الجامعة الإسلامية لعالمية
INTERNATIONAL ISLAMIC UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM 2018.1 & onwards

(Updated Fall-2020)

DEPARTMENT OF MECHANICAL ENGINEERING

Mission

BS Mechanical Engineering Program is committed to prepare competent mechanical engineers equipped with knowledge, skills and ethical values to address technical challenges.

Program Educational Objectives (PEOs)

PEO1: Employable graduates pursuing successful professional careers.
PEO2: Graduates serving industry and society through R&D, professional development and entrepreneurship.
PEO3: Graduates with leadership qualities having Islamic values, interpersonal and managerial skills.

Program Learning Outcomes (PLOs)

PLO-1	Engineering Knowledge - Apply knowledge of mathematics, science, eengineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO-2	Problem Analysis - Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO-3	Design/Development of Solutions - Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PLO-4	Investigation - Conduct investigation into complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PLO-5	Modern Tool Usage - Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the Limitations.
PLO-6	The Engineer and Society - Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PLO-7	Environment and Sustainability - Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO-8	Ethics - Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO-9	Individual and Team Work – Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PLO-10	Communication - Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO-11	Project Management and Finance - Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO-12	Life-long Learning - Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Linkage of PEOs and PLOs

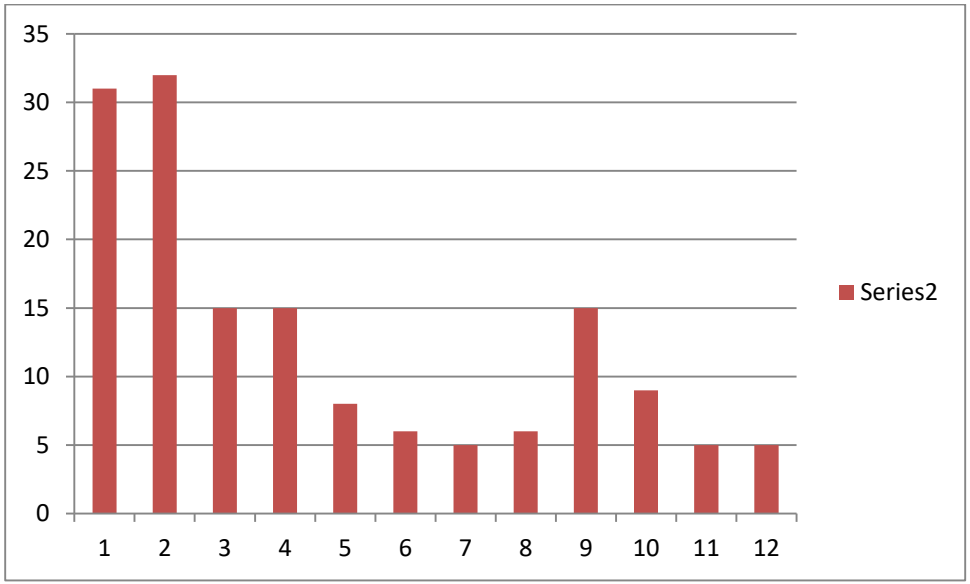
PLOs \ PEOs	PEO1 (Engineering Practice)	PEO2 (Professional Growth)	PEO3 (Social Service)
PLO-1 (Engineering Knowledge)	√		
PLO-2 (Problem Analysis)	√		
PLO-3 (Design/Development of Solutions)	√		
PLO-4 (Investigation)	√		
PLO-5 (Modern Tool Usage)		√	
PLO-6 (The Engineer and Society)		√	
PLO-7 (Environment and Sustainability)		√	
PLO-8 (Ethics)			√
PLO-9 (Individual and Team Work)			√
PLO-10 (Communication)			√
PLO-11 (Project Management and Finance)			√
PLO-12 (Life-long Learning)		√	

Mapping of CLO'S and PLO'S to curriculum																
Semester	Course Code	Course Title	Type of Course	PLO-01	PLO-02	PLO-03	PLO-04	PLO-05	PLO-06	PLO-07	PLO-08	PLO-09	PLO-10	PLO-11	PLO-12
				Engineering Knowledge	Problem Analysis	Design and Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life Long Learning
1	GS-101	Mathematics-1	T	√	√		√								
	GS-103	Applied Chemistry	T	√						√					
	GS-102	Applied Physics	T	√	√										
	ME-114	Introduction to Engineering	T						√		√				√
	EN-101	Functional English	T										√		
	CS-101	Computer Systems and Programming	T	√											

	ME-111	Engineering Drawing and Graphics	T	√	√											
	GR-101	Introduction to Arabic/Arabic for understanding Quran	T						√							√
	ME-111L	Engineering Drawing and Graphics Lab	L	√							√					
	GS-102L	Applied Physics Lab	L				√					√				
	CS-101L	Computer Systems and Programming Lab	L			√		√				√				
2	GS-104	Mathematics-2	T		√											
	EE-101	Electrical Engineering	T	√												
	ME-115	Engineering Materials	T	√	√		√			√						
	ME-113	Engineering Mechanics-I: Statics	T	√	√											
	GR-102	Communication Skills	T										√			
	GR-102L	Communication Skills Lab	L										√			
	ME-116L	Computer Aided Drawing Lab	L					√				√				
	ME-112L	Workshop Practice Lab	L	√		√								√		
	EE-101L	Electrical Engineering Lab	L				√					√				
3	GR-201	Pakistan Studies	T						√							
	ME-221	Thermodynamics-I	T	√												
	ME-211	Engineering Mechanics-II: Dynamics	T	√	√											
	ME-212	Mechanics of Materials–I	T	√	√											
	GS-201	Mathematics-3	T	√	√											
	EN-201	Technical Report Writing and Presentation Skills	T										√			√
	EN-201L	Technical Report Writing and Presentation Skills Lab	L										√			

	ME-211L	Engineering Mechanics Lab	L				√							√	
4	ME-224	Thermodynamics-II	T		√					√					
	EE-201	Electronics Engineering	T	√											
	GS-202	Social Sciences (Elective)	T						√		√				√
	ME-215	Mechanics of Materials–II	T	√	√										
	ME-223	Fluid Mechanics-I	T	√	√										
	ME-214	Machine Design-I	T	√		√							√		
	EE-201L	Electronics Engineering Lab	L				√					√			
	ME-215L	Mechanics of Materials Lab	L				√					√			
	ME-224L	Thermodynamics Lab	L		√		√					√			
5	ME-311	Machine Design-II	T		√	√									
	ME-322	Fluid Mechanics-II	T		√	√									
	ME-313	Manufacturing Processes	T	√	√										
	ME-321	Heat & Mass Transfer	T		√	√									
	ME-316	Instrumentation and Measurement	T	√	√	√									
	GS-301	Mathematics-4	T	√	√										
	GS-301L	Mathematics-4 Lab	L		√	√									
	ME-316L	Instrumentation and Measurement Lab	L				√					√	√		
	ME-313L	Manufacturing Processes Lab	L	√			√								
	ME-322L	Fluid Mechanics Lab	L				√					√			
6	GS-302	Engineering Statistics	T		√							√			
	ME-xxx	Technical Elective-I	T												
	ME-317	Control Engineering	T		√	√									

	ME-312	Mechanics of Machines	T	√	√	√											
	ME-323	Heating, Ventilating and Air Conditioning	T		√	√											
	MS-301	Health, Safety and Environment	T		√				√								
	ME-317L	Control Engineering Lab	L	√	√			√									
	ME-323L	Heat Transfer and HVAC Lab	L				√					√					
7	ME-421	Internal Combustion Engines	T	√			√										
	ME-411	Mechanical Vibrations	T	√	√	√											
	MS-401	Engineering Economics	T	√	√			√									
	ME-412	Introduction to Finite Element Analysis	T	√	√			√									
	ME-4xy	Technical Elective-II	T														
	ME-499	Senior Design Project-I	L	√	√	√		√	√	√		√	√	√			
	ME-411L	Mechanisms and Mechanical Vibrations Lab	L	√								√					
	ME-412L	Introduction to Finite Element Analysis Lab	L					√									
8	GR-401	Islamic Studies/ Ethics	T								√						
	MS-402	Entrepreneurship	T	√	√	√											
	ME-422	Power Plants	T		√	√				√							
	ME-4xy	Technical Elective-III	T														
	MS-4xy	Management Elective	T											√			
	ME-499	Senior Design Project-II	L				√	√			√	√	√	√	√	√	
	ME-422L	IC Engines & Power Plants Lab	L				√					√	√				



PLOs and CLOs mapping

Mapping of CLO'S and PLO'S of Technical Electives													
Course Code	Course Title	PLO-01	PLO-02	PLO-03	PLO-04	PLO-05	PLO-06	PLO-07	PLO-08	PLO-09	PLO-10	PLO-11	PLO-12
		Engineering Knowledge	Problem Analysis	Design and Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life Long Learning
ME-423	Renewable Energy Technology	√			√								
ME-416	Tribology	√											
ME-424	Computational Fluid Dynamics	√	√										
ME-425	Gas Dynamics	√	√										
ME-426	Aerodynamics	√	√										
ME-319	Automation and Robotics	√						√					
ME-315	Mechanical Engineering Design	√	√		√								
ME-318	Introduction to Mechatronics		√										

ME-428	Nuclear Engineering	√											
ME-413	Maintenance engineering	√	√										
ME-414	CAD/CAM	√	√			√							
ME-415	Product Design & Development	√	√										
ME-417	Production Engineering		√	√									

Mapping of CLO'S and PLO'S of Management Electives													
Course Code	Course Title	PLO-01	PLO-02	PLO-03	PLO-04	PLO-05	PLO-06	PLO-07	PLO-08	PLO-09	PLO-10	PLO-11	PLO-12
		Engineering Knowledge	Problem Analysis	Design and Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life Long Learning
MS-406	Industrial management											√	
MS-403	Operations research											√	
MS-404	Total quality management											√	
MS-405	Operations management											√	
MS-407	Engineering Law											√	

SECHEME OF STUDIES
BACHELORS (Mechanical Engineering)

Semester 1

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	GS101	Mathematics-I	3	0	3
2	GS102	Applied Physics	2	1	3
3	GS103	Applied Chemistry	2	0	2
4	EN101	Functional English	2	0	2
5	CS101	Computer Systems and Programming	2	1	3
6	ME111	Engineering Drawing and Graphics	1	1	2
7	ME114	Introduction to Engineering	1	0	1
8	GR101	Introduction to Arabic/Arabic for understanding Quran	2	0	2
	Total		15	3	18

Semester 2

Sr.No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	ME116L	Computer Aided Drawing Lab	0	1	1
2	EE101	Electrical Engineering	2	1	3
3	GS104	Mathematics-II	3	0	3
4	GR102	Communication Skills	1	1	2
5	ME112L	Workshop Practice	0	2	2
6	ME113	Engineering Mechanics-I:	3	0	3
7	ME115	Engineering Materials	3	0	3
	Total		12	5	17

Semester 3

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	GR201	Pakistan Studies	2	0	2
2	ME211	Engineering Mechanics-II: Dynamics	3	0	3
3	ME212	Mechanics of Materials–I	3	0	3
4	ME221	Thermodynamics-I	3	0	3
5	EN201	Technical Report Writing and Presentation Skills	1	1	2
6	ME211L	Engineering Mechanics Lab	0	1	1
7	GS201	Mathematics-III	3	0	3
	Total		15	2	17

Semester 4

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	EE201	Electronics Engineering	2	1	3
2	ME224	Thermodynamics-II	3	0	3
3	GS202	Social Sciences (Elective)	2	0	2
4	ME214	Machine Design-I	3	0	3
5	ME215	Mechanics of Materials–II	3	0	3
6	ME215L	Mechanics of Materials Lab	0	1	1
7	ME223	Fluid Mechanics-I	3	0	3
8	ME224L	Thermodynamics Lab	0	1	1
	Total		16	3	19

Semester 5

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	ME322	Fluid Mechanics-II	3	0	3
2	GS301	Mathematics-IV	2	1	3
3	ME311	Machine Design –II	2	0	2
4	ME316	Instrumentation and Measurement	2	1	3
5	ME321	Heat & Mass Transfer	3	0	3
6	ME313	Manufacturing Processes	3	1	4
7	ME322L	Fluid Mechanics Lab	0	1	1
	Total		15	4	19

Semester 6

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	GS302	Engineering Statistics	3	0	3
2	ME3XX	Technical Elective-I	2	0	2
3	ME317	Control Engineering	3	1	4
4	ME312	Mechanics of Machines	3	0	3
5	ME323	Heating, Ventilating and Air Conditioning	3	0	3
6	ME323L	Heat Transfer and Air Conditioning Lab	0	1	1
7	MS301	Health, Safety and Environment	2	0	2
	Total		16	2	18

Semester 7

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	MS401	Engineering Economics	2	0	2
2	ME411	Mechanical Vibrations	3	0	3
3	ME421	Internal Combustion Engines	2	0	2
4	ME4xx	Technical Elective-II	2	0	2
5	ME499	Senior Design Project-I	0	3	3
6	ME411L	Mechanisms and Mechanical Vibrations Lab	0	1	1
7	ME412	Introduction to Finite Element Analysis	2	1	3
	Total		11	5	16

Semester 8

Sr. No	Course Code	Subjects	Credit Hrs		Credit Hours
			Theory	Lab	
1	GR401	Islamic Studies/ Ethics	2	0	2
2	ME4xx	Technical Elective-III	2	0	2
3	MS4xx	Management Elective	2	0	2
4	MS402	Entrepreneurship	2	0	2
5	ME422	Power Plants	2	0	2
6	ME422L	IC Engines & Power Plants Lab	0	1	1
7	ME499	Senior Design Project-II	0	3	3
	Total		10	4	14
	Grand Total		110	28	138

No. of credit hours (Non-Engineering Domain) = 42

No. of credit hours (Engineering Domain) = 96

List of Elective Courses in BS Mechanical Engineering

(Recommended by the Board of Studies DME)

List of Technical Electives Major Based Core *(Breadth)*:

Sr.#	Course Code	Technical Electives Course Title	Credit Hrs	Knowledge Area	Pre-requisite Courses (if any)
1	ME-315	Mechanical Engineering Design	(2,0)	Major Based Core (Breadth)	Nil
2	ME-318	Introduction to Mechatronics	(2,0)	Major Based Core (Breadth)	Nil
3	ME-319	Automation and Robotics	(2,0)	Major Based Core (Breadth)	Nil
4	ME-414	CAD/CAM	(2,0)	Major Based Core (Breadth)	Nil
5	ME-415	Product Design & Development	(2,0)	Major Based Core (Breadth)	Nil
6	ME-423	Renewable Energy Technology	(2,0)	Major Based Core (Breadth)	Nil

List of Technical Electives Major Based Core *(Depth)*:

Sr.#	Course Code	Technical Electives Course Title	Credit Hrs	Knowledge Area	Pre-requisite Courses (if any)
1	ME-412	Tribology	(2,0)	Major Based Core (Depth)	Nil
2	ME-413	Maintenance Engineering	(2,0)	Major Based Core (Depth)	Nil
3	ME-424	Computational Fluid Dynamics	(2,0)	Major Based Core (Depth)	Nil
4	ME-425	Gas Dynamics	(2,0)	Major Based Core (Depth)	Nil
5	ME-426	Aerodynamics	(2,0)	Major Based Core (Depth)	Nil
6	ME-428	Nuclear Engineering	(2,0)	Major Based Core (Depth)	Nil
7	ME-429	Production Engineering	(2,0)	Major Based Core (Depth)	Nil

List of Management Electives:

Management Electives		Course Title	Credit Hrs
Sr#	Course Code		
01	MS-406	Industrial Management	(2,0)
02	MS-405	Operation Management	(2,0)
03	MS-403	Operation Research	(2,0)
04	MS-404	Total Quality Management	(2,0)
05	MS-407	Engineering Law	(2,0)

Course codes:

0 Non Mechanical

1, 3 Design

2 Thermo-Fluid

9 Project

Course code methodology

The following course code methodology is followed for the curriculum and syllabus of this program

- The first two alphabets in the course code indicate the discipline being referred to, for example, ME for Mechanical Engineering
- The first digit in the course code indicates the academic year during which the course is offered. The second digit indicates the stream and third digit indicates the sequence of the course in the respective area in that year.

Second Digit Stream

0 Non Mechanical Engineering Courses

1, 3 Design and Manufacturing Courses

2 Thermo fluid Courses

- For different domain abbreviations used are as follow

ME: Mechanical Engineering

EE: Electrical Engineering

CS: Computer Systems Engineering

GS: General Sciences

EN: English Sciences

MS: Management Sciences

GR: Arabic/Islamic Studies/Pakistan Studies

Bachelor in Mechanical Engineering Program
Course Details

The course outlines of the Bachelor in Mechanical Engineering courses are given below. The course learning outcomes (CLOs) and their mapping with the program learning outcomes (PLOs) and the learning levels of each course are provided.

ARABIC FOR UNDERSTANDING QURAN-I (GR-101)

Contact Hours:	Credit Hours:
Theory =32	Theory =2.0
Practical = 00	Practical = 0.0
Total = 32	Total = 0.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Memorize** basic principles and vocabulary of Arabic Grammar.	Cognitive	1	6
2	**Translate** few verses of the Holy Quran in the light of principles of Arabic Grammar.	Cognitive	2	12

Course Outline

General Arabic Terms / Definitions

The Alphabet (28+1)	**حروف هجَا / تهجّی**
3 Long Vowels (Alif – waw – ya)	**حروف مَدّة** (الف – واو – ی)
3 Short Vowels (u-a-i)	**الحركات:** (ضمۃ/ پیش/ رفع) – (فتحۃ / زبر/ نصب) - (کسرۃ / زیر / جرّ)
2 Dipthongs (au/aw – ai/ay)	**واو - ی**
Jazma	**جزمۃ / سُکُون**
Shortend Alif	**الف مقصورۃ**
Ta marbuta (Round)	**تاء مربوطۃ**
Definite Article	**ال / حرف تعریف**
Nunation/Indefinite Article	**تنوین / حرف تنکیر**
Sun / Solar Letters	**الحروف الشَّمسیۃ**
Moon /Lunar. Letters	**الحروف القمریۃ**

Tashdid/Shadda/Doubled letters	**تشديد/شدّة**
Hamza of Connection and Ordinary Hamza	**بمزة الوصل و بمزة القطع**
Word: Parts of Speech: 1. Noun (Nouns-Pronouns-Adjectives-Adverbs) 2. Verb 3. Particle (Prepositions, Conjunctions, Interjections & Vocative Particles)	**أنواع الكلمة:** (اسم – فعل – حرف) **اسم :** (اسم - ضمير – صفت – ظرف) **فعل :** (فعل) **حرف:** حرف جرّ – حرف عطف – حرف نداء – فجائية)
Definite Nouns: • Proper Noun, • Personal Pronouns, • Demonstrative Pronouns, • Relative Pronouns, • Noun having Definite Article, • Vocative Nouns/Case, • Related to a Definite Noun	**اسماء المعرفة:** اسم عَلَم ، اسم ضمير، اسم اشارة ، اسم موصول ، اسم مُنَادى، معرف باللام و مضاف الى المعرفہ
Indefinite Nouns: (1) Concrete Noun and (2) Adjective	**اسماء النكرة:** اسم ذات و اسم صفت
Interrogative Nouns	**اسماء استفہام**
Adverbs: • Adverb of Time and Adverb of Place	**ظرف زمان / ظرف مكان**
Compounds: Different constructions	مركبات: **مركب توصيفى - مركب اضافى – مركب اشارى – مركب جارى - مركب عددى**
Gender: Masculine and Feminine	**مذكر و مؤنث**
Cases/Declension of Nouns: • Nominative Case • Objective / Accusative Case • The Genitive with Prepositions • The Genitive of Possession • Vocative Case	**إعراب:** **مرفوع – منصوب – مجرور** **(حالت رفعى – نصبى و جرّى)**
Number: • Singular • Dual • Sound Plural (Masculine &	**مفرد –** **تثنية /مُثنى** **جمع مذكر سالم / جمع مؤنث سالم** **الجمع التكسير/ المكسر**

Feminine) • Broken Plural (and its Patterns)	
Collective Noun	**اسم جمع**
Pronouns: • Personal Pronouns (Attached & Detached)	**الضمائرالمرفوعہ المنفصلۃ / المتصلۃ** **الضمائرالمنصوبۃ المنفصلۃ / المتصلۃ** **الضمائرالإضافية:** ہ – هما – هم **/** **الضمائرالمجرورۃ:** ہ – هما - هم
• Demonstrative Pronouns	**اسماء الإشارة:** هذا - هذه – هذان/هذين – هاتان/هاتين – هؤلاء / ذلك - تلك – ذانك / ذينك / تانك/تينك - اولئك / ما – من
Verbs: Present, Past & Future Tenses	**افعال:فعل ماضی** (تصريف) **– فعل مضارع** (تصريف و بناء) **فعل أمر/ فعل نهی** (تصريف وبناء)
Particles: • Prepositions, Conjunction, Interjection, Vocative and Interrogative particles	**حروف:** **حرف جرّ، حرف عطف ، حروف نجائية – حرف نداء – حرف سوال**
Sentence: • Nominal Sentence & Verbal Sentence	**الجملۃ:** **جملۃ اسمية و جملۃ فعلية**
Counting: (1-10) with things to be counted	**عدد – معدود**
Diptotes and Triptotes	**منصرف و غير منصرف/الممنوع من الصرف**

Recitation, Tajweed, Translation and Grammatical Analysis:
01 Al-Fatiha (the Opening)
97. Al-Qadar (the Night of Decree)
98 Al-Bayinah (the Proof)
99. Az-Zilzal (the Earthquake)
100 Al-‘Adiyah (the Runners)
101. Al-Qari’ah (the Striking Hour)
102 At-Takathur (the Piling Up)
103. Al-‘Asr (the Time)
104. Al-Humazah (the Slanderer)
105. Al-Fil (the Elephant)
106 Quraish (Quraish)
107. Al-Ma’un (the Assistance)
108 Al-Kauthar (the River of Abundance)
109. Al-Kafirun (the Disbelievers)
110 An-Nasr (the Help)
111. Al-Masad (the Palm Fiber)
112 Al-Ikhlas (the Sincerity)
113. Al-Falaq (the Daybreak)
114 An-Nas(Mankind)

Text and Reference books:

- Duroos al-Lughatil al-Arabia by Dr. V. Abdur Rahim (Vol.1) – an International Series

Published by Darussalam, Islamabad.

- [Arabic Course – Originally devised and taught at Islamic University, Madinah, KSA.]
- The text in the lessons will be translated and exercises will be solved by the teacher during the class.
- Lisan ul Quran by Dr. Habib ur Rehman Asim, IIUI
- Lisan ul Quran (Vo.1) – Maktaba al-Bushra, Karachi
- Language of the Quran by Izzat Uroosa, Darussalam, Islamabad
- Al-Arabia bayna Yadaik (Vol.1)
- Arabic Tutor (Vol.1) by Abdus Sattar Khan

Mathemtics-1 (Calculus I) (GS-101)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical = 00	Practical = 0.0
Total = 48	Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** the ideas of rate of change and derivatives using the concept of limits and continuity.	Cognitive	2	1
2	**Apply** the techniques of derivatives for solving different problems arising in engineering sciences.	Cognitive	3	2
3	**Use** the techniques of integration for solving problems in integral calculus.	Cognitive	3	4

Course Outline:

1. Functions of one variable,
2. Limits and continuity,
3. Differentiation of functions of one variable,
4. Properties of differentiable functions,
5. Differentials and linear approximation,
6. Maxima minima & curvature,
7. Applied optimization problems of functions of one variable,

8. Indefinite integrals and techniques of integration,
9. Definite integrals and fundamental theorem of calculus,
10. Applications of definite integrals,
11. Polar coordinates and polar curves,
12. Parametric functions and curves,
13. Conic sections and their parametric representations,
14. Properties of famous plane curves,
15. Algebra of complex numbers and some applications of complex numbers.

Recommended Text:

1. G. B. Thomas Jr., M. D. Weir, J. R. Hass, "*Thomas' Calculus*", 12th Edition, 2002. Pearson, USA.
2. J. Stewart. "*Calculus: Early Transcendentals*", 6th Edition, 2008, Brooks/Cole USA.
3. E. Swokowski, M. Olinick, D. D. Pence "*Calculus*", 6th Edition 1994. PWS, USA.

English I (Functional English) (EN-101)

Contact Hours:	Credit Hours:
Theory =32	Theory =2.0
Practical = 00	Practical =0.0
Total =32	Total =2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Prepare** official letters, memorandums and reports, and also to be able to produce these documents in a professional manner.	Cognitive	3	10
2	**Differentiate** between different kinds of essays and to construct brainstorming-clustering method to generate ideas in the form of a coherent essay.	Cognitive	4	10
3	**Apply** extensive reading habits in a bid to improve reading skills, learn to apply place punctuation marks and use question tags in an appropriate manner.	Cognitive	3	10

Objectives: Enhance language skills and develop critical thinking.

Course Contents

1. Basics of Grammar
2. Parts of speech and use of articles
   Sentence structure, active and passive voice Practice in unified sentence
3. Analysis of phrase, clause and sentence structure Transitive and intransitive verbs
4. Punctuation and spelling
5. Comprehension

Answers to questions on a given text

6. Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

7. Listening

To be improved by showing documentaries/films carefully selected by subject teachers

8. Translation skills
   Urdu to English

9. Paragraph writing

Topics to be chosen at the discretion of the teacher

10. Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books

1. Functional English

a) Grammar
   1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
   2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing
   1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension
   1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Computer Systems and Programming (CS-101)

Contact Hours:	Credit Hours:
Theory =32	Theory =2.0
Practical = 48	Practical =1.0
Total =80	Total =3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Define** the fundamental concepts of computing and basic computer programming	Cognitive	1	1
2	**Explain** the concepts of computer programming to a particular situation	Cognitive	2	1
3	**Apply** the acquired knowledge to conceive, design, implement and debug small-to-moderate scale C programs	Cognitive	3	1

Course Outline:

1. Basics of Computer Software and Hardware: Computers & Applications, History of Computing, Introduction to Hardware and Software, Peripheral Devices, Data Representation, Number Systems, Conversion Methods, ASCII / Unicode, Microprocessors, Memory, Storage Devices.
2. Basic Computer Programming: Algorithms, Flowcharts & Pseudocode, Assignment Operators, If Selection Statement, If… Else Selection Statement, Nested Control Structures, switch Multiple-Selection Statement, Passing Arrays to Functions, Searching Arrays, Pointers, Library Functions and Header Files

Recommended Text:

1. P. J. Deitel, H. Deitel, *C++ How to Program*, 10th Edition, 2017, Pearson.

Computer Systems and Programming Lab Work

S.No	CLO Statement	Domain	Learning Level	PLO

1	**Demonstrate** basic understanding of programming language syntax and output manipulation	Cognitive	2	5
2	**Apply** learned concepts to complete the project or activity and write a comprehensive report including both pseudo and programming code	Cognitive	5	3
3	**Present** the pseudo and programming code for assigned activity or project related to lab	Affective	2	9

Applied Physics (GS-102)

Contact Hours:
Theory =32
Practical = 48
Total = 80

Credit Hours:
Theory =2.0
Practical = 1.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Comprehend** key concepts related to position, velocity and acceleration in Cartesian Coordinate System for particles.	Cognitive	2	1
2	**Comprehend** concepts related to kinetics including work, energy and momentum for particles.	Cognitive	2	1

3	**Apply** the key concepts of electrostatic force/field/potential; electric dipole; electric flux and magnetic dipole, magnetic field etc. to real world / engineering problems	Cognitive	3	2
4	**Analyze** the problems related to electromagnetics using different principles and techniques for their solution	Cognitive	4	2

Course Outline

1. Measurement of Physical Quantities
2. Introduction to Mechanics
   a. Rectilinear Motion
   b. Vectors
   c. Motion in two and three Dimension
   d. Force and Motion
3. Kinetic Energy and Work
4. Coulomb's Law
5. Electric and Magnetic Fields
6. Gauss's Law

Practical Work

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** experiment to find spring constant, unknown weight, coefficient of friction and other variables related to applied physics lab	Psychomotor	2	4
2	**Understand** the fundamentals of different parameters of applied physics lab	Cognitive	2	4
3	**Contribute** to experiment by working individually and in a group.	Affective	2	9

List of Experiments

Sr.No	Experiments
1	To measure length, height and diameter using vernier caliper.
2	To find the diameter of a given wire using screw guage.
3	To determine unknown force by graphical method
4	To find unknown weight in a weight pulley system by rectangular method.
5	To verify the Hook's Law and find the stiffness of helical spring.
6	To determine co-efficient of friction of different materials.
7	To verify the relationship between linear velocity and angular velocity.
8	To resolve the combination of static forces by closed polygon method and rectangular component method.
9	To determine the time period of simple pendulum.

10	Open Ended Project Preparation

Teaching Methodology:

- Lecturing
- Problem Solving Sessions (Tutorial, Interactive)
- Written Assignments
- Practical Experiments for Lab Work

Assessment:

Quizzes, Assignments, Mid Exam, Final Exam

Textbook and Reference Books:

1. Halliday, Resnick and Walker, *Fundamentals of Physics*, John Wiley & Sons
2. Houg D. Young and Roger A. Freedman, *University Physics,* Addison-Weslay
3. Raymond A. Serway, John W. Jewett, Jr. *Physics for Scientists and Engineers with Modern Physics.*
4. Halliday, Rsenick, *Principles of Physics, International Student Version*
5. Paul A. Tipler, GeneMosca, *Physics for Scientists and Engineers with Modern Physics*

APPLIED CHEMISTRY (GS-103)

Contact Hours:	Credit Hours:
Theory =32	Theory = 2.0
Practical = 00	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** working Knowledge of applied chemistry and its application to mechanical engineering field.	Cognitive	3	1
2.	**Identify** chemical compounds with harmful effects on environment and propose their control	Cognitive	1	7
3.	**Apply** the acquired Knowledge to identify, formulate and solve engineering problems of chemical nature in field of mechanical engineering.	Cognitive	3	1

Course outline:

1. Physical Chemistry: Properties of various groups and periods of periodic table.

2. Atomic Structure and Interatomic bonding: Atomic structure, atomic bonding and mechanical bonding. Polymorphism and allotropic forms. Crystallography basics.
3. Basic Mechanical properties: Structure of metals and ceramics.
4. Thermo-chemistry: Chemical Thermodynamics, Hess's Law, heat of Formation and reaction, relation between H and U, measurement of heat reaction, Bomb calorimeter
5. Electrochemistry: Laws of electrolysis
6. Industrial Chemistry: Industrial chemistry introduction, manufacturing and uses of various hydrocarbons. Lubricants and oils. Production and application of paints, vulcanized rubber and fuels. Environmental pollution and control.
7. Water Treatment Methods: Water softening, treatment of water for industrial purposes.

Teaching Methodology:
Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:
Mid Term, Presentation, Assignments, Quizzes, Report Writing, Final Term

Text and Reference books:

1. W. H. Brown and L. S. Brown, *Chemistry for Engineering Students*, Cengage Learning.
2. O. V. Roussak, H. D. Gesser, *Applied Chemistry: A Textbook for Engineers and Technologists:* Springer.
3. S. S. Zumdahl, *Chemistry: An Atoms First Approach*, Cengage.
4. N. J. Tro, Chemistry: *A Molecular Approach,* Pearson.
5. M. J. Shultz, *Engineering Chemistry*, Cengage.
6. A. Bahl, B. S. Bahl, G. D. Tuli, *Essential of Physical Chemistry*, S. Chand Publishing, India

ENGINEERING DRAWING & GRAPHICS (ME-111)

Contact Hours:	Credit Hours:
Theory =16	Theory = 1.0
Practical = 48	Practical = 1.0
Total = 64	Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Acquire** the basic knowledge of drawing skills.	Cognitive	2	1
2.	**Apply** the concepts of basic drawing techniques.	Cognitive	3	2

Course outline:

Engineering Graphics (Theory)

1. Orthographic Projection
   Principle and Methods of projection, Orthographic projection, Planes of projection, First and Third-angle projection, Reference line
2. Projection of Points
   A point is situated in the first, second, third and fourth quadrant
3. Projection of Straight Lines
   Line parallel and perpendicular to one or both the planes, Line contained by one or both the planes, Projections of lines inclined to both the planes, True length of a straight line and its inclinations, Methods of determining traces of a line

4. Projection of Planes (2D)
   Types and Traces of planes, Projections of planes, Projections of oblique planes

5. Projections on Auxiliary Planes (2D)
   Types of auxiliary planes and views, Projection of a point on an auxiliary plane, Projections of lines and planes

6. Projections of Solids (3D)
   Types of solids and their projections, Projections of solids with axes inclined

7. Section of Solids (3D)
   Section of planes, prisms, pyramids, cylinders, cones, spheres, Methods of development, Triangulation development, Developments of lateral surfaces of right solids

8. Isometric Projections (3D)
   Isometric axes, lines, planes, and scale, Isometric drawing or isometric view, Isometric drawing of planes or plane figures, prisms and pyramids, cylinders, cones and sphere

Engineering Drawing and Graphics (Lab):

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Be aware** of appropriate Engineering Drawing tools and use the drawing principles for adequate representation of mechanical components.	Affective	1	8
2	**Practice** 2-D Drawings/Sketches using orthographic projections.	Psychomotor	3	1

1. Introduction
   Introduction to Engineering Drawing, I. S. specification for preparation of drawings, Use of drawing instruments and materials, Basic Tools, Lines: Types, configuration and application, Selection of line thickness,
2. Lettering, Numbering and Dimensioning
   Vertical and inclined single stroke letters, Lettering types and rules, Dimension lines, projection lines, leaders or pointer lines, Arrow heads, Dimensioning,

3. Geometric Construction
   Drawing simple geometric objects (polygon, pentagon and hexagons etc).
4. Orthographic Projections of different Solids
   I-beam etc.
5. Orthographic Projections of Machine Elements
   Rivets, Nut and bolts, Different kinds of threads, Lap and butt joints, Flange couplings, Journal bearing, Open bearing, Footstep bearing, Crankshaft, Bearings

Teaching Methodology:
Lecturing
Assignments
Drafting

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. N.D Bhatt, *Engineering Drawing and Graphics*
2. B. Wiebe, M. Mohler ,*Technical Graphics Communication,* McGraw-Hill
3. Abbot, *Practical Geometry & Engineering Graphics*
4. Craft, Meyers & Boyer, *Engineering Graphics*
5. G. R. Bertoline, E. N. Wiebe, *Technical Graphics Communication*; McGraw-Hill
6. D.F. Rogers, J.A. Adams; *Mathematical Elements for Computer Graphics*, McGraw-Hill
7. A. C Parkinson, A First Year Engineering Drawing

INTRODUCTION TO ENGINEERING (ME-114)

Contact Hours:	Credit Hours:
Theory = 16	Theory = 1.0
Practical = 00	Practical = 0.0
Total = 16	Total = 1.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Acquire** the knowledge of different engineering disciplines to get technological exposure	Cognitive	2	12

2.	**Understand** responsibility as an engineer to work closely with society for problems identification for future actions	Cognitive	2	6
3.	**Acquire** the knowledge for Ethical Reasoning and to take appropriate actions	Cognitive	2	8

Course outline:

1. Introduction to Engineering
   a. Evolution of engineering, steam engine, electronics etc.
   b. Effect of global wars for technology advancement
   c. Existing materials/Evolution of emerging materials
2. Difference between Engineering, Science and Technology
3. The Disciplines of Engineering
4. Engineering Design
5. Interdisciplinary Engineering (Science, Technology and Society)
6. Global Engineering and the Future (Renewable energy)
7. Problem Solving Techniques in Engineering
8. Visualization and Graphics
9. Analytical Tools for Engineers
10. Professional Ethics and Engineering Management
11. Engineering Fundamentals (Statics, Dynamics, Thermodynamics, Circuitry, Economics)
12. Future Challenges for the betterment of society

Teaching Methodology:

Lecturing
Class discussions
Documentaries using Audio Visual Tools
Field Visits to visualize real world problems
Report Writing

Assessment:

Mid Term, Quizzes, Reports, Assignments, Projects, Final Exams

Text and Reference books:

1. Paul H. Wright ,*Introduction to Engineering*
2. David Blockley, *Engineering: A Very Short Introduction*
3. Saeed Moaveni ,*Fundamentals: An Introduction to Engineering*

SEMESTER 2

COMPUTER AIDED DRAWING (CAD) LAB (ME-116L)

Contact Hours:	Credit Hours:
Theory = 0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Show** grasp over existing CAD software for designing mechanical components	Psychomotor	2	5
2.	**Comprehend** existing software for designing mechanical components	Cognitive	2	5
3.	**Contribute** to experiment by working individually and in a group.	Affective	2	9

Course outline:
1. Introduction to CAD
2. 2D Drafting
3. 3D Modeling of Machine Elements (Part and Assembly)
4. Mechanisms and assembly

Practical:
1. Select a machine and study its operation and machine elements detail.
2. Draw the 3D model of the machine element and draw 2D drawings.

Teaching Methodology
Lecturing
Assignments
Design Project

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:
1. R. Lal, R. Rana, *A Textbook of Engineering Drawing: Along with an*

Introduction to AutoCAD.
2. T. Jeyapoovan, *Engineering Drawing and Graphics Using AutoCAD.*
3. Z. A. Siddiqui, M. Ashraf and S. A. Siddiqui. *Basics of Engineering Drawing*
4. D. A. Jolhe, *Engineering Drawing with an introduction to AutoCAD*
5. Tickoo-Cadcim Series, PTC Creo Parametric 4.0 for Designer.

Electrical Engineering (EE-101)

Contact Hours:	Credit Hours:
Theory =32	Theory =2.0
Practical =00	Practical = 0.0
Total =32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	Describe and **illustrate** basic circuit concepts, network laws and theorems used to analyze linear circuits	Cognitive	3	1
2	**Describe** the basic construction, operation and characteristics of motors and generators	Cognitive	2	1

Course Outline:

1. Basic Concepts: System of Units, Basic Quantities, Circuit Elements,
2. Resistive Circuits: Ohm's Law, Kirchhoff's Laws, Single-Loop Circuits, Single-Node-Pair Circuits, Series and Parallel Resistor Combinations, Circuits with Series and Parallel Combinations of Resistors, Wye Delta Transformations, Circuits with Dependent Sources, Resistor Technologies for Electronic Manufacturing,
3. Capacitance and Inductance: Capacitors, Inductors, Capacitor and Inductor Combinations, Basic Analysis Using Kirchhoff's Laws, Analysis Techniques. DC & AC motors, DC & AC generators, Transformers.

Recommended Text:

1. William H. Hayt, Jack Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis," Seventh Edition, 2006, McGrawHill.

2. J. David Irwin and Robert M. Nelms, "Basic Engineering Circuit Analysis," Eighth Edition, 2006, John Wiley & Sons.
3. Robert L. Boylestad, "Introductory Circuit Analysis," Eleventh Edition, 2004, Prentice Hall.

Electrical Engineering Lab

Contact Hours:	Credit Hours:
Theory = 0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** experiment to investigate and note basic electrical quantities ,implementation of Kirchhoff's laws in series parallel circuits, and working of transformers and motors etc.	Psychomotor	2	4
2	**Demonstrate** positive working attributes by working individually and working with a group.	Affective	3	9

List of Experiments

Sr.No	Experiments
1	To inspect the Working of Digital Multi Meter.
2	To investigate the Measuring Methods of Resistance and Capacitance by color coding and DMM.
3	To investigate the characteristics of a series DC circuit.
4	To investigate the characteristics of a parallel DC circuit.
5	To inspect the verification of Kirchhoff's voltage and current Laws. (KCL& KVL).
6	To inspect the Variation of output voltage with setting of slides Potentiometer.
7	To investigate the Working of Clamp Meter.
8	To investigate the Working of Frequency Meter.
9	To investigate the Working of Watt Meter.

10	To inspect the Measurement of Earth Resistance using Earth Resistor meter.
11	To find unknown resistance by using Wheatstone Bridge.
12	To inspect the working of step up and step down Transformer.
13	To understand Working of Motor and generator.
14	To Perform the Electric boards wiring.

English II (Communication Skills) (GR-102)

Contact Hours:	Credit Hours:
Theory =16	Theory =1.0
Practical =48	Practical = 1.0
Total =64	Total = 1.0

Objectives: Enable the students to meet their real life communication needs.

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Summarize** lengthy as well as complex texts without losing the gist and important details of the original written piece.	Cognitive	2	10
2	**Apply** extensive reading habits in a bid to improve reading skills, learn to apply place punctuation marks and use question tags in an appropriate manner.	Cognitive	3	10
3	**Identify** presentation blind spots for sound presentation skills through presentation software such as Microsoft PowerPoint.	Affective	1	10

Course Contents:

1. Paragraph writing

Practice in writing a good, unified and coherent paragraph

2. Essay writing

Introduction

3. CV and job application

4. Translation skills

Urdu to English

5. Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

6. Academic skills

Letter/memo writing, minutes of meetings, use of library and internet

7. Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended Books

Communication Skills

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard York.

English II (Communication Skills) Lab

S.No	CLO Statement	Domain	Learning Level	PLO
1	Better **recognize** of nuances of language through audio- visual experience and group activities	Affective	1	10
2	Speaking with **clarity** and confidence thereby enhancing employability skills of the students	Affective	2	10

Workshop Practice (ME-112L)

Contact Hours:
Theory =0
Practical = 96
Total = 96

Credit Hours:
Theory = 0.0
Practical = 2.0
Total = 2.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** different operations to develop various parts by utilizing machines from different shops to solve practical engineering problems.	Psychomotor	2	3
2	**Describe** different machines, equipment and processes related to various mechanical operations to be performed in workshop.	Cognitive	1	1
3	**Practice** the correct and safe usage of machine components, tools and their associated operations individual and in a group.	Affective	2	11

Course outline:

1. Fitter Shop: Assembly/disassembly of basic mechanical components, e.g. bearings, keys, belts, etc.
2. Basic Processes in Wood Work Shop: Timber, its defects and preservation methods, different types of wood joints.

3. Basics of Electric Shop: Types and uses of cables. Study of household electrical appliances.
4. Functions of Forge & Foundry Shop: Brief introduction, tools and accessories, furnace types, heat treatment furnaces. Carbon dioxide casting.
5. Machine Shop: Introduction to machine tools, basic lathe operations including turning, facing, screw cutting.
6. Welding: Introduction to soldering, brazing and welding, brief details of gas, and electric arc welding.

List of experiments:

S.No	List of Experiments
1	To study and practice of different tool usage in fitting shop.
2	To construct open-ended spanners of different sizes in fitting shop. Part 1
3	To continue the construction of open-ended spanners in fitting shop. Part 2
4	To continue the construction of open-ended spanners in fitting shop. Part 3
5	To study and practice of different tool usage in wood shop, timber types, its defects, and prevention methods.
6	To make different joints of wood (a) Lap joint (b) Dado joint
7	To make different joints of wood (c) wood block joint (d) miter joint.
8	To study and practice of different tool usage in welding shop.
9	Use of power hacksaw and cutting of metal strips for welding.
10	To weld Butt joints and lap joints in welding shop through SMAW.
11	To weld Tee joints and corner joints in welding shop through SMAW
12	To perform spot welding.
13	To perform soldering process.
14	Practice of gas welding.
15	To perform brazing process.
16	Assembly and disassembly of keys and bearings.

17	To study different tools used in foundry shop and to make pattern for Casting.
18	To perform sand casting process and making of mold.
19	Working Process of electric furnace and Melting of aluminum metal.
20	Pouring of molten material in mold and parting off extra material and finishing process in foundry.
21	To study different tools in electric shop and to make a series and parallel circuit.
22	To study of cables and home wirings (for open ended project)
23	To Study of belt-pulley mechanism by increasing and decreasing speed of lathe machine.
24	To study and making of different tools for lathe machine by using grinding machine.
25	To study various parts of Lath machine and to perform tool gripping, job griping and centering processes on Lath machine.
26	To perform turning and facing on Lath machine.
27	To perform step turning and taper turning on lathe machine.
28	To perform grooving, knurling and chamfering operations.
29	To perform drilling, boring and parting off operations on Lath machine.
30	To make internal and external threads on lathe machine.

Teaching Methodology:
Demonstration
Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:

1. Lab Manual
2. W A J Chapman, Workshop Technology Part-I, 5th ed, Butterworth-Heinemann, 1972, ISBN 0713132698
3. H P Schwan, Electrical Wiring, McGraw Hill, 1982
4. Wiring Manual, Pak Cables Limited. ME-201 ENGINEER

ENGINEERING MECHANICS-I: STATICS (ME-113)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =00	Practical = 0.0
Total =48	Total = 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Describe** concepts of vectors and scalars, conditions of equilibrium for particles and rigid bodies in two and three dimensions.	Cognitive	2	1
2	**Analyze** structures such as trusses, beams and frames for reaction forces	Cognitive	4	2
3	**Explain** the concepts of shear and bending moment of beams and the concepts of dry friction.	Cognitive	2	1

Course outline:

1. Introduction to subject
2. Force System
   a. Introduction to Force System
   b. Rectangular components, Moment, Couple and Resultants (Two dimensional Force systems)
3. Equilibrium
   a. Mechanical system isolation and Equilibrium condition in two dimensions
   b. Equilibrium Conditions-Equilibrium in three Dimensions
4. Structures
   a. Plane Trusses
   b. Method of joints
   c. Method of Sections and Space Trusses
   d. Frames and Machines
5. Friction

a. Types of Friction

Teaching Methodology:
Lecturing
Problem Solving Sessions
- Tutorial
- Interactive

Written Assignments

Assessment:
Quizzes, Assignments, Mid Exam, Final Exam

Text and Reference books:

1. J L Meriam, L G Kraig, *Engineering Mechanics (Statics)*: John Wiley & Sons Inc.
2. Beer & Johnston, *Vector Mechanics for Engineers: Statics & Dynamics*, McGraw Hill
3. RC Hibbeler, *Engineering Mechanics (Statics)*, Prentice Hall
4. Anthony M Bedford, Wallace Fowler. *Engineering Mechanics (Statics)*, Prentice Hall
5. E. Nelson, *Engineering Mechanics: Statics*, Schaum's outline series New York.

Mathematics-2 (Calculus II) (GS-104)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =00	Practical = 0.0
Total =48	Total = 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Apply** the the techniques of partial derivatives for solving different problems arising in engineering sciences.	Cognitive	3	2
2	**Use** the techniques of integration for solving problems in vector calculus and analytical geometry in multiple dimensions	Cognitive	3	2

Course Outline:

1. Infinite sequences and series,
2. Convergence of infinite sequences and series, general properties of convergent sequences and series, tests of convergence,
3. Power series, Taylor's series,
4. Analytical geometry of three dimensions, planes and straight lines in space, quadric surfaces,
5. Functions of several variables, continuity of functions of several variables, partial derivatives and partial differentials, chain rule, directional derivatives and gradient, extreme values,
6. Lagrange multipliers, applied optimization problems, double and triple integrals and their evaluation, cylindrical and spherical coordinates, applications of double and triple integrals,
7. Vector calculus including line and surface integrals and theorems of Green, Gauss and Stokes.

Recommended Text:

1. G. B. Thomas Jr., M. D. Weir, J. R. Hass, “Thomas' Calculus”, 12th Edition, 2002. Pearson, USA.
2. J. Stewart. “Calculus: Early Transcendentals”, 6th Edition, 2008, Brooks/Cole USA.
3. E. Swokowski, M. Olinick, D. D. Pence “Calculus”, 6th Edition 1994. PWS, USA.

ENGINEERING MATERIALS (ME-115)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =00	Practical =0.0
Total =48	Total =3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Level	PLO
1	**Explain** different material types in terms of crystal structure.	Cognitive	2	1
2	Read and **interpret** Phase-Diagrams and effects of heat treatments on microstructure of ferrous materials.	Cognitive	2	2
3	**Analyze** the effect of micro-structure and heat treatment on end use properties/mechanical properties of materials.	Cognitive	4	4
4	**Differentiate** the property differences between Metals, Ceramics, Polymers & Composites and their implications in terms of	Cognitive	4	7

Course Outline / Contents

1. Introduction to Materials Science and Engineering
2. Structure of Crystalline Solids
3. Imperfections in Solids
4. Phase Diagrams
5. Applications and Processing of Metallic Materials
6. Structure, Properties and Applications of Polymer Materials
7. Composite Materials
8. Ceramics Materials
9. Heat Treatment of Materials
10. Corrosion and degradation of Materials

Teaching Methodology
Lecturing
Written Assignments

Assessment
Quizzes, Assignments, Mid Exam, Final Exam

Text and Reference books:

1. J. T. Black , Ronald A. Kohser, *DeGarmo's Materials and Processes in Manufacturing*, Wiley
2. Roy A. Lindberg, *Processes And Materials of Manufacturing*
3. *William D.Callister, Jr. 2nd Edition Jhon Wiley & Sons, Inc.*

SEMESTER 3

ENGINEERING MECHANICS-II: DYNAMICS (ME-211)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =00	Practical =0.0
Total =48	Total =3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Comprehend** key concepts related to kinematics and kinetics of particles in different Coordinate Systems.	Cognitive	2	1
2	**Solve** problems related to kinematics and kinetics of particles.	Cognitive	3	2
3	**Calculate** various motion Parameters related to the kinematics of rigid bodies under translation and rotation / general plane motion.	Cognitive	3	2
4	**Analyze** and solve the problems related to kinetics of rigid bodies using different principles and techniques for their solution	Cognitive	4	2

Course Outline

1. Introduction to subject and Basic Concepts

2. Kinematics of Particles
   a. Rectilinear Motion
   b. Plane Curvilinear Motion
   c. Space Curvilinear Motion
   d. Motion Relative to Trans Axes
   e. Constrained Motion of Connected Particles

3. Kinetics of Particles
   a. Second Law & Equation of Motion
   b. Work and Energy
   c. Linear Impulse and Momentum
   d. Impact
   e. Angular Momentum
   f. Rectangular and cylindrical Co-ordinates

4. Kinematics of Rigid Bodies
   a. Plane Motion
   b. Rotational about fixed axis
   c. Relative Velocity
   d. Relative Acceleration

5. Kinetics of Rigid Bodies
   a. Kinetics of Rigid Bodies
   b. Planar kinetics
   c. Equation of motions
   d. Moment of inertia

Teaching Methodology

Lecturing

Problem Solving Sessions
   - Tutorial
   - Interactive

Written Assignments

Assessment:

Quizzes, Assignments, Mid Exam, Final Exam

Textbook and Reference Books:

1. J L Meriam, L G Kraig. *Engineering Mechanics (Dynamics)*: John Wiley & Sons Inc.
2. Beer & Johnston. *Vector Mechanics for Engineers: Statics & Dynamics*, McGraw-Hill
3. RC Hibbeler. *Engineering Mechanics (Dynamics)*,13th Ed., Prentice Hall
4. Anthony M Bedford, Wallace Fowler. *Engineering Mechanics (Dynamics)*, Prentice Hall
5. E. Nelson, *Engineering Mechanics: Statics*, Schaum's outline series New York.

Mechanics of Materials-I (ME-212)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =00	Practical =0
Total =48	Total =3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** key concepts, such as stresses and strains and constitutive relationships.	Cognitive	2	1
2.	**Analyze** statically determinate and indeterminate structures for safety based on strength or deflection considerations.	Cognitive	4	2

Course outline:
1. Mechanical properties of materials; tensile, compressive and shear stress & strain
2. Moment of inertia
3. Axial loading, Hooke's law, stress strain relationship
4. Thermal stresses
5. Torsion of circular bars,
6. Pure bending of beams, shear stresses in beams
7. Shearing force and bending moment
8. Beam deflection using various methods
9. Residual stresses and stress concentration in various engineering applications
10. Analysis of statically indeterminate problems,
11. Thin and thick curved bars,
12. Thin walled pressure vessels.

Teaching Methodology
Lecturing
Written Assignments
Report writing

Assessment
Mid Term, Report writing/Presentation, Assignments, Quizzes, Final Term

Text books and Reference books:

1. James M. Gere, Barry J. Goodno, *Mechanics of Materials*
2. Ferdinand P. Beer & Russel Johnston Jr., *Mechanics of Materials* McGraw-Hill
3. R. C. Hibbeler, *Mechanics of Materials*
4. P. P. Benham& R. J. Crawford, *Mechanics of Engineering Materials*, Longman
5. Popov, *Mechanics of Materials*.
6. W. A. Nashi, *Static and Mechanics of Materials*, Schaum's outline series New York.

THERMODYNAMICS-I (ME-221)

Contact Hours:	Credit Hours:
Theory = 48	Theory =3.0
Practical =0	Practical =0.0
Total =48	Total =3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the nature and role of the thermodynamics properties of matter and processes on appropriate diagrams.	Cognitive	2	1
2.	**Apply** energy and entropy balances to the closed and open systems and limitations of the Second Law of Thermodynamics..	Cognitive	3	1

Course outline:

1. Introduction and Basic Concepts
   a. First law of thermodynamics and its applications
   b. System and boundary
   c. Specific volume, pressure and temperature

2. Energy, Energy Transfer, and General Energy Analysis
   a. Equilibrium state, processes
   b. Methods to solve thermodynamics problems

3. Properties of Pure Substances
   a. Phase change processes, P-v-T relation

b. Property diagrams
c. Equation of state, specific heats
d. Compressibility polytropic process relation.

4. Energy Analysis of Closed Systems
a. Energy balance of closed system

5. Mass and Energy Analysis of Control Volumes
a. Energy analysis of power, refrigeration and heat pump cycles

6. The Second Law of Thermodynamics
a. Spontaneous and non-spontaneous processes
b. Thermodynamic cycles, irreversible and reversible process, and Carnot cycle
c. Clausius inequality.

7. Entropy
a. Entropy change, T-s diagram, entropy generation
b. Increase of entropy principle, entropy rate balance of closed systems and control volumes
c. Isentropic efficiencies

Teaching Methodology
Lecturing
Written Assignments

Assessment
Mid Exam, Final Exam, Assignments, Quizzes, Computational assignments

Text and Reference books:

1. Yunus A. Cengel, Michael A., *Thermodynamics: An Engineering Approach*, McGraw-Hill.
2. M. J. Moran and H. O. Shapiro, *Fundamentals of Engineering Thermodynamics*, John Wiley & Sons.
3. Sonntang, Borgnakke, Van Wylen John, *Fundamentals of Thermodynamics*, Wiley & Sons.
4. T. D. Eastop and A. McConkey, *Applied Thermodynamics for Engineering Technologists*, Pearson.

Mathematics-3 (Differential Equations & Linear Algebra) (GS-201)

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO

1	Student will develop the capability to classify and **apply** basic rules to solve various types of linear upto second order ordinary differential equations.	Cognitive	3	1
2	**Apply** the knowledge of linear algebra to model and solve linear systems that appear in engineering sciences.	Cognitive	3	1
3	Capability to solve and **analyze** mathematical model for a given physical problem of practical engineering interest.	Cognitive	4	2

Course Outline:

1. Matrix algebra and general properties of matrices,
2. Elementary row operations, reduction of matrices into echelon and reduced echelon form, rank of a matrix,
3. Determinants and their properties, solution of system of linear algebraic equations,
4. Gaussian elimination and Gauss-Jordan method,
5. Vector spaces, linear dependent and independent vectors,
6. Basis, eigenvalue and eigenvectors,
7. First and second order differential equations and their solution techniques,
8. Higher order linear differential equations,
9. Applications of differential equations,
10. Power series solutions and systems of linear differential equations.

Recommended Text:

1. *A First Course in Differential Equations with Modeling Applications* by Dennis G. Zill, Brooks Cole USA (10th edition 2013).
2. *Advanced Engineering Mathematics*, by Erwin Kreyszig, Wiley USA (10th Edition 2011).

ENGINEERING MECHANICS LAB (ME-211L)

Contact Hours:	Credit Hours:
Theory =0.0	Theory =0.0
Practical =48	Practical =1.0
Total =48	Total =1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** experiment to find the key variable of interest such as force moment etc.	Psychomotor	2	4
2	**Analyze** parameter related to lab in relation to theoretical aspect	Cognitive	4	4
3	Student can effectively **perform** individually and shared team of work	Affective	2	11

List of Experiments

Sr.No	Experiments
1	Modulus of elasticity & rigidity of different springs by Hook's law
2	Difference b/w experimental & theoretical deflections of different beams in different arrangements
3	Compression & Extension of the members of Roof Truss (Graphical + Experimental readings)
4	Polygon forces (Graphical + Experimental readings)
5	Friction on inclined plane
6	Forces on hanging rope (Graphical + Experimental readings)
7	Screw jack
8	Derrick Crain (Graphical + Experimental readings)
9	Jib wall Crain (Graphical + Experimental readings)
10	Circular disk apparatus
11	Linear & angular velocity relationship
12	Fly wheel
13	Worm & worm wheel
14	Square & V-thread and Chord drum

Teaching Methodology:
Demonstration followed by hands-on experiments
Assessment
Lab Work, Lab reports, Viva / Oral test, Lab Exam

Text and Reference books:
Lab Manual

PAKISTAN STUDIES (COMPULSORY) (GR-201)

Contact Hours:	Credit Hours:
Theory =32	Theory =2.0
Practical =00	Practical = 0.0
Total =32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** the history of Pakistan (for understanding the peculiarities of Pakistani society).	Cognitive	2	6
2	**Explain** political and constitutional development in Pakistan.	Cognitive	3	6
3	**Analyze** socio-economic structure of Pakistan.	Cognitive	4	6

Introduction/Objectives

1. Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
2. Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective
   a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and geo-physical features.
2. Government and Politics in Pakistan

   Political and constitutional phases:

a. 1947-58
b. 1958-71
c. 1971-77
d. 1977-88
e. 1988-99
f. 1999 onward

3. Contemporary Pakistan
    a. Economic institutions and issues
    b. Society and social structure
    c. Ethnicity
    d. Foreign policy of Pakistan and challenges
    e. Futuristic outlook of Pakistan

Text and Reference books:

1. Burki, Shahid Javed. *State & Society in Pakistan,* The MacMillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S. M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: Wm Dawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.

14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

ENGLISH III (TECHNICAL WRITING AND PRESENTATION SKILLS) (EN-201)

Objectives: Enhance language skills and develop critical thinking

Contact Hours:	Credit Hours:
Theory =16	Theory =1.0
Practical =48	Practical = 1.0
Total =64	Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** academic writing and classify between in-text citation methods, footnotes, endnotes, references and bibliography.	Cognitive	2	10
2	**Examine** the style, content, language, form, clarity and consistency in technical and academic writing by analyzing user manuals, research proposals, technical papers, and project reports.	Cognitive	3	12
3	**Prepare** short and long reports, memorandums, cover letters, and other official letters on letterhead stationery.	Cognitive	3	10
4	**Recognize** the common mistakes in PowerPoint presentations, learn presentation rules, and develop sound presentation skills.	Cognitive	2	10

Course Contents

1. Presentation skills

2. Essay writing

Descriptive, narrative, discursive, argumentative
3. Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
4. Technical Report writing

5.Progress report writing

Note: Extensive reading is required for vocabulary building
Recommended Books
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3

(particularly suitable for discursive, descriptive, argumentative and report writing).

College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

Presentation Skills
Reading
The Mercury Reader. A Custom Publication. Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton.
(A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

English III (Technical Writing and Presentation Skills) Lab

S.No	CLO Statement	Domain	Learning Level	PLO
1	Students would be able to **communicate** effectively in English language.	Affective	2	10
2	Students will **learn** the technique of professional report writing	Cognitive	2	10

SEMESTER 4

Electronics Engineering (EE-201)

Contact Hours:	Credit Hours:
Theory =32	Theory = 2.0
Practical =48	Practical =1.0
Total =80	Total =3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** the basic construction, operation and characteristics of semiconductor devices like diodes and transistors	Cognitive	2	1
2	**Explain** the basics of combinational and sequential circuits in digital electronics	Cognitive	2	1

Course Outline:

1. Semiconductor Basics: Intrinsic & Extrinsic Materials, n-type & p-type Materials,
2. Semiconductor Diode: Construction, Diode equivalent Circuits, Zener Diode, Diode Applications e.g. Clipper, Clampers, Rectifier (Half-Wave & Full-Wave).
3. Bipolar Junction Transistors (BJTs): Construction, Region of Operations, Different Configuration, Transistor Switching Networksalong with DC Biasing. Number system, bolean algebra, logic gates, combination logic, sequence logic.

Electronics Engineering Lab

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** experiment to investigate and note the behavior of different electronic components such as logic gates, diode, transistor, LDR, temperature sensors etc.	Psychomotor	2	4

2	**Demonstrate** positive working attributes by working individually and working with a group.	Affective	3	9

Recommended Text:

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory," Ninth Edition, 2006, Prentice Hall.
2. Robert Paynter, "Introductory Electronic Devices and Circuits: Electron Flow Version," Seventh Edition, 2006, Prentice Hall.

THERMODYNAMICS-II (ME-224)

Contact Hours:	Credit Hours:
Theory =48	Theory =3.0
Practical =0	Practical =0.0
Total =48	Total =3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Analyze** thermodynamics cycles of power, refrigeration, and air-conditioning using energy and exergy principles.	Cognitive	4	2
2.	**Apply** the laws of thermodynamics to the chemical and phase equilibrium problems.	Cognitive	3	2
3	**Understand** the implications of thermodynamics power, refrigeration, and air-conditioning systems on the environmental and future sustainability.	Cognitive	2	7

Course outline:

1. Review of Thermodynamics I
   a. Energetics
   b. Efficiency

2. Exergy
   a. Exergy balance

b. Exergetic efficiency

3. Gas Power Cycles
   a. Air-Standard-Otto cycle
   b. Diesel cycle,
   c. Dual and Brayton cycle
   d. Regenerative gas turbines with reheat & inter cooling
   e. Combined cycles

4. Vapor and Combined Power Cycles
   a. Modeling and analyzing
   b. Superheat and Reheat vapor power cycles
   c. Regenerative vapor power cycles
   d. Other vapor cycle aspects

5. Refrigeration Cycles
   a. Vapor compression refrigeration systems
   b. Cascade and Multistage systems
   c. Absorption refrigeration, Heat pump, and Gas refrigeration systems

6. Thermodynamic Property Relations and Gas Mixtures
   a. Mixture composition
   b. P-v-T relations for gas mixtures
   c. U, H, S and specific heats for gas mixtures.

7. Chemical Reactions
   a. Combustion process and conservation of energy in reacting systems
   b. Importance of mathematical relations

8. Chemical and Phase Equilibrium
   a. Equilibrium fundamentals
   b. Chemical potential and equilibrium.

Teaching Methodology:
Lecturing
Written Assignments

Assessment
Mid Exam, Final Exam, Assignments, Quizzes, Computational Assignment

Text and Reference books:

1. Yunus A. Cengel and Michael A. Boles, *Thermodynamics, An Engineering Approach,* McGraw-Hill.
2. M. J. Moran and H. O. Shapiro*, Fundamentals of Engineering Thermodynamics*, John Wiley & Sons.
3. Sonntang, Borgnakke, and Van Wylen, *Fundamentals of Thermodynamics*, John Wiley & Sons.
4. Ibrahim Dincer and Marc A. Rosen, *Exergy: Energy, Environment, and Sustainable Development,* Springer.
5. T.D. Eastop and A. McConkey, *Applied Thermodynamics for Engineering Technologists*, Pearson.

SOCIAL SCIENCES (ELECTIVE) (PROFESSIONAL ETHICS) (GS-202)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2.0
Practical = 00	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** ethical and legal decision-making frame work for Engineers.	Cognitive	2	8
2	**Analyze** and explains the social and value dimensions of Technology	Cognitive	4	6
3	**Demonstrate** the ability to learn ethical resources for solving problems in order to contribute to lifelong learning.	Cognitive	3	12

Course outline:

1. An Overview of Engineering Ethics: Ethics Defined, Social Responsibility, and Ethics, The Development of Ethics, Why study Ethics?, Framework for Studying Ethics.
2. Ethical issues in Engineering: Foundation of Ethical Conflict, Classifications of Ethical, Issues, Ethical Issues Related to Participants and Functional Areas of Engineering, Recognizing an Ethical Issue. Applying Moral Philosophies to Engineering Ethics: Moral Philosophy Defined, Moral Philosophy Perspectives
3. Social Responsibility: The Economic Dimension, The legal Dimension, The Ethical Dimension, the Philanthropic Dimension
4. An Ethical Decision-Making Framework: Ethical Issue Intensity, Individual Factors: Stages of Cognitive Moral Development, Corporate Culture, Significant others, Opportunity, Engineering Ethics Evaluations and Intentions, Using the Ethical Decision-Making Framework to Improve Ethical Decisions
5. How the Organization Influences Ethical Decision Making: Organizational Structure and Engineering Ethics, the role of Corporate Culture in Ethical Decision-Making, Group Dimensions of Organizational Structure and Culture, Implications of Organizational Relationships for Ethical Decisions.
6. The Role of Opportunity and Conflict: Opportunity, Conflict.

7. Development of an Effective Ethics Programmed: An Effective Ethical Compliance, Programmed, Codes of Ethics and Compliance Standards. High-Level Manager's Responsibility for Ethical Compliance Programmed and the Delegation of Authority, Effective Communication of Ethical Standards. The Influence of Personal Values in Engineering Ethics Programmers, the Ethical Compliance Audit.
8. International Engineering Professionalism: Ethical resources for solving Boundary crossing problems,

MACHINE DESIGN-I (ME-214)

Contact Hours:	Credit Hours:
Theory = 48	Theory = 3.0
Practical = 00	Practical = 0.0
Total = 48	Total = 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the application of design standards and the importance of dimensional parameters in manufacturing aspects of mechanical	Cognitive	2	1
2.	**Analyze** different types of structural joints, power transmitting shafts and mechanical springs	Cognitive	4	3
3.	**Present** the design aspects effectively through oral presentation	Affective	2	10

Course outline:

1. Introduction
   - Design philosophy
   - Types of design
2. Mechanical behaviour of materials
   - Concepts of stress and strain
   - Different types of stress and strain in a machine element
   - Stress-strain diagram
   - Actual and permissible stresses
   - Factor of safety
3. Design of keys and coupling

Basic concepts
Methodology

4. Design of Riveted joint, Welded joints, Bolted joints
Basic concepts
Methodology

5. Design of Springs, Shafts
Basic concepts
Methodology

6. Metal fits and tolerances and Design Standards
Basic concepts of tolerance
Types of fits
ISO standard fits charts

Teaching Methodology
Lecturing
Written Assignments
Guest Speaker
Report Writing and Presentation

Assessment:
Mid Exam, Final Exam, Assignments, Quizzes, Computational Assignment

Text and Reference books (Latest Editions):

1. Robert L. Mott ,*Machine Elements in Mechanical Design*
2. Robert L. Norton, *Design of Machinery*
3. R. S. Khurmi & J. K. Gupta, *A Textbook of Machine Design*
4. Joseph E. Shigley, *Theory of Machines & Mechanisms*

MECHANICS OF MATERIAL-II (ME-215)

Contact Hours:	Credit Hours:
Theory =48	Theory = 3.0
Practical = 0	Practical = 0.0
Total = 48	Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Analyze** stresses and strains for two- and three-dimensional cases using and various technique.	Cognitive	4	2
2.	**Understand** theory of failure of materials	Cognitive	2	1
3.	**Solve** problems related to early failure of materials under special conditions like fatigue, creep and impact	Cognitive	3	2
4.	**Analyze** stresses in thick walled cylinders and columns	Cognitive	4	2

Course outline:

1. Analysis of stress and strain in two and three dimensions
2. Principal stresses and strains
3. Mohr's circle for stress and strain
4. Thick walled pressure vessels
5. Symmetrical and asymmetrical loading
6. Introduction to fracture mechanics
7. Impact loading
8. Fatigue and creep
9. Theories of elastic failure
10. Theory of columns

Teaching Methodology:

Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:

Mid Term, Report writing/Presentation, Assignments, Quizzes, Final Term

Text and Reference Books:

1. E J Hearn, *Mechanics of Materials Volume 1 & 2*
2. Ferdinand P. Beer & Russel Johnston Jr., *Mechanics of Materials*, McGraw-Hill
3. Popov, *Mechanics of Materials*
4. P. P. Benham & R. J. Crawford, *Mechanics of Engineering Materials*, Longman Sci & Tech
5. Boresi, Arthur P., Schmidt, Richard J. Sidebottom, Omar M., *Advanced Mechanics of Materials*
6. R. C. Hibbeler, Mechanics of Materials
7. Andrew Pytel and F. L. Singer, *Strength of Materials*
8. W. F. Riley, L. D. Sturges and D. H. Morris, *Mechanics of Materials*.
9. W. A. Nashi, *Statics and Mechanics of Materials*, Schaum's outline series New York.

MECHANICS OF MATERIAL-LAB (ME-215L)

Contact Hours:	Credit Hours:
Theory =0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1	**Perform** experiment to determine the key variable of interest (such as impact load, Brinell hardness number, SN curve, load displacements curve etc.)	Psychomotor	2	4
2	**Explain** parameters related to Lab in relation to the theoretical aspects	Cognitive	2	4
3	**Contribute** to experiment by working individually and in a group.	Affective	2	9

List of Experiments

Sr.No	Experiments
1	To perform Brinell Hardness Experiment on different Specimen
2	To perform Rockwell Hardness Experiment on different Specimen
3	Demonstrate Impact test on a high carbon steel specimen

4	Demonstrate Impact test on a Plastic specimen
5	The study of fatigue test on a brass specimen
6	The study of fatigue test on a mild steel specimen
7	The study of creep test on a lead specimen
8	The study of creep test on a nylon specimen
9	To Perform compression test on a spring specimen on hydraulic universal testing machine
10	To identify deflection of simply supported Brass beam
11	To identify deflection of overhang Brass beam
12	To study the strain at various angles in open end &close end condition in thin wall cylinder
13	To identify forces at each bar by applying desired load at a node in Truss 1 of universal Truss Apparatus
14	To identify of forces at each bar by applying desired load at a node in Truss 2 of universal Truss Apparatus
15	To identify of forces at each bar by applying desired load at a node in Truss 3 of universal Truss Apparatus

Teaching Methodology:
Demonstration
Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:
Lab Manual

FLUID MECHANICS – I (ME-223)

Contact Hours:	Credit Hours:
Theory =48	Theory = 3.0
Practical = 0	Practical = 0.0
Total = 48	Total = 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Apply** the basic concepts to hydrostatic fluid problems.	Cognitive	3	1
2.	**Analyze** the fluid kinematics and dynamics parameters using basic laws of mechanics.	Cognitive	4	2

3.	**Solve** the pipe flow problems using Bernoulli and energy equation.	Cognitive	3	2
4.	**Understand** the concept of dimensional analysis	Cognitive	2	1

Course outline:

1. Fluid Properties
   a. Definition of fluid and its classification
   b. Concept of continuum.
   c. Properties of the fluid.

2. Fluid Statics
   a. Concept of Pressure and basic equations for compressible and incompressible
   b. Pressure measurements and devices.
   c. Hydrostatics forces on plane and curved surfaces.
   d. Buoyancy and Stability.
   e. Pressure variation in fluid with rigid body motion.

3. Fluid Kinematics
   a. Flow characteristics, Descriptions of Velocity and acceleration field (Streamlines, streak lines and path lines).
   b. Control volume and representation of system.
   c. Reynolds transport theorem (RTT).

4. Fluid Dynamics
   a. Application of Newton's 2nd law in fluids.
   b. Total, stagnation and dynamic pressure.
   c. Deriving Bernoulli equation and its applications.

5. Integral Analysis of Fluid Flow
   a. Continuity equation using RTT.
   b. Linear momentum equation using RTT.
   c. Moment of momentum equation using RTT.

6. Dimensional Analysis, Similitude and Modeling
   a. Dimensional analysis
   b. Buckingham Pi theorem and determination of Pi terms

7. Flow in Pipes
   a. Characteristics of pipe flow laminar and turbulent.
   b. Calculating friction factor and wall shear stresses.
   c. Solving pipe flow network problems

Teaching Methodology:
Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments,

Text and Reference books:

1. Munson, Young And Okiishi HT John, *Fundamentals Of Fluid Mechanics*, J. Wiley & Sons.
2. Philip J. Pritchard and John C. Leylegian, *Fox and McDonald's Introduction to Fluid Mechanics*, J. Wiley & Sons.
3. Frank M White, *Fluid Mechanics*. McGraw-Hill.

THERMODYNAMICS-LAB (ME-224L)

Contact Hours:	Credit Hours:
Theory = 0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	Setup and **operate** various experimental apparatus related to thermodynamics.	Psychomotor	3	2
2	**Demonstrate** positive working attributes by working individually and with group.	Affective	3	9
3	**Write** a comprehensive report validating experimental results in the light of theoretical results.	Affective	2	4

List of Experiments

Sr.No	Experiments
1	To Study various temperature measuring Apparatus and To find their Accuracy or Calibration of different temperature measuring Apparatus
2	To measure the Relative Humidity of air in the thermodynamics Laboratory by using Dry bulb Hygrometer
3	To measure the Relative Humidity of air in the thermodynamics Laboratory by Wet bulb Hygrometer
4	To Find the Relationship between Pressure and Temperature by Using Marcet Boiler
5	To Verify the Gay Lussac's Law by using Marcet Boiler
6	To Study the working and sensitivity of different temperature measuring Instruments
7	The Calibration of Pressure Gauge by Using Plunger and Weights
8	Study of Internal Combustion Engine
9	Study of Two Stroke Petrol Engine Model
10	Study of Four Stroke Petrol Engine Model
11	Study of Four Stroke Diesel Engine Model
12	Demonstration of Steam Bench Apparatus

Teaching Methodology:
Lecturing
Demonstration

Assessment:
Lab Exam (Written/Practical Assessments), Lab Reports, Lab Assignments, Lab Session Performance, Problem Based Learning/Open Ended Lab Assessment (Optional)

Text and Reference books:
Lab Manual.

SEMESTER 5

FLUID MECHANICS – II (ME-322)

Contact Hours:	Credit Hours:
Theory =48	Theory = 3.0
Practical = 0	Practical = 0.0
Total = 48	Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Apply** governing equations to incompressible and compressible fluid flows.	Cognitive	3	2
2.	**Calculate** fluid flow parameters for various geometries.	Cognitive	3	2
3.	**Analyze** the performance of various fluid devices using scaling laws.	Cognitive	4	3

Course outline:

1. Differential Analysis of Fluid Flow
   a. Deriving continuity equation by applying conservation of mass principle.
   b. Evaluating velocity and acceleration field using material derivative.
   c. Deriving Navier-Stokes equation and some simple analytical solution

2. Potential flow theory
   a. Concept of vorticity, Circulation, Inviscid and Irrotational flow field
   b. Basic velocity potential function and its superposition.
   c. Prediction of Lift and drag using potential flow theory

3. Flow over immersed bodies
   a. Boundary layer theory and its thicknesses.
   b. Concept of local and average drag coefficient.
   c. Calculating drag and lift forces due to pressure and velocity field.

4. Introduction to Computational Fluid Dynamics
   a. Finite difference formulation

   b. Solving basic fluid flow problems using available CFD code.

5. Compressible Flows
   a. Mach number and speed of sound
   b. Isentropic flow of an ideal gas
   c. Convergent divergent Nozzle

6. Turbomachinery
   a. Fans, Pumps, turbines and other flow devices.
   b. Deriving Euler's equation and solving of turbo-machine problems using velocity triangle
   c. Pump and turbine performance characteristic curves.

Teaching Methodology:
Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:
1. Munson, Young, Okiishi, HT John, *Fundamentals Of Fluid Mechanics*, J. Wiley & Sons.
2. Philip J. Pritchard and John C. Leylegian, *Fox And McDonald's Introduction To Fluid Mechanics,* Wiley & Sons.
3. Frank M White, Fluid Mechanics, Mc-Graw Hill

MACHINE DESIGN-II (ME-311)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2.0
Practical = 00	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO

1.	**Calculate** stresses in gear teeth, flywheels, power screws, etc	Cognitive	3	2
2.	**Identify** the parameters for the selection of standard machine elements, such as journal bearings, rolling contact bearings, chains, belts, clutches and brakes.	Cognitive	4	2
3.	**Design** the machine elements for desired outputs, including gears, flywheels, clutches, brakes, journal bearings, rolling contact bearings, power screws, chains and belts etc	Cognitive	5	3

Course outline:

1. Spur, Helical, Bevel and Worm Gears
Stress analysis on gear teeth
Power transmission by the gears

2. Design of Flywheels
Concepts of designing flywheels for different requirements

3. Selection of bearings
Selection procedures of sliding contact bearings and rolling contact bearings

4. Design of Brake / Clutches
Different types of clutches and designing concepts
Different types of brakes and designing concepts

5. Design of Power Screws / Translation Screws
Introduction to power / translational screws
Stresses in power / translational screws
Efficiency of power / translational screws
Applications of power / translational screws

6. Selection of Standard Machine Elements
Selection of flat belts, V belts, chain drive and rope drives

Teaching Methodology:
Lecturing
Design/Selection Assignments

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. Robert L. Mott, *Machine Elements in Mechanical Design*
2. Robert L. Norton, *Design of Machinery*
3. Joseph E. Shigley, *Theory of Machines & Mechanisms*

INSTRUMENTATION AND MEASUREMENT (ME-316)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2
Practical = 48	Practical = 1
Total = 80	Total = 3

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the basic concepts related to measurement	Cognitive	2	1
2	**Understand** the construction, working and applications of various sensors.	Cognitive	2	1
3	**Analyze** the sensor data	Cognitive	4	2
4	**Develop** sensor based solution	Cognitive	3	3

Course outline:

3. Introduction to measurement and instrumentation. Significance of measurement, planning of experiments, general measurement system, calibration
4. Static and dynamic characteristics of instruments: measurement sensitivity, range, accuracy, precision, repeatability, and uncertainty of instruments, measurement errors
5. Measurement of length, displacement, force, torque, strain, frequency, pressure, flow, and temperature.
6. Introduction to data acquisition systems, signal conditioning, display elements.

INSTRUMENTATION AND MEASUREMENT LAB

S.No	CLO Statement	Domain	Learning Level	PLO
1	Perform experiments and **Measure** the experimental values of different unknowns using different measurement systems.	Psychomotor	4	4
2	**Demonstrate** positive working attributes by working individually and with a group.	Affective	3	9
3	**Write** a comprehensive report validating experimental results in the light of theoretical results.	Affective	2	10

List of Experiments

Sr.No	Experiments
1	Linear & Radial Measurement Of Given Specimen By Using Vernier Caliper.
2	Linear & Radial Measurement Of Given Specimen By Using Micrometer Screw Gauge.
3	Current, Voltage & Resistance Measurement Using Digital Multi Meter & Clamp Meter.
4	Measurement Of Sound Level Using Digital Sound Level Meter.
5	Measurement Of Frequency By Using Vibrating Reed Frequency Meter & Digital Multi Meter.
6	Demonstration On Earth Tester.
7	Measurement Of Electric Load By Using Watt Meter.
8	Measurement Of Electric Power Factor By Using Power Factor Meter.
9	Temperature Measurement Using Platinum RTD.
10	Measurement Of Resistance, Capacitance And Inductance Of Electronic Circuits By Using LCR Meter
11	Measurement Of Torsion In A Shaft By Using Strain Gauge.

Teaching Methodology:
Lecturing
Written Assignments

Lab. Reports

Assessment:
Mid Term, Quizzes, Assignments, Final Term

Text and Reference books:
1. E. Doeblin, *Measurement Systems Applications and Design*, McGraw Hill
2. D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics and Measurement Systems*.

MATHEMATICS-4 (NUMERICAL ANALYSIS) (GS-301)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2
Practical = 48	Practical = 1
Total = 80	Total = 3

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** main sources of numerical errors.	Cognitive	2	1
2	**Apply** appropriate numerical methods to the engineering and science problems to reduce numerical errors	Cognitive	3	2

Course Outline:
Error and computer arithmetic, root-finding for non-linear equations, interpolation and polynomial approximation, solution of system of linear equations, numerical differentiation and integration and numerical solution of ordinary differential equations.

Mathematics-4 (Numerical Analysis) Lab

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Manipulate** MATLAB from numerical analysis perspective	Psychomotor	3	2
2	**Make** MATLAB algorithms for various numerical analysis techniques.	Psychomotor	4	2

3	**Design** MATAB algorithm for given engineering/sciences problems.	Cognitive	5	3

List Experiments

Sr.No	Experiments
1	Develop algorithm/s on MATLAB to solve on ODE with iteration
2	Develop algorithm/s on MATLAB for iterative calculation using McLaurin Series
3	Develop algorithm/s on MATLAB for finding Truncation Error and Round-off Errors in Numerical Differentiation
4	Develop algorithm/s on MATLAB for finding Roots of an Equation Using Graphical Technique
5	Develop algorithm/s on MATLAB for Bisection Method
6	Develop algorithm/s on MATLAB for Newton Raphson Method
7	Use Matlab to solve Matrix based Physical system
8	Use Matlab to computer LU Factriozation
9	Use Matlab to determine all Eigen Values and Eigen Vectors for a given system
10	Develop MATLAB algorithm/s to implement Eulers Method for solving initial Value ODE problems
11	Develop MATLAB algorithm/s to implement 4^{th} order Runge-Kutta Method for solving Intial value ordinary Differential System equations
12	Develop MATLAB algorithm/s to generate linear Regression
13	Develop MATLAB algorithm/s to implement Newton interpolation
14	Develop MATLAB algorithm/s to implement Lagrange Interpolation on an Experimental Data collected form Industry

Recommended Text:

1. *Numerical Analysis (9th edition)* by R. L. Burden and J. D. Fairs, Books/Cole.
2. *Numerical Analysis* by D. Kincaid and W. Cheney.
3. *Numerical Methods, for Computer Science, Engineering and Mathematics* by John H. Mathew.

HEAT & MASS TRANSFER (ME-321)

Contact Hours:
Theory =48
Practical = 0
Total = 48

Credit Hours:
Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the impact of materials properties on heat transfer.	Cognitive	2	2
2.	**Use** modes and processes of heat transfer and apply them to solve basic heat transfer problems.	Cognitive	3	2
3.	**Analyze** and relate the relevant heat transfer phenomena for a given problem and quantify the heat transferred.	Cognitive	4	3

Course outline:

1. Introduction to Heat transfer
   a. Review of the concepts of equilibrium, steady state, heat and thermodynamics.
   b. Basic modes of heat transfer and their mechanisms.

2. Conduction
   a. Deriving heat conduction equation using principle.
   b. Solving heat conduction problems using equivalent electrical networks.
   c. Extended surfaces and their performance parameters.
   d. Transient heat conduction and lumped heat capacity method and its corresponding electrical analogy.

3. Radiation
   a. Fundamental characteristics of thermal radiation and surfaces
   b. Laws of black body radiation
   c. Intensity of radiation
   d. Solving problems of radiative heat transfer between surfaces and enclosures using equivalent electrical networks.

4. Convection
   a. Deriving energy equation for convection
   b. Heat transfer rate for laminar, turbulent and mixed boundary layers for external flow and internal flow problems.

c. Buoyancy driven flows and their heat transfer rate for external flow problems and enclosed spaces.
d. Heat transfer rate for phase change processes i.e. Boiling and condensation

5. Heat Exchangers
a. Classification and types of Heat exchangers.
b. LMTD method
c. NTU-effectiveness method

6. Mass transfer
a. Fick's law of diffusion and mass diffusivity.
b. Concept of concentration boundary layer.
c. Solving mass transfer problems using convective heat transfer analogy.

Teaching Methodology:
Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:
1. Incropera & DeWitt, Wiley, *Fundamentals of Heat and Mass Transfer*
2. Mills & Ganesan, Heat Transfer.
3. Frank Kreith, *Principles of Heat Transfer*.
4. J.P. Holman, *Heat and mass transfer*
5. Yunus Cengel, *Heat transfer*
6. Ozisik, *Heat Transfer*
7. D. Pitts, L. E. Sissom, *Heat Transfer*, Schaum's outline series New York.

MANUFACTURING PROCESSES (ME-313)

Contact Hours:	Credit Hours:
Theory =48	Theory = 3.0
Practical = 48	Practical = 1.0
Total = 96	Total = 4.0

Course outcome:

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.NO	CLO	Domain	Taxonomy level	PLO
1.	**Understand** various manufacturing processes	Cognitive	2	1
2.	**Identify** the right type of operation and its parameters for performing manufacturing processes	Cognitive	4	2
3.	**Apply** effectively various manufacturing techniques/operations in broad spectrum of engineering and manufacturing companies	Cognitive	3	2

Course outline:

1. Introduction: Basic concepts of manufacturing processes
2. Casting and Moulding: Metal casting processes and equipment, Powder metallurgy, Plastics
3. Forming: Extrusion and drawing, sheet metal forming, forming and shaping plastics and composite materials
4. Machining: Conventional and non-conventional machining processes
5. Joining: Welding, brazing, soldering, sintering, adhesive bonding, fastening, Press fitting
6. Additive Manufacturing: 3D Printing

Text and Reference books:

1. Mikell P Groover, *Fundamental of Modern Manufacturing: Materials,* Processes and Systems, John Wiley
2. S. Kalpakjian & S. R. Schmid, *Manufacturing Processes for Engineering Materials,* Pearson
3. Stanley A. Komacek, Ann E. Lawson & Andrew C. Horton, *Manufacturing Technology*, Glencoe/Mcgraw-Hill.

MANUFACTURING PROCESS LAB

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** basic foundry, spot, oxy-acetylene welding operations, basic operations of power press, bending machine and roller machine	Psychomotor	2	4
2	**Develop** theoretical knowledge of different manufacturing processes	Cognitive	3	4
3	**Contribute** to experiment by working individually and in a group	Affective	2	9

List of Experiments

Sr.No	Experiments
1	To make wood pattern for sand mold casting and to prepare sand mold.
2	To perform Aluminium casting.
3	To perform Sheet rolling operation using rolling machine.
4	To perform V-bending of sheet metal using bending machine.
5	To make a cone of thin sheet metal by riveting operation.
6	To perform blanking and punching operations on thin sheet metal using power press machine.
7	To make a single point cutting tool on Pedestal Grinding machine.
8	To perform conventional face and partial face milling operations on vertical milling machine.
9	To perform the following operations on Vertical Milling machine i. End and Profile Milling operation ii. Pocket and Surface Contouring Milling operation
10	To perform the following operations on Universal Milling machine i. Slab and Slot Milling operation ii. Side and Straddle Milling operation
11	To perform drilling, boring, reaming and centring operations on Radial drill/Drill Press
12	To perform V-groove, square groove, T-slot and dovetail slot operations on shaper machine
13	To perform turning, facing, taper turning, threading, grooving on CNC lathe machine.
14	To perform End milling, face milling, profile milling and pocket milling on CNC milling machine.

Teaching Methodology:
Lecturing
Written Assignments
Report Writing
Video lectures

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

FLUID MECHANICS LAB (ME-322L)

Contact Hours:	Credit Hours:
Theory =0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Perform** experiment to determine key variables of interest (such as flow rate, coefficient of Drag, coefficient of velocity, coefficient of contraction, lift, power output and efficiency etc.)	Psychomotor	2	4
2	**Explain** parameters related to Lab from the experiments in relation to the theoretical aspects.	Cognitive	2	4
3	**Contribute** to experiment by working individually and in a group.	Affective	2	9

List of Experiments

Sr.No	Experiments
1	Study of basic hydraulic feed and hydraulic bench and flow measurement using rotameter
2	Measurement of fluid flow using venturimeter
3	Measurement of fluid flow using venturimeter orifice meter
4	To measure Energy losses in different elements of flow meter (Rotameter, venturimeter & Orifice meter)
5	To study the impact of jet and measure forces on multiple deflectors.
6	Demonstration of laminar and turbulent flow using Reynolds Apparatus and measure Reynolds Number
7	Measure Hydraulic coefficients (Discharge, velocity and

	contraction) for different nozzles
8	Determine the center of gravity and study the Stability of Floating Body
9	To determine mechanical power produced by Kaplan Turbine
10	To determine mechanical power produced by Francis Turbine
11	To determine mechanical power produced by Pelton wheel
12	Determination of drag and lift coefficients of different airfoil at different angle of attack
13	Pressure distribution with flow around cylinders and aero foils
14	To study the performance and measure the power produced by reciprocating pump
15	To study the performance and measure the power produced by centrifugal pump.

Teaching Methodology:
Demonstration
Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:
Lab Manual

SEMESTER 6

Engineering Statistics (GS-302)

Contact Hours:		Credit Hours:	
Theory	= 48	Theory	= 3.0
Practical	= 0	Practical	= 0.0
Total	= 48	Total	= 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** the use of descriptive techniques to describe the statistical data	Cognitive	2	1
2	**Use** the concepts and methods of probability theory for solving problems in engineering sciences	Cognitive	3	1

3	**Analyze** the population parameters on the basis of sample study using the techniques of inferential statistics.	Cognitive	4	2

Course Outline:

1. Review of set algebra and combinatorial analysis,
2. sample space and events,
3. axiomatic definition of probability, rules of calculation of probabilities, conditional probability and probability of the composite random events, independent experiments,
4. discrete and continuous random variables, binomial, Poisson, multinomial, exponential and normal distribution, data analysis and descriptive statistics,
5. introduction to inferential statistics, point estimation, methods of moments and methods of maximum likelihood,
6. confidence intervals, tests of hypothesis, first and second types of errors, tests for mean, proportion and variance, chi-square and student's t-test.

Recommended Text:

1. *Probability and Statistics for Engineering and Sciences by* Jay L. Devore, (8th Edition, Brooks/Cole USA, 2012).
2. *Applied Statistics and Probability for Engineers by* Douglas C. Montgomery, George C. Runger, (5th Edition, John Wiley & Sons USA, 2011).
3. *Statistics and Probability for Engineering Applications* by W. J. DeCoursey, (1st Edition, Elsevier Science USA, 2003).

T ECHNICAL ELECTIVE-I

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 0	Practical	= 0.0
Total	= 32	Total	= 2.0

CONTROL ENGINEERING
(ME317)

Contact Hours:		Credit Hours:	
Theory	= 48	Theory	= 3.0
Practical	= 48	Practical	= 1.0
Total	= 96	Total	= 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.NO	CLO	Domain	Taxonomy level	PLO
1.	**Develop** mathematical models of different physical system.	Cognitive	5	3
2.	**Analyze** complex engineering problems using mathematical models to examine different properties of the system	Cognitive	4	2
3.	**Develop** a controller to achieve the desired response from the system	Cognitive	5	3

Course outline:

1. Introduction
   Basics of control system, Open-loop and closed-loop control systems, Block diagram terminology, Example of system for block diagrams, Signal flow graphs
2. Dynamic System modeling
   Mechanical Translational & Rotational Systems, Electrical Active & Passive Systems, Electromechanical Systems, Conversion of Electrical System to Equivalent Mechanical Systems and vice versa, Thermal system and fluid systems
3. Laplace Transforms and Transfer Function
   Mason Gain Formula to find transfer function, Mason's formula application of electrical and mechanical systems, Development of nodal equations from signal flow graph, Development of signal flow graph from nodal equations
4. State Space Formulation
   State space formulation from differential equations, State Space formulation from block diagram and signal flow graphs, Control and Observer Canonical form of block diagrams and state space, Types of inputs like impulse, step, ramp and sinusoidal input, Solution of state space for different responses, System linearization and its applications
5. Time Response of 1st and 2nd Order System
   Time response of the 1st and 2nd order systems (impulse, step, ramp etc.), Time response characteristics, Frequency response of 1st and 2nd order systems, Time response of higher order systems
6. Study of System Stability
   Introduction to stability, Poles and Zeros concept, Ruth-Hurwitz stability criteria and its applications, Concept of Root-Locus
7. Root Locus Design

Root Locus design, System stability by pole placement, Compensator Design (Lead and Lag Compensator), Design of PID Controller (P, PI and PID Controllers), different PID Controller Tuning method

8. Frequency Design
Introduction to frequency plots, Bode Plots, System Stability using Bode Plots

CONTROL ENGINEERING LAB (ME-317L)

S.No	CLO Statement	Domain	Learning Level	PLO
1	Students will be able to **estimate** transfer function, steady state error, state space representation and parameters for root locus analysis	Cognitive	4	2
2	Students will be able to **understand** the basics of different controllers	Cognitive	2	1
3	Students will be able to **practice** different existing software tools for control	Psychomotor	3	5

Teaching Methodology:
Lecturing
Tutorial sessions
Discussions

Assessment:
Quizzes, OHTs/Mid Term, Assignments, Final Exam

Text and Reference books:
1. Charles Phillips & Royce Harbor ,*Feedback Control Systems*, Prentice-Hall
2. Katsuhiko Ogata, *Modern Control Engineering.*
3. Norman S Nise, *Modern Control Engineering.*

List of Experiments

Sr.No	Experiments
1	Introduction To MATLAB
2	Transfer Function Using MATLAB
3	State Space Representation In MATLAB
4	Stability Analysis Using MATLAB
5	Steady State Error Analysis Using MATLAB (1)
6	Steady State Error Analysis Using MATLAB (2)

7	Root Locus Analysis Using MATLAB
8	Introduction To Simulink
9	Feed Forward And Feedback Systems In Simulink
10	Introduction To PID Controller And Arduino Controller
11	Magnetic Levitation /Flow Control By PID
12	Creating A GUI In MATLAB
13	Arduino Microcontroller As A PID Controller
14	Servo Mechanical System Control By Arduino

LabText and Reference books:
Lab Manual

MECHANICS OF MACHINES (ME-312)

Contact Hours:		Credit Hours:	
Theory	= 48	Theory	= 3.0
Practical	= 0	Practical	= 0.0
Total	= 48	Total	= 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the concepts of mechanics for the design of machine elements.	Cognitive	2	1
2.	**Calculate** the kinematic characteristics of mechanisms such as linkages, cams, gears, governors and unbalance masses.	Cognitive	3	2
3.	**Relate** analytical and/or graphical solutions to complex engineering problems in various machines and mechanisms.	Cognitive	4	3

Course outline:

1. Introduction to Mechanisms
Machine & Mechanisms, Mechanism Terminology, Kinematic Diagram, Kinematic Inversion, Four Bar Mechanism, Slider Crank Mechanism, Techniques of Mechanism Analysis

2. Vector, Position and Displacement Analysis

Motion, Vectors, Analytical Vector Methods Applied to the Displacement Analysis of Planar Linkages, Graphical Analysis, Complex-Number Methods Applied to the Displacement Analysis of Linkages, Spatial (Three-Dimensional) Linkages, Computer-Implemented Numerical Methods of Position Analysis

3. Velocity Analysis of Mechanisms

Average Speed in Mechanize Mechanism, Velocity of a Point in Mechanize Mechanism, Angular Velocity in Mechanize Mechanism, Motion of a Rigid Body about a Fixed Axis (Without Translation), Moving Coordinate Systems and Relative Velocity, Application of Analytical Vector and Matrix Methods to Linkages, Four-Bar Linkage, Complex-Number Methods Applied to Velocity Analysis

4. Acceleration Analysis of Mechanisms

Planar Motion, Spatial Motion, Relative Acceleration, Analysis of a Four-Bar Linkage by Analytical Vector Methods, Acceleration Analysis, Position Analysis, The Acceleration Polygon, Graphical Analysis of the Four-Bar Linkage, An Analytical Solution Based on the Acceleration Polygon, Graphical Analysis of Sliding Contact Linkages, Trial Solution Method Applied to Linkage Acceleration Analysis, Spatial Linkages, Acceleration Analysis of an RSSR

5. Design & Development

6. Mechanism Design

Time Ratio, Timing Charts, Design of Slider Crank Mechanism, Design of Crank Shaper Mechanism, Mechanism to Move a Link Between Two Positions

7. Cams

Types of Cams & Followers, Follower Motion Schemes, Graphical Disk Cam Profile Design, Pressure Angle, Design Limitations

8. Governors

Types of Governors, Centrifugal Governors, Porter Governors, Parallel Governors, Spring Loaded Governors

9. Gears

Toothed Gearing, Gear Trains

Teaching Methodology:

Lecturing
Tutorial sessions
Discussions

Assessment:

Quizzes, Mid Term/One hour tests (OHTs), Term Project, Final Exam

Text and Reference books:

1. David H. Myszka, *Machines and Mechanisms*.
2. Thomas Bevan, *The Theory of Machines*.
3. John J. Uicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines and Mechanisms*.

4. Robert Ferrier McKay, *The Theory of Machines*
5. J. A. Collins*, Mechanical Design of Machine Elements and Machines,* J. Wiley
6. W. B. Green, Theory of Machine
7. R. L. Norton, *Design of Machinery*
8. R. S Khurmi, J.K Gupta, Theory of Machine.

HEATING, VENTILATION AND AIR CONDITIONING (ME-323)

Contact Hours:	Credit Hours:
Theory = 48	Theory =3.0
Practical = 0	Practical = 0.0
Total = 48	Total = 3.0

Course Learning Outcome (CLOs)
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy Level	PLO
1.	**Analyze** the parameters involved in human comfort and health	Cognitive	4	2
2.	**Design** the solution by applying the skills gained to estimate the space heating and cooling loads	Cognitive	5	3

Course outline:

1. Refrigeration system basics:
   a. basics of vapour compression system
   b. Pressure-enthalpy chart
   c. coefficient of Performance
   d.

2. Refrigeration system analysis:
   a. vapor absorption refrigeration cycle
   b. Comparison of actual and theoretical refrigeration cycle
   c. Heat pump
   d. Types and properties of refrigerants
   e. Condensers and evaporators
   f. Compressors, Refrigerant flow control devices

3. Refrigeration load estimation (Refrigeration)
   a. Product load
   b. Air Change load

c. Heat gain through walls
d. Internal heat gain

4. Psychrometric properties of air:
a. Composition of air
b. Dew point temperature
c. Dry bulb and wet bulb temperatures
d. Psychrometric charts
e. Heating and humidification
f. Cooling and dehumidification

5. HVAC basics,
a. Thermal Comfort and Indoor environment Health
b. Water and vapour mixture
c. Air ventilation
d. calculation of fresh air supply of a building
e. air handling unit for untreated fresh air
f. indoor air quality

6. HVAC systems:
a. Air handling unit
b. Chilled water and hot water recirculation system
c. All-air systems basics
d. Single zone and reheat system

7. Heating and Cooling Load:
a. Space heating and cooling load
b. Design conditions
c. Transmission heat losses
d. Infiltration, ventilation and other heat loss and gain sources
e. Thermal radiation
f. Heat gain through fenestrations
g. Design conditions
h. Internal heat gain

8. Pressure loss, Duct design and Air flow balancing

Teaching Methodology:
Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:
Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. McQuiston, Parker and Spitler, *Heating, Ventilating, and Air-Conditioning Analysis and Design,* John Wiley & Sons
2. W. F. Stoecker ,*Refrigeration and Air Conditioning*
3. Ed. Kreider, Curtiss &Rabl, *Heating and Cooling of Buildings* ,Mc-Graw-Hill

4. Dossat, R. J., John Wiley, Principles of Refrigeration.
5. Haines, Roger W. Wilson, Lewis, *HVAC Systems Design Handbook*, McGraw-Hill Companies
6. Dincer, Ibrahim, Ratlamwala, Tahir Abdul Hussain ,*Integrated Absorption Refrigeration Systems, Comparative Energy and Exergy Analyses*, Springer
7. *ASHRAE Fundamentals Handbook*
7. 8. *Shan K. Wang, Handbook of Air Conditioning and Refrigeration*

8. *9. Air conditioning principles and systems an energy approach by Edward G. Pita*

HEAT TRANSFER AND HVAC LAB (ME-323L)

Contact Hours:	Credit Hours:
Theory =0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Operate** multiple Heat Transfer testing units under different setting and control system to investigate the effect of heat transfer	Psychomotor	3	4
2	**Operate** multiple RAC testing units under different setting and control system to to observe different properties of air and refrigerants after heating and cooling processes	Psychomotor	3	4
3	**Demonstrate** positive working attributes by working individually and with a group	Affective	3	9

LIST OF EXPERIMENTS

Sr.No	Experiments
1	Fourier's law study for linear conduction of heat along a homogenous bar
2	Conduction of heat and overall heat transfer along a composite bar

3	The effect of a change in cross sectional area on the temperature profile along thermal conductor
4	Temperature distribution and determine the rate of heat transfer from radial conduction through wall of a thick cylinder
5	Determination of the relationship between power input and surface temperature in free convection
6	Determination of the relationship between Input velocity and surface temperature in force convection
7	Study the effects of shell and tube heat exchanger and determination of logarithmic mean temperature distribution for parallel flow and counter flow
8	Study the effects of concentric tube heat exchanger and determination of logarithmic mean temperature distribution for parallel flow and counter flow
9	Study the effects of double pipe type heat exchanger and determination of logarithmic mean temperature distribution for parallel flow and counter flow
10	To carry out the thermodynamic analysis of the Simple Compression Refrigeration Cycle
11	Study of characteristics of automotive refrigeration cycle and to find coefficient of performance.
12	Demonstration and Working of reverse air conditioning system and to find coefficient of performance.
13	Demonstration and working of Vapour Absorption Refrigeration System
14	Determination of power input, heat output and coefficient of performance of Mechanical Heat Pump
15	Investigation of the Relationship between Cooling Load and Cooling Range
16	Production of heat pump performance curves over a range of source and delivery temperatures of Mechanical Heat Pump

Teaching Methodology:
Demonstration
Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:
Lab Manual

SAFETY, HEALTH AND ENVIRONMENT (MS-301)

Contact Hours:
Theory = 32

Credit Hours:
Theory = 2.0

Practical = 0	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy Level	PLO
1.	**Demonstrate** knowledge of Safety Health and Environment	Cognitive	3	6
2.	**Analyze** various types of hazards at work and living places.	Cognitive	4	2

Course outline:

1. Introduction of Health and Safety: Industrial Safety: introduction objectives of Safety, Importance of Safety in an industry, Industrial accidents, Effects of accidents, Types of accidents incidence of fire. Fire prevention and control.
2. Techniques of Safety Management: Principles of accident prevention, hazard analysis. Legal, humanitarian and economic reason for action. Safety inspection procedures. Safety training, First aid and emergency procedures.
3. Environment and Health: Introduction: importance of clean environment, Scale of Environmental Pollution. Environmental Act. Health and Safety Act.
4. Atmospheric Pollution: Types of Atmospheric pollution, Their Causes and Effects on Human Health, Available Technologies for Controlling Pollution.
5. Industrial Waste: Solid Waste, Industrial Effluents and Waste Gases, waste treatment plants.
6. Noise Pollution: Measurement of Noise level, Effect of excessive noise on human health. Remedial Measures.
7. ISO Standards for Safety and Health and Environment

Teaching Methodology:

Lecturing
Tutorial sessions
Discussions

Assessment:

Quizzes, Mid Exams, Assignments, Term Project, Final Exam

Text and Reference books:

1. J. Ridley and J. Channing, *Safety at Works*, Routledge.
2. K. G. Lockyer, *Factory & Production Management*, Pitman Publishing.

SEMESTER 7

ENGINEERING ECONOMICS (MS-401)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy Level	PLO
1.	**Understand** the basic knowledge of cost and taxation concepts	Cognitive	2	1
2.	**Develop** the cash flow diagrams based on the time value of money	Cognitive	3	2
3.	**Solve** economics problems involving comparison and selection of alternatives by using variety of analytical and computational techniques.	Cognitive	3	5

Course outline:

1. Introduction
   a. Engineering Costs
   b. Estimation Models & Cash Flow Diagram
   c. Life cycle cost

2. Time value of Money
   a. Time value of money, equivalence, use of spread sheet, simple and compound interest
   b. Uniform series & Arithmetic & geometric gradient
   c. Nominal & effective, continuous compounding Economic criteria,
   d. Present Worth, future worth and annuity

3. Rate of Return
   a. Minimum acceptable rate of return(MARR),
   b. Internal rate of return, External rate of return
   c. Choosing the best alternative
   d. Incremental Analysis

4. Benefits and Cost ratio and Payback period
   a. Benefit and cost ratio (B/C Ratio), discounted benefit and cost ratio
   b. Simple payback period, discounted payback period
   c. Sensitivity & breakeven analysis
   d. Principle of comparative advantage

5. Depreciation
   a. Depreciation
   b. Depreciation using Unit of Production
   c. Depreciation using straight line method
   d. Depreciation using Depletion

6. Taxes
   a. Income Taxes, After tax RoR

7. Replacement analysis
   a. Design life, salvage value
   b. Up gradation Vs replacement

8. Risk and Uncertainty
   a. Estimation of future events
   b. Monte Carlo Simulation
   c. Bayes theorem

9. Concepts of Imports and Exports
   a. Basic concepts of import and export
   b. Dumping and anti-dumping and related laws

Teaching Methodology:

7. Lecturing
8. Written Assignments
9. Presentation

Assessment:

Mid Exam, Quizzes, Final Exam, Assignments, Presentations.

Text and Reference books:

1. William G. Sullivan and Elin M. Wicks, *Estimation of future events*
2. N. M. Fraser and E. M. Jewkes, *Engineering Economics: Financial Decision Making for Engineers*
3. D. G. Newnan, J. Whittaker, T. G. Eschenbach and J. P. Lavelle, *Engineering Economic Analysis*
4. A. J. Tarquin, L. T. Blank, *Engineering Economy*, McGraw-Hill

MECHANICAL VIBRATIONS (ME-411)

Contact Hours:		Credit Hours:	
Theory	= 48	Theory	= 3.0
Practical	= 0	Practical	= 0.0
Total	= 48	Total	= 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Use** different techniques to model vibrating systems for one/two/multi Degree of Freedom.	Cognitive	3	1
2.	**Analyze** the physical parameters involved in natural frequency and system response to free and forced or impulse inputs.	Cognitive	4	2
3.	**Construct** engineering structures and mechanical systems under dynamic conditions.	Cognitive	3	3

Course outline:

1. Introduction
   a. Fundamentals of Vibrations, Degrees of Freedom
   b. Discrete and Continuous Systems, SHM, Vibration Analysis Procedure
2. Single Degree of Freedom Systems - Free Vibratory Systems
   a. Newton's Method, Energy Method
   b. Viscously Damped Free Vibration
   c. Logarithmic Decrement, Springs and dampers in Combination
3. Single Degree of Freedom Systems – Forced Vibratory Systems
   a. Forced Harmonic Vibration, Rotating Unbalance
   b. Base Excitation, Vibration Isolation, Energy Dissipation by Damping
   c. Whirling of Rotating shafts
4. Transient Vibration
   a. Impulse Response Function, Response to an Arbitrary Input
5. Systems with Two Degrees of Freedom
   a. The Normal Mode Analysis, Free Vibration Analysis of an Undamped Systems
   b. Coordinate Coupling, Free Vibration Analysis of Damped systems
   c. Forced Harmonic Vibration of an Undamped Systems
   d. Forced Harmonic Vibration of Damped Systems
6. Multi Degree of Freedom Systems
   a. Eigen Values and Eigen Vectors, Dunkerley's Method, Rayleigh's Method
   b. Influence co-efficients, Matrix Iteration Method
   c. Stodola's Method, Holzer's Method

Teaching Methodology:
Lecturing
Tutorial sessions
Discussions

Assessment:
Quizzes, Mid Exams, Assignments, Term Project, Final Exam

Text and Reference books:
1. W. T. Thomson and M. D. Dahleh, *Theory of Vibration with Applications*
2. S. S. Rao, *Mechanical Vibrations*
3. D. J. Inman, *Engineering Vibration*

MECHANISMS AND MECHANICAL VIBRATIONS LAB (ME-411L)

Contact Hours:	Credit Hours:
Theory = 0	Theory = 0.0
Practical= 48	Practical = 1.0
Total = 48	Total = 1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Conduct** different experiments to measure different mechanical properties like moment of inertia, natural frequencies of different systems etc. with some confidence and proficiency	Psychomotor	4	1
2	**Contribute** effectively as an individual member of a team	Affective	2	9

List of Experiments

Sr.No	Experiments
1	Bi-Filer suspension system
2	Inertia in rotation motion
3	Universal vibration apparatus
4	Torsional vibration
5	Vibration of spiral spring
6	Whirling of shaft
7	Static & dynamic balancing
8	Demonstration of Gears (Helical, Spur, Rack & pinion)
9	Four Bar Mechanism with applications
10	Motorized Gyroscope apparatus
11	Demonstration of Corroli's effect
12	Governor apparatus
13	CAM & Follower
14	Static & Dynamic/Journal Bearing apparatus
15	Internal Gear train

Teaching Methodology:
Demonstration
Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:
Lab Manual

INTERNAL COMBUSTION ENGINES (ME-421)

Contact Hours:	Credit Hours:
Theory =32	Theory = 2.0
Practical = 0	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy Level	PLO
1.	**Explain** the basic knowledge, construction and working of various types of IC engines and its components.	Cognitive	2	1
4.	**Analyze** the effect of engine operating parameters (air/fuel ratio, ignition timing, fuel properties etc.) on engine performance and emissions.	Cognitive	4	4

Course outline

1. Introduction to I.C engines:
   a. History of I.C engine development
   b. Engine classifications
   c. Engine components and terminologies
   d. Working principle of turbo-charged, supercharged engine, its performance characteristics.

2. SI & CI engines systems:
   Basic engine cycle and operation
   a. Two and four stroke engines
   b. Engine operating characteristics (engine speed, compression ratio, sfc, A/F, F/A, etc)
   c. Engine parameters (efficiency, MEP, Power, torque, etc)
   d. Carburetors
   e. Fuel injectors
   f. Ignition system
   g. Electronic control unit, Engine management system

h. Otto, Diesel and Dual cycle and their comparison

3. Fuel and combustion:
   a. Hydrocarbon fuels and their properties
   b. Thermochemistry and Chemical equilibrium
   c. Self-ignition and engine knock
   d. Ignition delay
   e. Octane and Cetane Numbers

4. Gas exchange processes and mixture preparation:
   a. Intake Manifold
   b. Volumetric efficiency
   c. Intake valves
   d. Variable valve Control
   e. Fuel injection, EFI systems (PFI, MPFI, GDI and Common-rail)
   f. Super-charging and turbo-charging
   g. Fluid Motion within combustion chamber
   h. Turbulence, Swirl, Squish and Tumble
   i. Crevice Flow and blowby

5. Combustion in SI and CI engines:
   a. Ignition and flame development
   b. abnormal combustion and knock
   c. Spark timing and Maximum brake torque spark timing
   d. Diesel Fuel injection and mixture preparation
   e. Phases of combustion and ignition delay
   f. Injection timing, injection pressure
   g. common rail fuel injection

6. Exhaust Flow:
   a. Turbocharging
   b. Exhaust manifold
   c. Exhaust gas recirculation

7. Pollution control,
   a. engine emissions
   b. pollutant formation
   c. after treatment
   d. catalytic converters
   e. soot traps

8. Heat Transfer in Engines and engine cooling system

9. Friction and Lubrication of engine, Lubrication systems

Teaching Methodology:

Lecturing
Written Assignments
Video showing components and operation of IC engine
Assembling and dis-assembling of IC engines
Field Visits
Report Writing

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. W. W. Pulkrabek, *Engineering Fundamentals of IC engine*, Pearson Education Inc, USA
2. J. B. Heywood, *Internal Combustion Engine Fundamentals*, Heywood McGraw-Hill
3. Richard Stone Palgrave Macmillan, *Introduction to I. C. Engines*
4. C. F Taylor, *Internal combustion engines*. MIT Press.
5. R. V. Schäfer, F. Schäfer, *Internal Combustion Engine Handbook - Basics, Components, Systems, and Perspectives*, Fred SAE International.
6. C. R. Ferguson, *Internal Combustion Engines: Applied Thermo-sciences*, Wiley Science

TECHNICAL ELECTIVE-II

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 0	Practical	= 0.0
Total	= 32	Total	= 2.0

SENIOR DESIGN PROJECT-I (ME-499)

Contact Hours:		Credit Hours:	
Theory	= 00	Theory	= 0.0
Practical	= 48	Practical	= 3.0
Total	= 48	Total	= 3.0

INTRODUCTION TO FINITE ELEMENT ANALYSIS (ME-412)

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 48	Practical	= 1.0
Total	= 80	Total	= 3.0

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy Level	PLO

1.	**Understand** the basic knowledge of FEA, Software tools; element performance, FEA methods, formulations of 1-D, 2-D and 3-D elements	Cognitive	2	1
2.	**Apply** knowledge for linear, structural, thermal, dynamic and couple field problems	Cognitive	2	5
3.	**Analyze** structural, thermal, dynamic problems	Cognitive	4	2

Course outline:

a. Introduction to FEA and Element Performance
b. Introduction to Finite Element Modeling and preliminary decisions
c. Elements types and their properties
d. Basic concepts of equilibrium & compatibility
e. General factors affecting element performance – Sources of errors
f. Convergence.

2. FE Methods, Shape Functions, Stiffness Matrix and Transformation
   a. Direct Stiffness Method, Energy Methods
   b. Shape Function: Linear and Quadratic Element
   c. Beam Elements, Truss Elements, Linear and Planar elements
   d. Stiffness matrix, Local to Global Co-ordinate Transformation Assembly

3. Static Structural Analysis
10. Modeling and analysis of 1D, 2D and 3D structures under static loading

4. Heat Transfer and Thermal Stress Analysis:
   a. Introduction to Heat transfer, Thermal and Thermal Stress analysis concepts
   b. Selection of Boundary Conditions based on the identification of problem
   c. Thermal Analysis (Steady State)
   d. Thermal stress Analysis

5. Dynamic Analysis
   a. Introduction to different types of dynamic analysis
   b. Modal Analysis, Frequency Response Analysis, Transient Response Analysis, Master Degrees of Freedom

Teaching Methodology:
Lecturing
Written Assignments and projects (individual and as group)
Report Writing

Assessment:
Mid Term, Quizzes, Assignments, Project, Final Exams

INTRODUCTION TO FINITE ELEMENT ANALYSIS LAB (ME-412L)

S.No	CLO Statement	Domain	Learning Level	PLO
1	Students will be able to **practice** ANSYS tools to setup engineering problems for different boundary conditions	Psychomotor	3	5
2	Students will be able to **analyze** result of simulations based on their engineering knowledge.	Cognitive	4	5
3	Students shall **analyze** a given problem using ANSYS and discuss their findings.	Cognitive	4	5

List of Experiments

Sr.No	Experiments
1	Introduction to Ansys
2	Plate With a Hole
3	Triangular Plate
4	Cantilever Beam
5	W16x50 Beam
6	Tensile Bar
7	Threaded Bolt
8	Beam Bracket
9	Mid Exam/Project
10	Laminar Pipe Flow
11	Pipe With an obstacle
12	Introduction to ICEM
13	Mesh of Nozzle in ICEM

SEMESTER 8

ENTREPRENEURSHIP (MS-402)

Contact Hours:	Credit Hours:
Theory = 32	Theory = 2.0
Practical = 00	Practical = 0.0
Total = 32	Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Acquire** basic concepts of Entrepreneurship, its characteristics, factors affecting entrepreneurship growth, entrepreneur and a manager, starting new enterprise, E-commerce, Business plan and issues, marketing strategies, franchising	Cognitive	1	1
2.	**Apply** knowledge for different business plans as case studies	Cognitive	3	2
3.	**Demonstrate** individually and as team member during assignments, and projects for different case studies	Affective	3	3

Course outline:

1. Evolution of the concept of entrepreneur, Characteristics of an entrepreneur, Distinction between an entrepreneur and a Manager, Economic Development, Factors affecting entrepreneurial growth (economic, Non-Economic and Government factors)
2. Critical factors for stalling a new enterprise. Ingredients for a successful new business. Self-assessment and feedback, Personal

entrepreneurial competencies. Goal setting.

3. Creativity and sources of new business ideas, the difference between ideas and opportunity and creativity. Assessing business opportunities in Pakistan. Screening and evaluating opportunities Product planning and development process. Creating parallel competition by developing a similar product or service, Product life cycle, finding sponsorship. Acquiring a going concern, E-Commerce and business start-up and growth.
4. Marketing as a philosophy, marketing management: Creating a marketing plan, Analyze the environmental situation and the market opportunity, Setting marketing objective, formulating a marketing strategy.
5. The business plan as selling document, reasons for writing a business plan your company: What's your identity, Field work started, Marketing issues: Who are your buyers? Product issues: What are you selling?, Production exercise, Sales and Promotion: Financial issues: Targeting and writing the plan: Business Plan compilation exercise.
6. What is franchising? Becoming a franchisee versus starting a stand- alone business, The franchisee contract, Non-contractual
7. considerations of buying a franchise, Limitations of franchising, Conclusion, Course evaluation.

Teaching Methodology:

Lecturing
Written Assignments and projects (individual and as group)
Report Writing

Assessment:

Mid Term, Quizzes, Assignments, Project, Final Exams

Text and Reference books:

2. Rober D. Hisrich and Michael P. Peter, Entrepreneurship/lip,5th Edition, McGraw Hill
3. S.S. Khanka, Entrepreneurial Development
4. Irving Burstiner, The small Businesses Handbook
5. Bruce A. Kirchhoff, Entrepreneurship and Dynamic Capitalism
6. Modern Business Management, A System & Environment Approach by McGraw-Hill
7. William D. Bygrave, The Portable MBA in Entrepreneurship/lip Entrepreneurship CEFE, Germany, Development Manual

Text and Reference books:

1. Richard G. Budynass, *Advanced Strength and Applied Stress Analysis*, McGraw-Hill
2. Saeed Moaveni, *Finite Element Analysis – Theory and Applications*

with ANSYS , Prentice Hall
3. M J Fagan ,*Finite Element Analysis – Theory and Practice* ,Pearson Publications

ISLAMIC STUDIES (Compulsory) (GR-401)

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 0	Practical	= 0.0
Total	= 32	Total	= 2.0

Objectives:

This course is aimed at:

1 To provide Basic information about Islamic Studies

2 To enhance understanding of the students regarding Islamic Civilization

3 To improve Students skill to perform prayers and other worships

4 To enhance the skill of the students for understanding of issues related to faith and religious life.

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** the basic concept of Islam (faith, pillars and moral value systems etc.)	Cognitive	2	8
2	**Discuss** differences between religion, shahri'ah and fiqh.	Cognitive	2	8
3	**Present** Islam as complete code of life (emphasizing ethical standards defined by it	Affective	2	8

Detail of Courses

1. Introduction to Quranic Studies

a. Basic Concepts of Quran
b. History of Quran
c. Uloom-ul-Quran

2. Study of Selected Text of Holly Quran

a. Verses of Surah Al-Baqara Related to Faith(Verse No-284-286)
b. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
c. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
d. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
e. Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

3. Study of Selected Text of Holly Quran

a. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
b. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgmen
c. Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

4. Seerat of Holy Prophet (S.A.W) I

a. Life of Muhammad Bin Abdullah (Before Prophet Hood)
b. Life of Holy Prophet (S.A.W) in Makkah
c. Important Lessons Derived from the life of Holy Prophet in Makkah

5. Seerat of Holy Prophet (S.A.W) II

a. Life of Holy Prophet (S.A.W) in Madina
b. Important Events of Life Holy Prophet in Madina
c. Important Lessons Derived from the life of Holy Prophet in Madina

6. Introduction to Sunnah

a. Basic Concepts of Hadith
b. History of Hadith
c. Kinds of Hadith
d. Uloom –ul-Hadith
e. Sunnah & Hadith

f. Legal Position of Sunnah

7. Selected Study from Text of Hadith

8. Introduction to Islamic Law & Jurisprudence

a. Basic Concepts of Islamic Law & Jurisprudence
b. History & Importance of Islamic Law & Jurisprudence
c. Sources of Islamic Law & Jurisprudence
d. Nature of Differences in Islamic Law
e. Islam and Sectarianism

9. Islamic Culture & Civilization

a. Basic Concepts of Islamic Culture & Civilization
b. Historical Development of Islamic Culture & Civilization
c. Characteristics of Islamic Culture & Civilization
d. Islamic Culture & Civilization and Contemporary Issues

10. Islam & Science

a. Basic Concepts of Islam & Science
b. Contributions of Muslims in the Development of Science
c. Quran & Science

11. Islamic Economic System

a. Basic Concepts of Islamic Economic System
b. Means of Distribution of wealth in Islamic Economics
c. Islamic Concept of Riba
d. Islamic Ways of Trade & Commerce

12. Political System of Islam

a. Basic Concepts of Islamic Political System
b. Islamic Concept of Sovereignty
c. Basic Institutions of Govt. in Islam

13. Islamic History

a. Period of Khlaft-E-Rashida
b. Period of Ummayyads
c. Period of Abbasids

14. Social System of Islam

a. Basic Concepts of Social System of Islam
b. Elements of Family

c. Ethical Values of Islam

Text and Reference books:

1. Hameed ullah Muhammad, "Emergence of Islam" , IRI, Islamabad
2 Hameed ullah Muhammad, "Muslim Conduct of State"
3 Hameed ullah Muhammad, 'Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,"
5 Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
6 Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
7 Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
8 H. S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
9 Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

TECHNICAL ELECTIVE-III

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 0	Practical	= 0.0
Total	= 32	Total	= 2.0

MANAGEMENT ELECTIVE

Contact Hours:		Credit Hours:	
Theory	= 32	Theory	= 2.0
Practical	= 0	Practical	= 0.0
Total	= 32	Total	= 2.0

POWER PLANTS (ME-422)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Review** different energy resources, environmental impacts of power generation and flue gas cleaning techniques.	Cognitive	2	7
2.	**Analyze** strengths and weaknesses of different types of power plants by performing its thermodynamic calculations.	Cognitive	4	2
3	**Illustrate** the construction and operation of different components of a power plant.	Cognitive	4	2
4	**Design** of the major components or systems of a conventional or alternative energy power plant.	Cognitive	5	3

Course outline:

1. Introduction
Review of mass and energy balances for steady flow devices, energy sources and classification; Fossil fuels; composition, ranking and analysis; combustion calculations; environmental pollution
2. Steam Generators and Turbines
Combustion equipment and firing methods, boiler types and their applications; boiler components, boiler operation and safety, water

treatment. Impulse and reaction turbines; Pressure and Velocity Compounding, Turbine governing and controls

3. Steam Powerplants

Rankine Cycle, Superheat, Reheat; Regenerative Cycle, Open Type Feed Water Heaters (FWH), Closed Type FWHs with Drains Cascaded Backwards and Pumped Forward

4. Gas Turbine Powerplants

Gas turbine (Brayton) cycle, regeneration, intercooling

5. Combined Cycle Powerplants

Topping and bottoming cycles, combined cycle efficiency

6. Cogeneration

Cogeneration of power and process heat, Back Pressure and Extraction Turbines

7. Diesel Engine Powerplant

General layout, Site selection criterion, performance characteristics & environmental impact consideration

8. Nuclear Power Plant

Nuclear fuels, nuclear reaction types, Components, reactor types, Site selection criterion, safety and environmental considerations

9. Renewable Energy Powerplants

Introduction to Solar, Wind, Hydro and Geothermal Powerplants

10. Powerplant Economics and Management

Effect of variable load, load curve, economics of thermal power plants, energy conservation and management

Teaching Methodology:

Lecturing
Written Assignments
Field Visits
Report Writing

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. Pedersen, E.S., *Nuclear Power, Ann Arbor Science*
2. El-Wakil, M.M., *Power Plant Technology*, McGraw-Hill
3. I. Dincer, C. Zamfirescu, *Advanced Power generation systems*, Elseveir
4. Larry Drbal, Pat Boston, "Powerplant Engineering", CBS Publishers
5. Black, Veatch, "*Power Plant Engineering*", Springer.
6. P.K. Nag, "*Power Plant Engineering*", McGraw-Hill.
7. Everett Woodruff, Herbert Lammers, Thomas Lammers, *"Steam Plant Operation"*, McGraw-Hill.
8. Thomas Elliott, Kao Chen, Robert Swanekamp, "*Standard Handbook of Powerplant Engineering*", McGraw-Hill.

I.C ENGINES AND POWER PLANTS LAB (ME-422L)

Contact Hours:	Credit Hours:
Theory =0	Theory = 0.0
Practical = 48	Practical = 1.0
Total = 48	Total = 1.0

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Measure** different parameters of Power Plant such as Fuel Consumption, Boiler Efficiency, and relations between different parameters of gas turbine	Psychomotor	4	4
2	**Identify** different components of and their working in internal combustion engine	Psychomotor	1	4
3	**Demonstrate** positive working attributes by working individually and with a group	Affective	3	9
4	**Write** a comprehensive report validating experimental results in the light of theoretical results	Affective	2	10

List of Experiments

Sr.No	Experiments
1	The Demonstration and Working of Four Stroke Petrol Engine
2	The Demonstration And Working of Two Stroke Petrol Engine
3	To Determine the RPM And Voltages of Stirling Engine
4	Demonstration of Mini Steam Power Plant
5	To Find the Theoretical and Experimental T-P Curve for the Fire Tube Boiler of Mini Steam Power Plant
6	To Find The Fuel Consumption of Mini Steam Power Plant
7	To Find The Boiler Efficiency of Mini Steam Power Plant
8	To Find the Efficiency of Reaction Turbine of Mini Steam Power Plant
9	To Find the Generator Power Output of Mini Steam Power Plant at Different Loads
10	Demonstration of Two Shaft Gas Turbine Power Plant
11	To Find the Actual and Theoretical Air Fuel Ratio Two Shaft Gas Turbine
12	To Find the Compression and Expansion Ratio of Different Components of Two Shaft Gas Turbine

13	To Find The Power Output Of Different Components Of Two Shaft Gas Turbine
14	To Find the Individual Efficiencies of Different Components and The Overall Efficiency of Two Shaft Gas Turbine

Teaching Methodology:
11. Demonstration
12. Lab Report Writing

Assessment:
Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:
Lab Manual

SENIOR DESIGN PROJECT-II

Contact Hours:		Credit Hours:	
Theory	= 00	Theory	= 0.0
Practical	= 48	Practical	= 3.0
Total	= 48	Total	= 3.0

Technical Electives

1. Renewable Energy Technology
(ME-423)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	Cognitive	2	1
2	**Describe** the main components of different renewable energy systems	Cognitive	2	1
3	**Design** renewable/hybrid energy systems that meet specific energy demands are economically feasible and have a minimal impact on the environment	Cognitive	5	4

Course outline:

1. Introduction to types of renewable energy, solar energy, wind energy, geothermal energy, biomass energy. Hydro energy, energy efficiency issues and energy storage. Potential of using renewable energy resources as supplement of conventional energy resources.
2. Renewable and non-renewable energies used as hybrid energy systems, Modern renewable energy plants.
3. Wind/solar energy, wind turbine/solar system design specifications, compatible electric generators and major operational issues of the wind mill for electric power generation. Wind mills design usage for pumping water.
4. Biomass energy conversion methods, detailed description of biomass energy conversion plant, operational and maintenance

problems and their remedies.

Recommended Books:

1. G. Boyle, *Renewable Energy*, 2nd Edition, Oxford University Press.
2. J. Twidell, T. Weir, *Renewable Energy Resources*, Spon Press.

2. Gas Dynamics
(ME-425)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	Student should be able to **apply** the fundamental flow equations and basic solution techniques in solving compressible one dimensional flow.	Cognitive	3	1
2	Students shall be able to **evaluate** first order solutions for compressible internal flows for variable geometry ducts with friction and heat transfer.	Cognitive	6	2

Course outline:

1. Basic governing laws of conservation of mass, momentum and energy, limitations.
2. Sub-sonic and supersonic gas flow. Mach number and Mach angle. Isentropic Flow and Applications; Operation of nozzles under varying pressure ratios.
3. Normal and oblique shocks, Prandtl-Meyer compression and expansion with applications.
4. Rayleigh flow and Fanno flow, Busemann's shock polar diagram.

Recommended Books

1. M. J. Zucrow and J.D. Hoffman, Gas Dynamics, John Wiley & Sons, 1976

2. A. H. Shapiro, R. Wiley, *The Dynamics and Thermodynamics of Compressible Fluid Flow*-Vol. 1, 1st Edition
3. J. E. John, Allyn and Bacon, *Gas Dynamics*, 2nd Edition
4. B.W. Imrie, *Compressible Flow*

3. Aerodynamics
(ME-426)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** governing equations of aero dynamics and turbulence.	Cognitive	2	1
2	**Analyze** convection-diffusion equations using finite volume methods.	Cognitive	4	2
3	**Solve** convection-diffusion problems using discretization schemes.	Cognitive	3	1

Course outline:

1. Introduction,
2. Aerodynamics of incompressible flow,
3. Compressible and ideal fluid flow,
4. Aerofoil theory,
5. Finite wing aerodynamics,
6. Blade element theory and aircraft propellers,
7. Cascade aerodynamics,
8. Jet propulsion,
9. Intake and nozzle performance,
10. Aircraft performance measurement.

Recommended Books
1. El. Houghton, A. E. Brock, St. Mortin, *Aerodynamics for Engineering Students*, Cambridge University Press, 2003

2. L. J. Clancy, Hallstead Pr., *Aerodynamics*

4. Computational Fluid Dynamics (CFD)
(ME-424)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** governing equations of fluid Dynamics and Turbulence.	Cognitive	2	1
2	**Analyze** convection-diffusion equations using finite volume methods.	Cognitive	4	2
3	**Solve** convection-diffusion problems using discretization schemes.	Cognitive	3	2

Course outline:

1. Types of ordinary and partial differential equations,
2. solution of equation sets, boundary value and initial value problems,
3. control volume approach, time stepping, accuracy, stability, consistency, linearization,
4. diffusion, dispersion, vorticity stream function and primitive variable formulations.
5. Turbulence modeling.
6. Examples of external flow across various configuration, internal flows through pipes, ducts and valves.

Recommended Books:
1. J. D. Anderson Jr., *Computational Fluid Dynamics*, 1st Edition, McGraw-Hill Science

5. Maintenance Engineering
(ME-413)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0

Total = 32 Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** different statistical methods available for analysis of different processes.	Cognitive	2	1
2	**Describe** the importance of the maintenance and process improvement functions within industry.	Cognitive	2	1
3	**Analyze** the various methodologies used in industry to estimate the level of reliability and remaining life of a critical component at a certain point in time, using statistical and mathematical techniques where appropriate.	Cognitive	4	2

Course outline:

1. Introduction and types: Preventive maintenance, its objectives, benefits and economics, inspection and implementation.
2. Routine maintenance and monitoring of fault indicators, main concepts and implementation.
3. Proper assembly/disassembly, alignment aspects, machine handling.
4. Record keeping and maintenance scheduling, stocking spares and cost effectiveness, safety in maintenance.
5. Basic repairs of electro-mechanical equipment, fault diagnosis and assessment.
6. Introduction to predictive maintenance. Condition base monitoring.
7. Basic Repairs. Replacement/refurbishment of defectiveness parts e.g.bearings, brakes, shafts.

Recommended Books:

1. L. R. Higgins, L. C. Morrow, Maintenance Engineering Handbook, 3rd Edition, McGraw-Hill
2. B.J. Lewis, Management Handbook for Plant Engineers 2nd Edition, McGraw-Hill.

6. Introduction to Mechatronics (ME-318)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** working principles and application of 8051 microcontroller	Cognitive	4	2
2	**Explain** working principles and application of programmable logic	Cognitive	4	2

Course outline:

Introduction to Mechatronics, Measurement & Control Systems, Introduction to Embedded Systems, Representation of Numbers in Embedded Systems, Microcomputer Organization, Microcontroller Units, Introduction to Microprocessors, Memory Organization, Bus Arbitration & DMA Transfers, Internal Architecture of 8051 Microcontroller, GPIO Modes & GPIO Registers, Serial Communication, Embedded Programming in C, Introduction to Programmable Logic, Ladder Logic Programming, Introduction to SCADA Systems.

Recommended Books:

1. Microprocessor & Microcomputer Technology by Noel M. Morris
2. 8051 Microcontroller architecture, programming, and applications by Kenneth Ayala
3. PLC Programmable Logic Controller by Hugh Jack

7. Automation and Robotics (ME-319)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO

1	**Describe** in detail how industrial robot systems are used, computer-aided production tools and data communication within an industrial robotics network.	Cognitive	2	1
2	**Identify** fundamental issues within sustainable industrial development from an automation perspective.	Cognitive	2	7

Course outline:

1. Robotics: Basic concepts in robotics, classification and structure of robotic system, drive and control system, coordinate transformation, kinematics dynamic analysis and trajectory interpolation, interfacing with micro controllers and PLCs, applications of robots.

2. Robotics and Automated Guided Vehicles. Basic robot motion, path control, robot drive system sensors, robot-computer interface, robot programming, Automated Guided Vehicles (AGV) types.

3. Programmeable logic controller (PLC). Basics components and terminologies, ladder diagram elements, relay sequencing, processor input and output modules, programming unit and programming procedures with machines or assembly language.

4. Microcontroller. Basic elements of microcontroller, types of microcontroller, microprocessor and PLC, overview of architecture and principles of operations, assembly, machine and high level programming languages for microcontroller, input and output peripherals for specific application in mechanical engineering with interfacing techniques. Actuators, sensor, input signals, output signals, signal conditioning.

5. Automations: Introduction to automations, automation strategies, economics of automations, partial automations, group technology and flexible manufacturing. Use of sensors and actuators in automations.

Recommended Books:

1. Y. Korem, *Robotics for Engineers*, 1985
2. J. Craig, *Introduction to Robotics*, 3rd Edition, Prentice Hall
3. D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics & Measurement Systems*, 2nd Edition, McGraw-Hill
4. C. D. Johnson, *Process Control Instrumentation Technology*, 7th Edition, Prentice Hall
5. C. R. Asfahd, *Robotics and Manufacturing Automation*, John Wiley

& Sons

6. M. P. Groover, *Automation Production Systems*, 1987

8. Tribology (ME-412)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLOStatement	Domain	Learning Level	PLO
1	**Describe** basic knowledge of surface topography actuators.	Cognitive	2	1
2	**Explain** the theoreticaln background about processes in tribological system, mechanisms and forms of interaction of friction surfaces, hertz contact and rough surface contact.	Cognitive	2	1
3	To **Identify** the methods to reduce the friction for engineering surface.	Cognitive	1	1

Course outline:

1. Friction, wear mechanism, wear debris classification, surface roughness, friction and wear measurement techniques, lubrication of sliding and rolling parts.
2. Types of lubricants, grades and their properties; theories of lubrication, oil whirl, Hydrodynamic and elasto-hydrodynamics lubrication of journal bearing.
3. Solid lubricants, self-lubricating fuel, tribology in manufacturing, tribology in automobiles.

Recommended Books:

1. A Cameron, *Basic Lubrication Theory*,
2. D.D. Fuller, *Theory and Practice of Lubrication for Engineers*, John Wiley & Sons Inc. 1956
3. B. Bhushan, *Modern Tribology Handbook*, Vol-I, CRC Press, 2001

9. Nuclear Engineering (ME-428)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** basic calculations related to nuclear fissions including binding energy, the fission process and energy release and actinide yields.	Cognitive	2	1
2	**Describe** reactor physics and calculate fundamental parameters: the harnessing of energy, the roles of the moderator and the coolant, reactor dynamics, neutron life cycle, criticality and reactor transients.	Cognitive	2	1
3	**Describe** the effects of radiation on matter including alpha, beta, gamma and neutrons, material defects, the origin of swelling and material degradation mechanisms.	Cognitive	2	1

Course outline:

1. Review of nuclear physics, reactor physics, reactor heat transport.
2. Types of nuclear reactors, and power plants.
3. Reactor material. Nuclear fuels, enrichment and reprocessing; handling of fuels.
4. Safety aspects.

Recommended Books:

1. J.P. Lamarsh, *Introduction to Nuclear Engineering*, Prentice Hall 2001
2. M. M. El Wakil, *Nuclear Power Engineering*, McGraw-Hill 1962

10. Mechanical Engineering Design (ME-315)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	To know the different criteria of design to **solve** the problems of machine elements like keys, couplings, brakes, clutches, fly wheels and screws.	Cognitive	3	1
2	**Analyze** the behavior of machine element like keys, couplings, brakes, clutches, fly wheels and screws	Cognitive	4	2
3	Ability to **evaluate** design problems related to fasteners.	Cognitive	6	4

Course outline:

1. Philosophy and concept of engineering design.
2. Engineering creativity, phases and procedure in design.
3. Management of engineering project. Computer aided design.
4. Modeling and similitude, optimization and reliability.
5. Application of industrial design codes.

Recommended Books:

1. W. Eder, S. Hosnell, Design Engineering: A manual for enhanced creativity, CRC Press, 2007
2. A. H. Burr, J. B. Cheatham, Mechanical Analysis and Design, Prentice Hall.
3. D. G. Ullman, The mechanical design process, McGraw Hill.

11. CAD/CAM (ME-414)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** fundamental understanding of the principles of CAD/CAM	Cognitive	2	1
2	**Use** engineering mathematics related to geometry to understand CAD/CAM concepts.	Cognitive	3	2
3	**Apply** computer aided manufacturing principles to perform manual and computer aided numerical control programming.	Cognitive	3	5

Course outline:

1. Engineering product specification
2. Engineering drawing and orthographic projection
3. Part modeling
4. Solid and feature based design
5. Geometric tolerancing
6. Geometric modeling
7. Process engineering
8. Tooling and fixturing
9. Numerical control programming
10. Virtual and rapid prototyping
11. Design for manufacturing and assembly
12. Product lifecycle management

Recommended Books:
1. Chang, T. C., Wysk, R. A., Wang, H. P, "Computer-aided Manufacturing," Prentice Hall, Third Ed., ISBN-10: 0131429191, ISBN-13: 978- 0131429192.

12. Product Design & Development (ME-415)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** the product design methodology and developments methods management techniques.	Cognitive	2	1
2	**Describe** various manufacturing cost components and cost analysis of product design.	Cognitive	2	1
3	**Analyze** various factors affecting design problems.	Cognitive	4	2

Course outline:

1. Product design, development and management process over whole product life cycle.
2. Methodology for product design, development and management
3. Lean new product introduction
4. The relationship of tangible product and brand
5. Marketing and product specification
6. Creativity and innovation in product design
7. Product prototyping and manufacturing technologies Product performance test
8. Cost models for product design, development and production
9. Design protection and intellectual property rights
10. Case study

Recommended Books:

1. Planchard, D. C. and Planchard, M. P., (2012). Engineering design with SolidWorks 2012: A step-by-step project based approach utilizing 3D solid modeling, Schroff Development Corporation, Mission, Kansas. ISBN 978-1-58503-697-4.
2. Additional lecture notes and materials given in class.

13. Production Engineering (ME-429)

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Analyze** processing operations (Machining, Grinding, surface processing) with their process dynamics and performance.	Cognitive	4	03
2	**Analyze** machining operations with their process dynamics and performance.	Cognitive	4	03
3	**Compare**, organize, and select appropriate manufacturing processes, equipment, and process parameters.	Cognitive	4	04

Course outline:

Material removal, Calculation of material removal rate for different machining processes

Machine Processes for Producing Various Shapes. Milling operation, milling machines, planning and shaping, broaching and broaching machines, gear manufacturing by machining.

Abrasive Machining & Finishing Operations. Abrasive, bonded abrasives (grinding wheels), grinding process, grinding fluids, design considerations for grinding, ultrasonic machining.

Non-Conventional Machining Process. Machining, electrochemical, electrical – discharge machining, wire E D M

Control of Machine Tools. Machine tools control, numerical control system, Computerized Numerical Control.(CNC), programming for numerical control

Jigs & Fixtures. General design principle, elements of jig, locating devices and clamping devices.

Computer Integrated Manufacturing System. Manufacturing system, Computer Integrated Manufacturing (CIM), Flexible Manufacturing System (FMS), Cellular manufacturing.

Metrology. Specification and standardization limit and fits tolerances and allowances.

Precision measurements: Standards; optical projection straightness and flatness testing, surface finish measurement.

Introduction to Process Planning

Recommended Books:

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems by Mikael P. Groover, John Wiley & Sons, 2nd edition 2001.

Manufacturing Processes for Engineering Materials, Fourth Edition, Serope Kalpak jian, Steven R. Schmid, Prentice Hall

Metal Cutting and High Speed Machining by D. Dudzinski, A. Molinari, H. Schulz, Plenum Pub Corp, 2002.

Applied Manufacturing Process Planning: With Emphasis on Metal Forming and Machining by Donald H. Nelson, George, Jr. Schneider, Prentice Hall, 1st edition, 2000.

MANAGEMENT ELECTIVES

1. Operations Management

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:
Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	Identify and **articulate** how operations management contributes to the achievement of an organization's strategic objectives.	Cognitive	3	11
2	Critically **evaluate** the operations function in manufacturing and service production settings.	Cognitive	6	11
3	**Evaluate** approaches to problem solving and process improvement in production settings.	Cognitive	6	11

Course outline:

1. Basics of managing manufacturing and service organizations;
2. Strategic decision making;
3. Facility location and layout;
4. Job design and work compensation;
5. Demand forecasting;
6. Capacity and material planning;
7. Scheduling in various environments;
8. Emerging trends in managing operations.
9. Focus on selection and use of quantitative management tools after introducing fundamental concepts.

Recommended Books:

1. W. J. Stevenson, *Operations Management*, 12th Edition 2015, McGraw Hill
2. A. Greasley, *Operations Management*, 3rd Edition, 2013,Wiley

2. Total Quality Management

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Explain** the different meanings of the quality concept and its influence.	Cognitive	2	11
2	**Analyze** several techniques and quality management tools.	Cognitive	4	11
3	**Explain** and differentiate the normalization, homologation and certification activities.	Cognitive	4	11

Course outline:

Fundamental principle
Current Standards, ISO and others
Techniques for quality analysis and improvement.
Seven improvement tools.
Statistical process control.
Accepting sampling.
Benchmarking
QFD
Six sigma
Control charts
Customer satisfaction
Management tools
Leadership
Cross functional management

Recommended Books:

1. A. Rao, Lawrence P. Carr, I. Dambolena, R. J. Kopp, J. Martin, F.

Rafii, P. Fineman Schlesinger, *Total Quality Management: A Cross Functional Perspective*, 1996, Wiley
2. S. Ramasamy, Total Quality Management, McGraw Hill Education, 2012

3. Project Management

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** a project life cycle, and can skillfully map each stage in the cycle.	Cognitive	2	11
2	**Identify** the resources needed for each stage, including involved stakeholders, tools and supplementary materials.	Cognitive	2	11
3	**Describe** the time needed to successfully complete a project, considering factors such as task dependencies and task lengths.	Cognitive	2	11

Course outline:

1. Fundamental principles;
2. Project life cycle;
3. Project organization and human resource management;
4. PM planning;
5. Work breakdown structure;
6. Estimating time and cost;
7. Precedence relationships;
8. Project scheduling and control techniques;
9. Project risk analysis;
10. Time compression and resource leveling;
11. Computerized project management;
12. Special software packages

Recommended Books:

1. Project Management - A Contemporary Approach, Darren Dalcher, WELEY, 2014
2. Managing High-Technology Programs and Projects, 3rd Edition, Russell D. Archibal, WILEY, 2003
3. Project Management, Gary R. Heerkens, PMP McGraw-Hill, 200

4. Operations Research

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Understand** the mathematical tools that are needed to solve optimization problems.	Cognitive	2	11
2	**Use** mathematical software to solve the proposed models.	Cognitive	3	11
3	**Develop** operational research models from the verbal description of the real system.	Cognitive	5	11

Course outline:

1. Operations research techniques and basics,
2. Linear programming,
3. Graphical method,
4. Simplex method,
5. Geometric programming,
6. Dynamic programming,
7. Sensitivity and post-optimal analysis,
8. Transportation models,
9. Queuing theory (weighting live models).
10. Replacement Models. Simulation.
11. Basic principles, discrete models vs. continuous system simulation, applications,
12. Use of digital computer for simulation,
13. Languages of simulation,

14. Introduction to GPSS (General Purpose System Simulation) language, practical applications of GPSS.

Recommended Books:

1. H. A. Taha, *Operations Research*, 7th Edition, Maxwell Macmillan International
2. *J.A. Chisman*, *Introduction To Simulation Modeling Using GPSS/PC,* Prentice-Hall, 1992
3. *M. Anderson, Lievano*, R.J. Kent, *Quantitative Management: An Introduction*, Publishing Co.

5. Engineering Law

Contact Hours:	Credit Hours:
Theory = 32	Theory =2.0
Practical = 0.0	Practical = 0.0
Total = 32	Total = 2.0

Course Outcome:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Describe** Litigation for Engineers, Basics of Contract Law and Exposure to Liability for the Engineer.	Cognitive	2	11
2	**Describe** the Pakistan court structure and legal system.	Cognitive	2	11
3	**Analyze** and define the engineer's role in construction and technical claims according to Pakistan/International Law.	Cognitive	4	11

Course outline:

1. Introduction to legal studies,
2. concepts and sources of law,
3. basic principles of the law contract as it relates to engineers.
4. The duty of care for engineers and the concept of negligence.
5. Aspects of employment law.
6. Intellectual property.
7. Designs, patents, copyright in engineering.
8. Enforcing rights to intellectual property.

Recommended Books:

1. Allen, Business Law for Engineers
2. A. R. Dick, Engineering Law, 5th Edition, University Press
3. Additional lecture notes and materials given in class.