master/liner bushes

1.6.2 Explain jig supporting elements

1.6.2.1 Jig feet (a) square (b)hex type (c) adjustable type (d) round type

1.6.3 Explain tool standard clamping elements

1.6.3.1 (a) Strap clamps (b) cam clamps (c) Screw clamps (d) latch clamps (e) Wedge clamps (f) Toggle clamps (g) Hydraulic and pneumatic clamps

1.6.4 Explain tool locating elements and locating methods

1.6.4.1 (a) Pin and button locaters (b) lock pin screw locators (c) rest pads and plates(d) Chip control (f) Nest or Cavity location

1.6.4.2 (a)Locating from plain surfaces (b) locating from circular surfaces (c) Locating from irregular surfaces

2. Form Tool

2.1 Introduction ofForm tools

2.2 Types of Form Tools

2.2.1 Flat form tool

2.2.2 circular form tool

2.3 Flat form tool Design

2.4 Circular form tool Design

3. Press and Press Work Operations

3.1 Introduction to Press Working

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3.2 Enlist and explain the Press working operations
- 3.2.1 Punching/piercing
- 3.2.2 Blanking
- 3.2.3 Perforating
- 3.2.4 Cutting off and parting
- 3.2.5 Notching
- 3.2.6 Lancing
- 3.2.7 Drawing
- 3.2.8 Bending
- 3.2.9 Forming
- 3.2.10 Embossing
- 3.2.11 Coining

3.3 Describe different types of presses
- 3.3.1 Hydraulic press
- 3.3.2 Mechanical press
  - 3.3.2.1 CAM operated press
  - 3.3.2.2 Crank operated
  - 3.3.2.3 Eccentric operated
  - 3.3.2.4 Rack and pinion operated
  - 3.3.2.5 Toggle and knuckle joint press
  - 3.3.2.6 Screw press
  - 3.3.2.7 O.B.I press
- 3.3.3 Explain CNC Presses

3.4 Classification of presses
- 3.4.1 Classification w.r.t. type of frame
- 3.4.2 Classification w.r.t source of power
- 3.4.3 Classification w.r.t method of actuation of slides
- 3.4.4 Classification w.r.t No. of slides incorporated
- 3.4.5 Classification w.r.t intended use of special purpose

3.5 Describe general press information
- 3.5.1 Press tonnage
- 3.5.2 Stroke
- 3.5.3 Shut height
- 3.5.4 Die space

3.6 Describe material handling equipments
- 3.6.1 Coil unwinding equipment
- 3.6.2 Strip straightening devices
- 3.6.3 Strip feeding equipment

3.7 Describe different term used in press working
- 3.7.1 Punch and Die
- 3.7.2 Stroke
- 3.7.3 Shut height
- 3.7.4 Bolster plate
- 3.7.5 Guide post pins and bushings
- 3.7.6 Knock out pin
- 3.7.7 Stripper
- 3.7.8 Back up plate
- 3.7.9 Upper and lower shoe

4. Punch and Die design

4.1 Understand punches
- 4.1.1 Define punches

4.2 Describe the types of punches with respect to operations

4.2.1 Explain Plain punches

4.2.2 Explain Pedestal punches

4.2.3 Explain Perforated punches

4.2.4 Explain Compound punches

4.2.5 Explain Pilot Punches

4.3 Understand dies

4.3.1 Define die

4.4 Describe the types of dies.

4.4.1 Explain simple blanking die and piercing die

4.4.2 Explain Compound die

4.4.3 Explain Progressive die

4.4.4 Explain Drawing die

4.4.5 Explain inverted die

4.5 Understand punch and die design procedure

4.5.1 Clearance after considering the elastic recovery of the material
4.5.2 Cutting force
4.5.3 Method of reducing cutting force
4.5.4 Punch and die mounting

4.6 Describe fundamental of die design (piercing and blanking)

4.6.1 Blanking land piercing die construction
4.6.2 Die block design
4.6.3 Punch design and its types
4.6.4 Pilot and its types
4.6.5 Stripper and pressure pads
4.6.6 Guide stops
4.6.7 Stock strips
4.6.8 Strips lay out

5. Sheet Metal Dies

5.1 Explain Sheet Metal Dies (Blanking, Piercing, Progressive and Drawing Dies)
5.2 Design of (Blanking, Piercing, Progressive and Drawing Dies)
5.3 Introduction of Compound, Inverted, Bending and Forming Die

6. Die Casting

6.1 Introduction to Die Casting Machine

6.1.1 Explain die casting machine

6.2 Understand die casting Design

6.2.1 Enlist the put line of die casting die design

6.2.1.1 Gate location and size
6.2.1.2 Vents
6.2.1.3 Runner design
6.2.1.4 Riser pin design
6.2.1.5 Minimum section of thickness
6.2.1.6 Design Cored Type and their design

6.2.1.7 Draft requirements
6.2.1.8 Core slide and pins
6.2.1.9 Die materials

7. Standards of Steel used in Tool making

7.1 Introduction to Steel Standards
7.2 S.A.E, A.I.S.I, DIN, and BSS Standards

8. Injection Mould & Blow Mould

8.1 Introduction of Injection Moulding Machine
8.2 State Mould and its Types
- 8.2.1 Injection Moulding
- 8.2.2 Compression Moulding
- 8.2.3 Vacuum Moulding
- 8.2.4 Extrusion Moulding
- 8.2.5 Blow Moulding

8.3 State the Types of Plastic
- 8.3.1 Thermosetting
- 8.3.2 Thermo Plastic

8.4 Process of injection moulding
- 8.4.1 State the stages of Injection Moulding
  - 8.4.1.1 Melting
  - 8.4.1.2 Injection
  - 8.4.1.3 Solidification
  - 8.4.1.4 Ejection

8.5 Describe basic features of Blow Moulding Machine
8.6 Explain Control Parameter for Blow Moulding Machine

9. Mould Design

9.1 State the outline design of injection mould
- 9.1.1 Basic mould structure
- 9.1.2 Standard parts
- 9.1.3 Gate and runner
- 9.1.4 Ejection method
- 9.1.5 Parting line
- 9.1.6 Draft angle
- 9.1.7 Mould shrinkage
- 9.1.8 Air vent
- 9.1.9 Mould cooling
- 9.1.10 Strength and fastening Methods
- 9.1.11 Cycle of injection Moulding
- 9.1.12 Heating mechanism
- 9.1.13 Introduction to DELCAM software in mould design

9.2 Enlist the Types of Moulds
9.3 Describe the Alignments of Moulds
9.4 Explain Clamping of Moulds
9.5 Elaborate Injection Pressure & temperature management
9.6 Describe Surface finishing of moulds
9.7 Interpret the Coatings on mould cavities
9.8 Explain Shrinkage allowance in mould design

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Recommended Textbooks:

1. Tool Design By Donaldson
2. Machine Tool Technology by Repp/ Mccarthy
3. Fundamentals of Modern Manufacturing by Groover
4. Mould Design by R.G.W. Pye
5. Introduction Jig and Tool Design by M.H.A Kempster
6. Fundamental of Tool Design by: Frank W.Wilson (National Book Foundation Pakistan)

Mech-363 **TOOL AND MOULD DESIGN**

List of Practical:

1. Draw standard parts used in jigs and fixtures i.e. hex. head nut & bolt, screws and washers 6 Hrs
2. Draw clamps,(a) hook type (b) latch type (c)quarter turn bolt (d)cam clamp 6Hrs
3. Draw locators 3Hrs
4. Draw template jig/plate type Jig 6 Hrs
5. Draw a swinging leaf jig 6Hrs
6. Draw an indexing jig 6Hrs
7. Draw an Angle milling fixture 3Hrs
8. Draw a lathe fixture for turning and boring operation 6 Hrs
9. Draw a blanking die and calculate the size of punch and die for making a blank of dia. 40 mm 6Hrs
10. Draw a progressive die and calculate the size of punch and die for making a washer inner dia.25 and outer dia 50mm 6 Hrs
11. Draw a simple drawing die for a cup for inner dia. 40mm, depth 30mm and sheet thickness 1mm 6 Hrs
12. Draw an injection moulding machine used in plastic injection moulding 3Hrs
13. Assembling/disassembling of simple mould 3 Hr
14. Draw an injection mould of a Mobile Top by 3D CAD 30Hrs

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Mech-332 **MATERIALS TESTING AND HEAT TREATMENT**

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

AIMS: After going through this course, student will be able to:

I) understand destructive and non-destructive test

II) Understand working of testing equipment

III) Know the basic theories of heat treatment processes

IV) Understand common heat treatment processes

V) Understand common heat treatment processes of nonferrous metals

Course Contents:

(A) MATERIALS TESTING

1.	Mechanical properties of Metallic Materials	2 Hrs
2.	Destructive Test	7Hrs
3.	Non-Destructive Tests	7Hrs

(B) HEAT TREATMENT

4.	Heat Treatment of steels	3 Hrs
5.	Heat Treatment Equipment	3 Hrs
6.	Heat Treatment Processes	4 Hrs
7.	Case hardening Processes	3 Hrs
8.	Heat Treatment of Non-Ferrous Metals and Cast Iron	3 Hrs

Detail of Contents:

(A) MATERIALS TESTING

1. Mechanical properties of Metallic Materials **2 Hrs**

1.1 Mechanical Properties of Materials

1.1.1 Hardness

1.1.2 Toughness

1.1.3 Ductility

1.1.4 Malleability

1.1.5 Elasticity

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1.1.6 Brittleness

1.1.7 Plasticity

1.1.8 Stiffness

1.2 Testing of materials

1.2.1 Destructive tests.

1.2.2 Nondestructive tests

2. Destructive Test **7 Hrs**

2.1 Hardness tests
- 2.1.1 Brinall hardness test
- 2.1.2 Rockwell hardness test
- 2.1.3 Vickers hardness test
- 2.1.4 Shore Hardness Test

2.2 Izod impact test
2.3 Tensile test
2.4 Compression Test
2.5 Bending test
2.6 Shear Test
2.7 Torsion test
2.8 Fatigue test

3. Non-Destructive Test (NDT) **7 Hrs**

3.1 Field of Utilization of NDTs
3.2 Pressure Test
3.3 Hammer Test (Sonic Inspection)
3.4 Visual Inspection (Boroscopy and video scopy)
3.5 Dye Penetrant Test (DPT)
3.6 Eddy Current inspection
3.7 Ultrasonic Inspection
3.8 Magnetic Particle Inspection
3.9 Radiographic Inspection
3.10 Infrared Thermography

B) HEAT TREATMENT

4. Heat Treatment of steels **3 Hrs**

4.1 Iron-Iron carbide diagram
4.2 Phase diagrams
4.3 Effect of heating on steel
4.4 Effect of cooling on steel

5. Heat Treatment Processes **4 Hrs**

5.1 Annealing
5.2 Hardening
5.3 Tempering
5.4 Normalizing

6. Heat Treatment Equipment **3 Hrs**

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6.1 Heat Treatment Furnaces
6.2 Pyrometers
6.3 Metallurgical microscope

7. Case Hardening Processes **3 Hrs**

7.1 Carburizing (pack, gas, liquid)
7.2 Induction hardening
7.3 Flame hardening
7.4 Cyaniding
7.5 Nitriding

8. Heat Treatment of Non-Ferrous Metals and Cast Iron **3 Hrs**

8.1 Heat treatment of cast iron
8.2 Heat treatment of Non-ferrous metals and alloys
8.3 Annealing of non-ferrous metals and precipitation hardening

Recommended Textbooks:-

1. **Mettalurgy & Mettalography By Shrager**
2. **The Testing and Inspection of Engineering Materials By Harmer E-Davis, George Earl Troxel (McGraw Hill Book Company, New York)**
3. **Materials and Processes by James. F. Young (Jhon wiley & sons Inc. New York)**
4. **Physical Metallurgy by AVNER**

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Mech-332 MATERIALS TESTING AND HEAT TREATMENT

Instructional Objectives:

1. **Mechanical properties of materials**

   1.1 Know Mechanical Properties of Materials

      1.1.1 Enlist mechanical properties of materials (hardness, toughness, ductility malleability, brittleness, elasticity, plasticity and stiffness)

      1.1.2 Define each property

   1.2 Know Destructive Tests

      1.2.1 Enlist destructive tests

      1.2.2 Define each test

   1.3 Know Non-Destructive Tests

      1.3.1 Enlist non-destructive tests

      1.3.2 Define each test

2. **Destructive Tests**

   2.1 Understand Hardness Tests and selection of test for a material

      2.1.1 Explain Brinnel Hardness Test

         2.1.1.1 Knows types of hardness tests

         2.1.1.2 Enlist parts of brinell hardness testing machine

         2.1.1.3 Explain working of Brinell hardness testing machines

         2.1.1.4 Explain preparation of specimen for Brinell hardness testing machine

         2.1.1.5 Explain the measurement of impression by microscope for brinell test

         2.1.1.6 Describe relevant calculations

      2.1.2. Explain Rockwell hardness testing machine

         2.1.2.1 Explain construction and working of Rockwell hardness testing machine (minor load, major load, scales B, C)

         2.1.2.2 Explain preparation of specimen for Rockwell hardness testing machine

         2.1.2.3 Appreciate correct dial reading procedure

         2.1.2.4 Enlist difference between brinell and Rockwell hardness testing

2.1.3 Explain Vicker hardness test

2.1.3.1 Describe Vicker hardness testing machine

2.1.3.2 Explain Vicker hardness testing method

2.1.4 Interpret Shore Hardness Test

2.1.4.1 Describe shore hardness testing machine

2.1.4.2 Explain shore hardness testing method

2.2 Explain the working Principles of Impact testing Machine

2.2.1 Enlist capacity and parts of Izod impact machine

2.2.2 Explain function of each part

2.2.3 Explain working principle

2.2.4 Explain preparation of specimen (ASTM, JIS, and ISO)

2.2.5 Appreciate correct dial reading technique

2.3 Explain the working Principle of Universal Testing Machine

2.3.1 Describe tensile testing machine

2.3.2 Enlist capacity and different parts of tensile testing machine and extensometer

2.3.3 Describe different function of tensile testing machine

2.3.4 Explain the preparation of standard tensile test specimen (ASTM, ISO)

2.3.5 Explain the procedure of tensile test of mild steel

2.3.6 Describe the stress strain curve obtained in a tensile test of mild steel

2.3.7 Describe the %age elongation and %age reduction in area of specimen in tensile test

2.3.8 State need of correct holding of specimen on machine

2.4 Explain Compression test

2.4.1 Describe compression test

2.4.2 Describe procedure for the conduct of compression test

2.4.3 Describe standard specimen for compression test

2.5 Understand Bending Test

2.5.1 Describe bending

2.5.2 Explain bending test and shape factor

2.5.3 Describe deflection in specimen and bending equation.

2.6 Understand Shear Test

2.6.1 Explain shear test procedure on universal testing machine

2.6.2 Explain shear stress calculation of round bar and punched plate specimen

2.7 Understand Torsion Testing Machines and Torsion Test

2.7.1 Describe torsion

2.7.2 Explain shafts subjected to twisting moment

2.7.3 Explain working of torsion testing machine

2.7.4 Explain procedure of torsion test

2.8 Understand Fatigue Testing Machine and Fatigue Test

2.8.1 Define fatigue

2.8.2 Describe the Phenomenon of Stress Hysteresis

2.8.3 Describe cyclic loading

2.8.4 Explain effect of fatigue on metals and fatigue failure

2.8.5 Explain working of fatigue testing machine

2.8.6 Explain procedure for fatigue test

3. Non Destructive Test

3.1 Describe Pressure Test (pneumatic, hydraulic)

3.2 Describe Hammer Test

3.3 Describe Visual Inspection

3.4 Explain Dye Penetrant Test

3.4.1 Describe need and uses of Dye penetrant test

3.4.2 Describe procedure of Dye penetrant test

3.5 Explain Eddy Current Inspection

3.5.1. Describe need and uses of Eddy Current test

3.5.2 Describe procedure of Eddy Current test

3.5.3 Describe equipment of Eddy Current test

3.6 Understand Ultrasonic Test of metals

3.6.1 Describe need and uses of Ultrasonic test in the Inspection of Metals and Metallic Component

3.6.2 Explain Ultrasonic testing Equipment

3.6.3 Describe procedure of Ultrasonic test

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3.7 Understand Magnetic particles inspection Methods

3.7.1 Enlist advantages disadvantages

3.7.2 Explain the equipment used

3.7.3 Explain the basic principle

3.7.4 Explain crack detection procedure

3.8 Understand Radiographic inspection

3.8.1 X-Ray Method

3.8.1.1 Enlist advantages and disadvantages of x-ray test.

3.8.1.2 Explain the basic principle of x-ray test

3.8.1.3 Explain the equipment used

3.8.1.4 Enlist the safety measures adapted in x-ray method

3.8.1.5 Explain the use of x-ray method in the inspection of castings and welded joints

3.8.1.6 Describe Visual Inspection techniques (Videoscopy & Boroscopy)

3.8.1.7 Infrared Thermography

3.8.2 Gamma Ray Method

3.8.2.1 Describe basic principle of Gamma Rays methods

3.8.2.1 Enlist advantages and disadvantages of Gamma Rays methods with respect to X-ray method

4. Heat Treatment

4.1 Understand Heat Treatment of Steel

4.1.1 Describe heat treatment of steel

4.1.2 Explain constituents of steel

4.1.3 Describe allotropic phases of steel

4.1.4 Explain change of structure on heating

4.1.5 Explain role of heating rate/cooling rate

4.1.6 Distinguish between micro and macro structure

4.1.7 Sketch iron carbide diagram

4.1.8 Describe significance of various areas in iron carbide diagram

4.1.9 Explain role of iron carbide diagram in heat treatment of carbon steel

4.1.10 Describe time temperature transformation diagram

4.2 Understand Phase Diagram (Alloy steel)

4.2.1 Define phase diagram

4.2.2 Explain importance of phase diagram

4.2.3 Name different phases

4.2.4 Explain different phases

4.3 Understand effect of heating on steels

4.3.1 Describe heating curve of steels

4.3.2 Describe its importance in heat treatment of steel

4.4 Understand Effect of rate of Cooling on Steel

4.4.1 Explain the change of micro structure on cooling

4.4.2 Explain the importance of rate of cooling

4.4.3 Enlist different methods of cooling and its effect

4.4.4 Explain cooling curve of steels

5. Heat Treatment Processes

5.1 Understand Hardening

5.1.1 Describe hardening and its objectives

5.1.2 Enlist steps taken in hardening

5.1.3 Describe effects of cooling rate on hardening

5.1.4 Define different media used for quenching

5.1.5 Describe harden ability of steels

5.2 Understand Tempering

5.2.1 Describe tempering and its objectives

5.2.2 Describe au tempering and martempering

5.3 Understand Annealing

5.3.1 Define annealing and its objectives

5.3.2 Describe types of annealing

5.3.2.1 Process Annealing

5.3.2.2 Full annealing

5.3.2.3 Isothermal annealing

5.3.2.4 Spherodizing annealing

5.4 Understand Normalizing

5.4.1 Define Normalizing and its objectives

5.4.2 Describe comparison between annealing and normalizing

6. Heat Treatment Equipment

6.1 Understand Heat Treatment Furnaces

6.1.1 Describe heat treatment furnaces

6.1.2 Classification of furnaces

6.1.2.1 Hearth Furnaces (Muffle and Semi-Muffle)

6.1.2.2 Bath furnaces

6.2 Understand Pyrometer

6.2.1 Define Pyrometer

6.2.2 Enlist types of pyrometers

6.2.3 Enlist different parts of thermocouple optical pyrometer, radiation pyrometer

6.2.4 Explain working principle of pyrometer

6.3 Understand Metallurgical Microscope

6.3.1 Describe microscope

6.3.2 Describe working and construction of metallurgical microscope

6.3.3 Explain Metallography

6.3.4 Describe preparation of specimen for metallogrphy

6.3.5 Describe etching and etchants

6.3.6 Describe microstructure study of iron

7. Case Hardening Processes

7.1 Understand Carburizing

7.1.1 Describe pack Carburizing

7.1.2 Describe liquid Carburizing

7.1.3 Describe gas Carburizing

7.2 Understand Induction hardening

7.2.1 Induction hardening process

7.2.2 Advantages of Induction hardening

7.3 Describe flame hardening

7.4 Describe cyaniding

7.5 Describe Nitriding

8. Understand Heat Treatment of Non Ferrous Metals, Alloys and Cast Iron

8.1 Explain heat treatment of cast iron

8.2 Explain heat treatment of nonferrous metals and alloys

8.3 Describe precipitation hardening and annealing of nonferrous metals

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Mech-332 MATERIALS TESTING AND HEAT TREATMENT

List of Practical:

(A) MATERIALS TESTING

1.	Practice for brinnell hardness test	3 Hrs
2.	Practice for Rockwell hardness test for B-scale hardness	6 Hrs
3.	Practice for Rockwell hardness test for C-scale hardness	3 Hrs
4.	Practice for Izod test on cast iron or Aluminum standard test specimens	3Hrs
5.	Practice for tensile test on universal testing machine on standard specimen	6Hrs
6.	Practice for Compression test on cast iron specimen.	6Hrs
7.	Practice for bending test on universal testing machine	3 Hrs
8.	Practice for shear test on universal testing machine	3 Hrs
9.	Practice for torsion test on torsion testing machine	3 Hrs
10.	Practice for fatigue test	3 Hrs
11.	Practice for Dye Penetrant test	3 Hrs
12.	Practice for Ultrasonic test on ultrasonic testing equipment	3 Hrs
13.	Practice for Magnetic particle test	3Hrs

(B) HEAT TREATMENT

14.	Practice for working of metallurgical microscope	3 Hrs
15.	Practice of preparation of specimen for metallography	6 Hrs
16.	Observe micro-structure of carbon steel specimen	6 Hrs
17.	Observe micro-structure of cast iron specimen	6 Hrs
18.	Practice for hardening and observe micro structure of carbon steel	6Hrs
19.	Practice for annealing and observe grain structure of carbon steel	6 Hrs
20.	Practice for normalizing and observe grain structure	6 Hrs
21.	Practice for pack carburizing and observe grain structure	6 Hrs
22.	Practice for stress relieving of Aluminum	3 Hrs

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Mech-354 WORK SHOP PRACTICE – III

Total Contact Hours	T	P	C
Theory 64	2	6	4
Practical 192			

AIMS At the end of this course the students will be able to:

i) Operate Milling, Hobbing and Grinding machines
ii) Make simple Mechanical projects
iii) Write Project report

Course Contents:

1.	**Milling Machines**	**4 Hrs**
2.	**Attachments and Work Holding Devices**	**4 Hrs**
3.	**Milling Cutters**	**4Hrs**
4.	**Milling Operations**	**2 Hrs**
5.	**Gears and Gear Calculation**	**4 Hrs**
6.	**Indexing Methods**	**4 Hrs**
7.	**Helical Milling**	**6 Hrs**
8.	**Hobbing Machine**	**7 Hrs**
9.	**Precision Grinding Machines**	**3 Hrs**
10.	**Grinding Operations**	**2 Hrs**
11.	**Non-Traditional Machining Processes**	**4 Hrs**
12.	**Project**	**20 Hrs**

Detail Contents :

1. **Milling Machines** **4 Hrs**
   - 1.1 Types and constructions
   - 1.2 Parts and their function
   - 1.3 Care and Maintenance
   - 1.4 Safety precaution to operate milling machine
2. **Attachments and Work Holding Devices** **3 Hrs**
   - 2.1 Milling attachments and accessories
   - 2.2 Work holding devices
   - 2.3 Compound angle setting
3. **Milling Cutters** **3Hrs**
   - 3.1 Horizontal arbor milling cutters
   - 3.2 Vertical arbor milling cutters
   - 3.2 Cutter materials
   - 3.4 Cutting speed and feed for milling work
4. **Milling Operations** **2Hrs**

4.1 Methods of Milling
- 4.1.1 Climb milling
- 4.1.2Conventional milling

4.2 Milling Operations
- 4.2.1 Plain milling
- 4.2.2 Side milling
- 4.2.3 End milling
- 4.2.4 Slot milling
- 4.2.5 Straddle milling
- 4.2.6 Gang Milling
- 4.2.7 Sawing
- 4.2.8 Gear cutting

5. Gears and Gear Calculation — **6 Hrs**
- 5.1 Types of Gears (Spur, Rack & Pinion, Helical, Bevel, Worm & worm gear)
- 5.2 Gear and gear blank
- 5.3 Spur gear terminology
- 5.4 Spur gear formulae and calculations
- 5.5 Straight Bevel gear formulae and calculations

6. Indexing Methods — **4 Hrs**
- 6.1 Introduction
- 6.2 Direct indexing method and calculations
- 6.3 Simple or plain indexing method and calculations
- 6.4 Differential indexing method and calculations
- 6.5 Angular indexing method and calculations

7. Helical Milling — **6 Hrs**
- 7.1 Use of helical gears in power transmission
- 7.2 Lead of helical gear
- 7.3 Lead of milling machines
- 7.4 Formulae and calculation of helical gears
- 7.5 Work table setting for left and right hand helical gears

8. Hobbing Machine — **7 Hrs**
- 8.1 Introduction
- 8.2 Working principles of differential type hobbing machine
- 8.3 Construction and use of hobbing machine
- 8.4 Spur gear calculation and machine setting
- 8.5 Helical gear calculation and machine setting
- 8.6 Worm and worm gear calculations and machine setting

9. Precision Grinding Machines — **3 Hrs**
- 9.1 Types and construction
- 9.2 Work holding devices and accessories
- 9.3 Grinding fluids

10. Grinding Operations — **2 Hrs**
- 10.1 Surface grinding
- 10.2 Cylindrical Grinding
- 10.3 Internal grinding
- 10.4 Form grinding
- 10.5 Center less grinding
- 10.6 Form cutter grinding

11. Non-Traditional Machining Processes — **4 Hrs**
- 11.1 Electro-Discharge machining (EDM) and its working principle

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11.2 Electron beam machining. (EBM) and its working principle
11.3 Electrolytic grinding (ELG) and its working principle
11.4 Electrochemical machining (ECM) and its working principle
11.5 Electrochemical Gridding (ECG) and its working principle
11.6 Ultrasonic Machining. (USM) and its working principle
11.7 Hydro-jet Machining / Water-jet machining (WJM) and its working principle
11.8 Laser beam machining (LBM) and its working principle
11.9 Additive Manufacturing (SLS, FDM, E-Beam)

12. Project **20 Hrs**

12.1 Introduction
12.2 Necessity and need of project
12.3 Planning a project
12.4 Detail and assembly drawings
12.5 Material requirements of project
12.6 Project report
12.7 Proposed projects
- 12.7.1 Surface gauge (Roughness Meters)
- 12.7.2 Rack and Pinion assembly
- 12.7.3 Index plate of dividing head
- 12.7.4 Spur gear assembly (simple gear train)
- 12.7.5 Spur gear assembly (compound gear train)
- 12.7.6 Helical gear assembly (Simple gear train)
- 12.7.7 Helical gear assembly (Compound gear train)
- 12.7.8 Gear box comprising worm and worm gear
- 12.7.9 Shaper tool post
- 12.7.10 Drill press vice
- 12.7.11 Screw jack
- 12.7.12 Working model of drilling machine
- 12.7.13 Working model of shaper
- 12.7.14 Tool wear Measurements (CMM, Profile Projector etc.)
- 12.7.14 Any other project assigned by the concerned teacher

Recommended Textbooks:

1. **Technology of machine tools by S.F.Krar and A.F.Check(Publisher: McGRAW-HILL , 2004)**
2. **Machine tool practice by RICHARD R. KIBBLE (Publisher: John Wiley & Sons, 2009)**
3. **Machine tool operation part II by Henry D.Burghardt**
4. **Workshop Technology part III by W.A.J Chapman**
5. **Machinery Handbook (Latest Edition)**

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Mech-354 WORKSHOP PRACTICE – III

Instructional Objectives:

1. **Milling Machines**
   - 1.1 State working principle of milling machine
   - 1.2 Identify and describe the use of different types of milling machines
   - 1.3 Explain the construction of universal milling
   - 1.4 State safety precautions to operate milling machine
2. **Attachments and Work Holding Devices**
   - 2.1 Describe the use and necessity of dividing head
   - 2.2 Describe the use and necessity of vertical head
   - 2.3 Describe the use and necessity of slotting head
   - 2.4 Describe the use and necessity of rotary table and slotting head
   - 2.5 Describe the use and necessity of machine vice and swivel base vice
   - 2.6 Describe the use and necessity of universal vice and milling arbor
3. **Milling Cutters**
   - 3.1 Describe the use of horizontal arbor milling cutters
   - 3.2 Describe the use of vertical arbor milling cutters
   - 3.3 Describe the necessity and importance of different cutter materials
   - 3.4 Describe cutting speed and feeds as applied to milling work
   - 3.5 Calculate r.p.m. of milling spindle and feed rate in mm/mint
4. **Milling Operations**
   - 4.1 Explain methods of milling (dimb and conventional milling)
   - 4.2 Explain plain and side milling operation
   - 4.3 Explain end milling and slotting operation
   - 4.4 Explain straddle and gang milling operation
   - 4.5 Explain sawing and gear cutting operation
5. **Gears and Gear Calculation**
   - 5.1 Describe types of gears (Spur, Rack & Pinion, Helical, Bevel, Worm & worm gear)
   - 5.2 Describe gear and gear blank
   - 5.3 Explain spur gear terminology in detail
   - 5.4 Calculate module, gear blank size, depth of cut, circular pitch etc
   - 5.5 Calculate Straight Bevel gear formulae
6. **Indexing Methods**
   - 6.1 Define indexing
   - 6.2 Explain direct indexing method in detail
   - 6.3 Explain simple/plain indexing method in detail
   - 6.4 Explain differential indexing method in detail
   - 6.5 Explain angular indexing method in detail
   - 6.6 Calculation of above said indexing methods
7. **Helical Milling**
   - 7.1 Describe difference between spur and helical gear
   - 7.2 Describe the use of helical gears in power transmission
   - 7.3 Explain the lead of helical gear
   - 7.4 Explain the lead of milling machine
   - 7.5 Describe the work table setting for right/left hand helical gears
   - 7.6 Explain the formulae and calculation for helical gears
8. **Hobbing Machine**

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8.1 Describe the working principle of hobbing machine
8.2 Describe the construction and use of vertical differential type hobbing machine
8.3 Explain spur gear formulae , calculation and machine setting
8.4 Explain helical gear formulae , calculation and machine setting
8.5 Explain worm and worm gear formulae, calculation and machine setting

9. Precision Grinding Machines

9.1 Describe the construction and use of surface grinding machine
9.2 Describe the construction and use of cylindrical grinding machine
9.3 Describe the construction and use of cylindrical grinding machine
9.4 Describe the construction and use of universal tool and cutter grinding machine
9.5 Describe the importance and use of grinding fluids

10. Grinding Operations

10.1 Describe surface and cylindrical grinding
10.2 Describe internal and form grinding
10.3 Describe centre less and form cutter grinding

11. Non-Traditional Machining Processes

11.1 Describe electro discharge machining (EDM) and its working principle
11.2 Describe electron beam machining (EBM) and its working principle
11.3 Describe electrolytic grinding (ELG) and its working principle
11.4 Describe electro chemical machining (ECM) and its working principle
11.5 Describe ultrasonic machining (USM) and its working principle
11.6 Describe hydro-jet machining /water jet machining (WJM) and its working principle
11.7 Describe laser beam machining (LBM) and its working principle
11.8 Describe Additive Manufacturing

12. Project

12.1 Describe the necessity and need of the project
12.2 Explain material requirements of the project
12.3 Describe the importance of detail and assembly drawings
12.4 Explain the importance of right process selection
12.5 Estimation and costing of the project
12.6 Explain the format of project report
12.7 Explain project report writing including drawings, procedures, material list, process chart, difficulties faced and suggestions for improvements

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Mech-354 WORKSHOP PRACTICE - III

List of Practical:

1.	Practice of Slot milling	9Hrs
2.	Practice of Spur rack cutting	9Hrs
3.	Practice of Helical rack cutting	9Hrs
4.	Practice of Spur gear cutting (Direct indexing method)	9 Hrs
5.	Practice of Spur gear cutting (Plain indexing method)	9 Hrs
6.	Practice of Spur gear cutting (Differential indexing method)	9 Hrs
7.	Practice of Left hand helical gear cutting on milling machine	9 Hrs
8.	Practice of Right hand helical gear cutting on milling machine	9 Hrs
9.	Practice of Spur gear cutting on hobbing machine	9Hrs
10.	Practice of Right hand helical gear cutting on hobbing machine	9Hrs
11.	Practice and calculation of worm and worm gear, worm gear cutting	9Hrs
12.	Practice of Straight Bevel gear cutting on milling machine	9 Hrs
13.	Practice of Grinding of flat surfaces	9 Hrs
14.	Practice of Cylindrical Grinding operation	9 Hrs
15.	Practice of Grinding of form milling cutter	9 Hrs
16.	Practice of Straddle milling	9 Hrs
17.	Project	48 Hrs

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Mech-352 CAD / CAM

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

AIMS: At the end of this course the students will be able to:

I. Sketches (2D & 3D)
II. Solid Modeling
III. Assembly Modeling
IV. CAM for Milling, Turning, Wire Cut(EDM) & Die Sinker
V. Process Planning

Course Contents:

1.	**Introduction to 2D and3D CAD**	**1 Hrs**
2.	**2D Sketch (ASTM standards)**	**2 Hrs**
3.	**Dimension and Constraint (ASTM standards)**	**2 Hrs**
4.	**Tolerances (ASTM standards)**	**2 Hrs**
5.	**Solid Modeling**	**8 Hrs**
6.	**Assembly Modeling**	**4Hrs**
7.	**Drawing View**	**1 Hr**
8.	**Presentation Module**	**1 Hr**
9.	**Sheet Metal Components**	**3 Hrs**
10.	**CAM**	**6 Hrs**
11.	**Process Planning**	**2 Hrs**

Detail of Contents:

1. Introduction to 2D and 3D CAD **1 Hr**
- 1.1 Modules
- 1.2 Toolbars
- 1.3 Units and Dimensions
- 1.4 Important Terms and Definitions

2. 2D Sketch (ASTM standards) **2 Hrs**
- 2.1 Sketch Environment
- 2.2 Drawing Display Tools
- 2.3 Sketching Entities
- 2.4 Pattern
- 2.5 Tolerance
- 2.6 Work Feature

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3. Dimension and Constraint(ASTM standards) **2Hrs**
- 3.1 Dimension

3.2 Geometric Constraint

3.2.1 Perpendicular Constraint

3.2.2 Parallel Constraint

3.2.3 Tangent Constraint

3.2.4 Coincident Constraint

3.2.5 Concentric Constraint

3.2.6 Collinear Constraint

3.2.7 Horizontal Constraint

3.2.8 Vertical Constraint

3.2.9 Equal Constraint

3.2.10 Fix Constraint

3.2.11 Symmetric Constraint

3.2.12 Smooth Constraint

3.3 Measurement

4. Tolerances (ASTM standards) **2Hr**

4.1 Parameter

4.2 3D Sketching Entities

5. Solid Modeling **8Hrs**

5.1 Modeling Tools

5.1.1 Extrude Feature

5.1.2 Revolve Feature

5.1.3 Holes Feature

5.1.4 Fillets Feature

5.1.5 Chamfers Feature

5.1.6 Ribs Feature

5.1.7 Thicken and Offset Feature

5.2 Concept of Edit Feature

5.3 Advanced Modeling Tools

5.3.1 Sweep Feature

5.3.2 Lofted Feature

5.3.3 Coil Feature

5.3.4 Thread Feature

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5.3.5 Shell Feature

5.3.6 Face Draft Feature

5.3.7 Replacing Face Feature

5.3.8 Boundary Patch Feature

5.3.9 Stitching Surfaces Feature

5.3.10 Sculpt Feature

6. Assembly Modeling **4Hrs**

6.1 Types of Assembly

6.2 Assembly Component

6.2.1 Mate Constraint

6.2.2 Angle Constraint

6.2.3 Tangent Constraint

6.2.4 Insert Constraint

6.2.5 Rotation Constraint

6.2.6 Rotation-Translation Constraint

6.2.7 Transitional Constraint

6.3 Edit Assembly Constraint

7. Drawing View **1Hr**

7.1 Types of Views

7.2 Drawing Standards

7.3 Drawing Sheets

7.4 Dimension Style

7.5 Parts Lists

8. Presentation Module **1Hr**

8.1 Presentation View

8.2 Assembly Animation

9. Sheet Metal Components **3 Hrs**

9.1 Sheet Metal Components Parameter

9.2 Sheets Metal Components

9.2.1 Fold Feature

9.2.2 Flange Feature

9.2.3 Cut Feature

9.2.4 Corner Seam Feature

9.2.5 Bend Feature

9.2.6 Corner Round Feature

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9.2.7 Corner Chamfer Feature

9.2.8 Hem Feature

9.2.9 Contour Flange Feature

10. CAM **6 Hrs**

10.1 Introduction of CAM
- 10.1.1 User Interface
- 10.1.2 Setup of materials
- 10.1.3 Setup of cutting tools
- 10.1.4 Strategy and cutting processes
- 10.1.5 Generating tool paths
- 10.1.6 Tool parts simulation

10.2 2D CAM
- 10.2.1 Holes Drilling
- 10.2.2 Face cutting
- 10.2.3 Side cutting
- 10.2.4 Pocket cutting
- 10.2.5 Slot cutting

10.3 CAM Milling
- 10.3.1 Rough cutting
  - 10.3.1.1 Z level Roughing
  - 10.3.1.2 Parallel Roughing
  - 10.3.1.3 Plunge Roughing
  - 10.3.1.4 Flat Roughing
  - 10.3.1.5 Cutting Boundaries
  - 10.3.1.6 Stepovers and leads
- 10.3.2 Finish cutting
  - 10.3.2.1 Parallel Finishing
  - 10.3.2.2 Z Level Finishing
  - 10.3.2.3 Corner and Pencil Finishing
  - 10.3.2.4 Isoline Finishing
  - 10.3.2.5 Radial and Spiral Finishing
  - 10.3.2.6 Flowline Finishing
  - 10.3.2.7 Between 2 curves Finishing
  - 10.3.2.8 Swarf Finishing
  - 10.3.2.9 Cutting Finishing
  - 10.3.2.10 Step overs Finishing

10.4 CAM Lathe
- 10.4.1 Facing
- 10.4.2 Boring
- 10.4.3 Grooving
- 10.4.4 Threading (Inside and Outside)
- 10.4.5 Cut off

10.5 CAM Wire Cut
- 10.5.1 Die Cutting
- 10.5.2 Punch Cutting
- 10.5.3 Taper Cutting
- 10.5.4 4 Axis Wiring Cutting
- 10.5.5 No Core Cutting

10.6 CAM Router
- 10.6.1 Contouring
- 10.6.2 Pocketing

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10.6.3 Engraving
10.6.4 Chamfering
10.6.5 Raster to vector Translator
10.6.6 Nesting

10.7 CAM Multi-Axis
10.7.1 4 Axis Milling
10.7.2 5 Axis Swarf Milling
10.7.3 5 Axis Index Drilling

11. Process Planning **02 Hrs**

11.1 Types of Stocks
11.2 Squaring Graphs
11.3 Feature Interaction Graphs

Recommended Textbooks:

1. Mastering Solid Works by Ibrahim Zeid
2. The CNC Work Shop by Frank Nanfara (Publisher: SDC Publications, 2002)
3. Integrated Process & Fixture Planning, Theory & practice by Dr. Awais Ahmed Khan

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Instructional Objectives:

1. **Introduction of 3D CAD**
   - 1.1 Describe Modules
   - 1.2 Describe Toolbars
   - 1.3 Describe Units and Dimensions
   - 1.4 Describe Important Terms and Definitions
2. **2D Sketch (ASTM Standards)**
   - 4.1 Explain Sketch Environment
   - 4.2 Explain Drawing Display Tools
   - 4.3 Explain Sketching Entities
   - 4.4 Explain Pattern
   - 4.5 Explain Tolerance
   - 4.6 Explain Work Feature
3. **Dimension and Constraint (ASTM Standards)**
   - 3.1 Explain Dimension
   - 3.2 Geometric Constraint
     - 3.2.1 Understand Perpendicular Constraint
     - 3.2.2 Understand Parallel Constraint
     - 3.2.3 Understand Tangent Constraint
     - 3.2.4 Understand Coincident Constraint
     - 3.2.5 Understand Concentric Constraint
     - 3.2.6 Understand Collinear Constraint
     - 3.2.7 Understand Horizontal Constraint
     - 3.2.8 Understand Vertical Constraint
     - 3.2.9 Understand Equal Constraint
     - 3.2.10 Understand Fix Constraint
     - 3.2.11 Understand Symmetric Constraint
     - 3.2.12 Understand Smooth Constraint
   - 3.3 Explain Measurement
4. **Tolerances (ASTM Standards)**
   - 4.1 Understand Parameter
   - 4.2 Understand 3D Sketching Entities
5. **Solid Modeling**
   - 5.1 Modeling Tools
     - 5.1.1 Understand Extrude Feature
     - 5.1.2 Understand Revolve Feature
     - 5.1.3 Understand Holes Feature
     - 5.1.4 Understand Fillets Feature
     - 5.1.5 Understand Chamfers Feature
     - 5.1.6 Understand Ribs Feature
     - 5.1.7 Understand Thicken and Offset Feature

5.2 Explain Concept of Edit Feature
5.3 Advanced Modeling Tools
5.3.1 Understand Sweep Feature
5.3.2 Understand Lofted Feature
5.3.3 Understand Coil Feature
5.3.4 Understand Thread Feature
5.3.5 Understand Shell Feature
5.3.6 Understand Face Draft Feature
5.3.7 Understand Replacing Face Feature
5.3.8 Understand Boundary Patch Feature
5.3.9 Understand Stitching Surfaces Feature
5.3.10 Understand Sculpt Feature

6. Assembly Modeling
6.1 Describe Types of Assembly
6.2 Assembly Component
6.2.1 Understand Mate Constraint
6.2.2 Understand Angle Constraint
6.2.3 Understand Tangent Constraint
6.2.4 Understand Insert Constraint
6.2.5 Understand Rotation Constraint
6.2.6 Understand Rotation-Translation Constraint
6.2.7 Understand Transitional Constraint
6.3 Explain Editing of Assembly Constraint

7. Drawing View
7.1 Explain Types of Views
7.2 Explain Drawing Standards
7.3 Explain Drawing Sheets
7.4 Explain Dimension Style
7.5 Explain Parts Lists

8. Presentation Module
8.1 Explain Presentation View
8.2 Explain Assembly Animation

9. Sheet Metal Components
9.1 Explain Sheet Metal Components Parameter
9.2 Sheets Metal Components
9.2.1 Understand Fold Feature
9.2.2 Understand Flange Feature
9.2.3 Understand Cut Feature
9.2.4 Understand Corner Seam Feature
9.2.5 Understand Bend Feature
9.2.6 Understand Corner Round Feature
9.2.7 Understand Corner Chamfer Feature
9.2.8 Understand Hem Feature
9.2.9 Understand Contour Flange Feature

10. CAM
10.1 Introduction of CAM
10.1.1 Understand User Interface
10.1.2 Understand Setup of materials
10.1.3 Understand Setup of cutting tools
10.1.4 Understand Strategy and cutting processes
10.1.5 Understand Generating tool paths
10.1.6 Understand Tool parts simulation

10.2 2D CAM
- 10.2.1 Describe Holes Drilling
- 10.2.2 Describe Face cutting
- 10.2.3 Describe Side cutting
- 10.2.4 Describe Pocket cutting
- 10.2.5 Describe Slot cutting

10.3 CAM Milling
- 10.3.1 Rough cutting
  - 10.3.1.1 Describe Z level Roughing
  - 10.3.1.2 Describe Parallel Roughing
  - 10.3.1.3 Describe Plunge Roughing
  - 10.3.1.4 Describe Flat Roughing
  - 10.3.1.5 Describe Cutting Boundaries
  - 10.3.1.6 Describe Step-overs and leads
- 10.3.2 Finish cutting
  - 10.3.2.1 Describe Parallel Finishing
  - 10.3.2.2 Describe Z Level Finishing
  - 10.3.2.3 Describe Corner and Pencil Finishing
  - 10.3.2.4 Describe Isoline Finishing
  - 10.3.2.5 Describe Radial and Spiral Finishing
  - 10.3.2.6 Describe Flowline Finishing
  - 10.3.2.7 Describe Between 2 curves Finishing
  - 10.3.2.8 Describe Swarf Finishing
  - 10.3.2.9 Describe Cutting Finishing
  - 10.3.2.10 Describe Step-overs Finishing

10.4 CAM Lathe
- 10.4.1 Explain Facing
- 10.4.2 Explain Boring
- 10.4.3 Explain Grooving
- 10.4.4 Explain Threading (Inside and Outside)
- 10.4.5 Explain Cut off

10.5 CAM Wire Cut
- 10.5.1 Explain Die Cutting
- 10.5.2 Explain Punch Cutting
- 10.5.3 Explain Taper Cutting
- 10.5.4 Explain 4 Axis Wiring Cutting
- 10.5.5 Explain No Core Cutting

10.6 CAM Router
- 10.6.1 Explain Contouring
- 10.6.2 Explain Pocketing
- 10.6.3 Explain Engraving
- 10.6.4 Explain Chamfering
- 10.6.5 Explain Raster to vector Translator
- 10.6.6 Explain Nesting

10.7 CAM Multi-Axis
- 10.7.1 Explain4 Axis Milling
- 10.7.2 Explain5 Axis Swarf Milling
- 10.7.3 Explain5 Axis Index Drilling

11.Process Planning

11.1 Enlist Types of Stocks

11.2 Illustrate Squaring Graphs

11.3 Describe Feature Interaction Graphs

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List of Practical:

1. **Practice Sketch and Constrain** **10Hrs**
   - 1.1 Draw Line
   - 1.2 Draw Circle
   - 1.3 Draw Ellipse
   - 1.4 Draw Arc
   - 1.5 Draw Rectangle
   - 1.6 Draw Polygon
   - 1.7 Place Points/Center Point
   - 1.8 Create Fillet
   - 1.9 Create Chamfer
   - 1.10 Draw Spline
   - 1.11 Create 3D Intersection Curve
   - 1.12 Draw Helical curve
   - 1.13 Add Perpendicular Constraint
   - 1.14 Add Parallel Constraint
   - 1.15 Add Tangent Constraint
   - 1.16 Add Coincident Constraint
   - 1.17 Add Concentric Constraint
   - 1.18 Add Collinear Constraint
   - 1.19 Add Horizontal Constraint
   - 1.20 Add Vertical Constraint
   - 1.21 Add Equal Constraint
   - 1.22 Add Fix Constraint
   - 1.23 Add Symmetric Constraint
   - 1.24 Add Smooth Constraint
2. **Practice Solid Modeling** **20Hrs**
   - 2.1 Create Extrude
   - 2.2 Create Revolve
   - 2.3 Create Hole
   - 2.4 Create Fillet
   - 2.5 Create Chamfer
   - 2.6 Create Rib
   - 2.7 Create Thicken / Offset
   - 2.8 Create Emboss
   - 2.9 Create Decal
   - 2.10 Create Sweep
   - 2.11 Create Loft
   - 2.12 Create Coil
   - 2.13 Create Thread
   - 2.14 Create Shell
   - 2.15 Create Face Draft
   - 2.16 Create Split
   - 2.17 Create Boundary Patch
   - 2.18 Create Trim and Extend Surface
   - 2.19 Create Stitch Surface
   - 2.20 Create Replace Face
   - 2.21 Create Sculpt

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3.	**Practice Assembly Modeling**	**10Hrs**
3.1	Practice Top Down Assembly	
3.2	Practice Bottom Up Assembly	
3.3	Practice Assemble parts with Mate Constraint	
3.4	Practice Assemble parts with Angle Constraint	
3.5	Practice Assemble parts with Tangent Constraint	
3.6	Practice Assemble parts with Insert Constraint	
3.7	Practice Assemble parts with Rotation Constraint	
3.8	Practice Assemble parts with Rotation-Translation Constraint	
3.9	Practice Assemble parts with Transitional Constraint	
4.	**Practice Sheet Metal**	**14Hrs**
4.1	Create Fold	
4.2	Create Flange	
4.3	Create Cut	
4.4	Create Corner Seam	
4.5	Create Bend	
4.6	Create Corner Round	
4.7	Create Corner Chamfer	
4.8	Create Hem	
4.9	Create Contour Flange	
5.	**Practice Welds**	**8Hrs**
5.1	Create Fillet Weld	
5.2	Create Cosmetic Weld	
5.3	Create Groove Weld	
6.	**Practice 2.5D CAM**	**4Hrs**
6.1	Create Toolpath for Drilling	
6.2	Create Toolpath for Side Cutting	
6.3	Create Toolpath for Face Cutting	
6.4	Create Toolpath for Pocket	
7.	**Practice CAM Milling**	**10Hrs**
7.1	Create Toolpath for Z-Level Rough Cutting	
7.2	Create Toolpath for Parallel Rough Cutting	
7.3	Create Toolpath for Z-Level Finish Cutting	
7.4	Create Toolpath for Parallel Finish Cutting	
7.5	Create Toolpath for 3D Spiral Cutting	
7.6	Create Toolpath for Corner Re-machining	
7.7	Create Toolpath for Pencil Cutting	
7.8	Create Toolpath for Horizon + Vertical Cutting	
8.	**CAM Turn/Milling**	**10Hrs**
8.1	Create Toolpath for External / Internal Turning	
8.2	Create Toolpath for External/Internal Threading	
8.3	Create Toolpath for Engraving on SideFace	
8.4	Create Toolpath for Drilling/Slotting on Side Face	
8.5	Create Toolpath for Drilling/Slotting on External Face	
8.6	Create Milling Tool path on Side Face and External Face (Turn/Mill)	
8.7	Create Tool path for 4-Axies Rotary Milling	
9.	**CAM Wire Cut**	**10Hrs**
9.1	Create Profiling Tool path for Punch	

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Mech-372 CNC MACHINES

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

AIMS At the end of this course the students will be able to:-

i) Understand G code, M code and several types of CNC Tooling System.
ii) Operate Machining Center.
iii) Operate Turning Center.
iv) Operate Wire Cut

Course Contents:

1.	**Introduction to Numerical Control**	**1Hr**
2.	**NC Machine Tool Characteristics**	**1Hr**
3.	**Types of NC Machines Tools**	**6Hrs**
4.	**Configuration and Control Method of NC Machine Tools**	**2Hrs**
5.	**Accessories, Tools and Cutting Fluid**	**2Hrs**
6.	**Program (Turning Center)**	**6Hrs**
7.	**Program (Machining Center)**	**6Hrs**
8.	**Automated Manufacturing System**	**2 Hrs**
9.	**Condition for Cutting**	**2Hrs**
10.	**Cutting Tools and Chips**	**2 Hrs**
11.	**Selecting a Type of Tool Material**	**2 Hrs**

Detail of Contents:

1. **Introduction to Numerical Control** **1Hr**
   - 1.1 Numerical Control Theory
   - 1.2 NC Machine Tool Operations
2. **NC Machine Tool Characteristics** **1Hr**
   - 2.1 NC Machine Tool Characteristics and Types
   - 2.2 NC Machine Tool Structure, Names of Parts and Their Functions
   - 2.3 Use of NC Machine Tools
3. **Types of Machines Tools** **6Hrs**
   - 3.1 Turning Center
   - 3.2 Machining Center
   - 3.3 NC Milling Machine
   - 3.4 Horizontal NC Boring and Milling Machine
   - 3.5 NC Drilling and Tapping Machine

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3.6 NC Hobbing Machine
3.7 NC Grinder
3.8 NC Tool Grinder
3.9 NC Die-sinking Electric Discharge Machine
3.10 Wire-cut Electric Discharge Machine
3.11 NC Laser Machine Tool
3.12 Plasma Cutting Machine

4. Configuration and Control Method of NC Machine Tools **2Hrs**
4.1 Positioning Control and Profile Control
4.2 Servomechanism and Feedback Control
4.3 Ball Screws
4.4 Linear Motors
4.5 Linear Motion Guides
4.6 Tool Setting of Machining Centers

5. Accessories, Tools and Cutting Fluid **2Hrs**
5.1 Machining Center Accessories
5.2 Turning Center Accessories
5.3 Tools (Machining Center)
5.4 Tools (Turning Center)
5.5 Cutting Fluid

6. Program (Turning Center) **6Hrs**
6.1 Machining Process
6.2 Tooling
6.3 Coordinate System
6.4 G-Code, M-Code

7. Program (Machining Center) **6Hrs**
7.15 Machining Process
7.16 Tooling
7.17 Coordinate System
7.18 G-Code, M-Code

8. Automated Manufacturing System **2 Hrs**
8.1 DNC System
8.2 FMC and FMS
8.3 Networks (LAN)
8.4 CIM, FA
8.5 Robotics

9. Condition for Cutting **2Hrs**
9.1 Classification of Machining Methods and Cutting
9.2 Setting Cutting Conditions
9.3 Cutting Finish Allowance
9.4 Various Requirements Affecting a Finish Allowance
9.5 How to Calculate Cutting Power

10. Cutting Tools and Chips **2Hrs**
10.1 Names of Cutting Parts
10.2 Effects of Each Nose Edge Portion
10.3 Types and Applications of Cutting Tools
10.4 Nominal Symbols of Tip
10.5 Disposal of Chips

11. Selecting a Type of Tool Material **2 Hrs**
11.1 Classification of Cutting Tool Materials

11.2 High-speed Tool Steel
11.3 Cemented Carbide Tool
11.4 Coating High-speed Tool Steel
11.5 Cermet
11.6 Ceramics
11.7 Polycrystalline Compacts
11.8 Selection of tools using ISO system

Recommended Textbooks:

1. **The CNC Work Shop by Frank Nanfara (Publisher: SDC Publications, 2002)**
2. **Fundamental Knowledge of Cutting, Technical Educational Publication in Japan**
3. **Machining Center, Technical Educational Publication in Japan**
4. **NC Machine Tools, Technical Educational Publication in Japan**
5. **NC Lathe, Technical Educational Publication in Japan**

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Mech-372 CNC MACHINES

Instructional Objectives:

1. **Introduction of Numerical Control**
   - 1.1 Describe Numerical Control Theory
   - 1.2 Describe NC Machine Tool Operation
   - 1.3 Describe History of NC Machine Tool Development
   - 1.4 Describe Production Trends of NC Machine Tools
2. **NC Machine Tool Characteristics**
   - 2.1 Describe NC Machine Tool Characteristics and Types
   - 2.2 Describe NC Machine Tool Structure, Names of Parts and Their Functions
   - 2.3 Describe Use of NC Machine Tools
3. **Types of Machines Tools**
   - 3.1 Explain Turning Center
   - 3.2 Explain Machining Center
   - 3.3 Explain NC Milling Machine
   - 3.4 Explain Horizontal NC Boring and Milling Machine
   - 3.5 Explain NC Drilling and Tapping Machine
   - 3.6 Explain NC Die-sinking Electric Discharge Machine
   - 3.7 Explain Wire-cut Electric Discharge Machine
   - 3.8 Explain NC Laser Machine Tool
   - 3.9 Explain Plasma Cutting Machine
4. **Configuration and Control Method of NC Machine Tools**
   - 4.1 Describe Positioning Control and Profile Control
   - 4.2 Describe Servomechanism and Feedback Control
   - 4.3 Describe Ball Screws
   - 4.4 Describe Linear Motors
   - 4.5 Describe Linear Motion Guides
   - 4.6 Describe Tool Setting of Machining Centers
5. **Accessories, Tools and Cutting Fluid**
   - 9.1 Describe Machining Center Accessories
   - 9.1 Describe Turning Center Accessories
   - 9.1 Describe Tools (Machining Center)
   - 9.1 Describe Tools (Turning Center)
   - 9.1 Describe Cutting Fluid
6. **Program (Turning Center)**
   - 6.1 Explain Machining Process
   - 6.2 Explain Toolingand tool compensation
   - 6.3 Explain Coordinate System
   - 6.4 Explain G-Code, M-Code
7. **Program (Machining Center)**
   - 7.1 Explain Machining Process
   - 7.2 Explain Tooling
   - 7.3 Explain Coordinate System
   - 7.4 Explain G-Code, M-Code
8. **Automated Manufacturing System**
   - 8.1 Describe DNC System

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8.2 Describe FMC and FMS
8.3 Describe Networks (LAN)
8.4 Describe CIM, FA
8.5 Describe Robotics

9. Condition for Cutting

9.1 Explain Classification of Machining Methods and Cutting
9.1 Explain Setting Cutting Conditions
9.1 Explain Cutting Finish Allowance
9.1 Explain Various Requirements Affecting a Finish Allowance
9.1 Explain How to Calculate Cutting Power

10. Cutting Tools and Chips

10.1 Describe Names of Cutting Parts
10.2 Describe Effects of Each Nose Edge Portion
10.3 Describe Types and Applications of Cutting Tools
10.4 Describe Nominal Symbols of Tip
10.5 Describe Disposal of Chips

11. Selecting a Type of Tool Material

11.1 Explain Classification of Cutting Tool Materials
11.2 Explain High-speed Tool Steel
11.3 Explain Cemented Carbide Tool
11.4 Explain Coating
11.5 Explain Cermet
11.6 Explain Ceramics
11.7 Explain Polycrystalline Compacts

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Mech-372 CNC MACHINES

List of Practical:

1. **Observe Safety Precautions of CNC Machines** **3Hrs**
   - 1.1 General Safety Precaution for Machining Center, Turning Center and Wire Cut
   - 1.2 Machine Tool Safety Precautions for Machining Center, Turning Center and Wire Cut
   - 1.3 Warning and Marking Sign for Machining Center, Turning

2. **Observe Outline of Machine** **6Hrs**
   - 2.1 Conception of Machines
   - 2.2 Profile Diagram and Main Part Name of Machining Center, Turning Center and Wire Cut
   - 2.3 Machine Specification of Machining Center, Turning Center and Wire Cut
   - 2.4 Tool Specification
   - 2.5 Controller Specification
   - 2.6 Hydraulic and Pneumatic System (Coolant, Air)

3. **Operate Different Functions of Machines** **9Hrs**
   - 3.1 Operational Panel Introduction of Machining Center, Turning Center and Wire Cut
   - 3.2 Operation Step of Machining Center, Turning Center and Wire Cut
     - 3.2.1 Switch On, Switch Off
     - 3.2.2 Work Piece Setting
     - 3.2.3 Adjusting and Zero Setting
     - 3.2.4 Setting Tools and Tool Holders
     - 3.2.5 Running Machines

4. **Operate NC Program on Machining and Turning Center** **15Hrs**
   - 4.1 Main Program and Sub Program
   - 4.2 Interpolation Functions
   - 4.3 Feed Functions
   - 4.4 Coordinate and Local Coordinate System
   - 4.5 Miscellaneous Functions (M Code)
   - 4.6 Cycle Functions
   - 4.7 Compensation Functions
   - 4.8 Programming for Robotics

5. **Maintenance and Troubleshooting** **9Hrs**
   - 5.1 Regular Inspection
     - 5.1.1 Inspection before Starting, After Starting and End of Daily Operation
     - 5.1.2 Weekly, Monthly, Seasonal and Annual Inspection
   - 5.2 Lubrication Method
   - 5.3 Cleaning and Replacement Method
     - 5.3.1 Cleaning of the Lubrication Oil Reservoir
     - 5.3.2 Air Filter
     - 5.3.3 Coolant Tank
     - 5.3.4 Cleaning and Replacement of hydraulic Tank
     - 5.3.5 Replacement of Spin-Oil Filter
     - 5.3.6 Assembly Precautions after Cleaning or Replacement
     - 5.3.7 Oil Cooler for Spindle Cooling
     - 5.3.8 Replacement Method for Spindle Cooling and Gear Box Lubricant
   - 5.4 Disposal of Waste Water, Oil and Waste Material
   - 5.5 Steel Belt Chip Conveyor
   - 5.6 Trouble Shooting for Circuit Control Parts
   - 5.7 Trouble Shooting for Piping

6. Operate Different CNC Machines — 54Hrs

6.1 Operate Machining Center for following operations

- 6.1.1 Drilling
- 6.1.2 Tapping
- 6.1.3 Reaming
- 6.1.4 Shoulder Cutting
- 6.1.5 Face Cutting
- 6.1.6 Slot Milling
- 6.1.7 Spot Milling
- 6.1.8 Pocket Milling
- 6.1.9 Open Pocket and Island Milling
- 6.1.10 Core Milling
- 6.1.11 Project and its Inspection(Complete Part)

6.2 Operate Turning Center for following operations

- 6.2.1 External / Internal Turning
- 6.2.2 External / Internal Grooving
- 6.2.3 External/Internal Threading
- 6.2.4 Cut-Off
- 6.2.5 Drilling/Slotting on Side Face
- 6.2.6 Drilling/Slotting on External Face
- 6.2.7 Milling on Side Face and External Face (Turn/Mill)

6.3 Operate Wire Cut for following operations

- 6.3.1 Profiling for Punch
- 6.3.2 Profiling for Die
- 6.3.3 Side Cutting
- 6.3.4 Tapered Profiling
- 6.3.5 4-Axis Wire Cutting (Punch/Die/Side)