Curriculum

for

Bachelor of Automotive Engineering Technology Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
HEI	Higher Education Institution
HEC	Higher Education Commission
SA	Sydney Accord
IEA	International Engineering Alliance
CLO	Course Learning Outcome
PLO	Program Learning Outcome
PEO	Program Educational Objective
IDTE	Inter Disciplinary Technology Elective
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours

CONTENTS

1. Introduction

Curriculum is the total learning experience of a student that occurs in the educational process. The term refers specifically to a planned sequence of instruction, and to the student's experiences in terms of the educator's or institutions instructional goals. Curriculum is a systematic and intended packaging of competencies (i.e., knowledge, skills, and attitudes, underpinned by values) that learners should acquire through organized learning experiences.

Curriculum forges in learners' life-long learning competencies, as well as social attitudes and skills, such as tolerance and respect, constructive handling of diversity, peaceful conflict management, promotion and respect of Human Rights, gender equality, justice, and inclusiveness. At the same time, curriculum must be singularly aligned to national development goals, and produce human resources that becomes an effective factor of production in the economy.

Curriculum is thus the foundation on which rests the edifice of academic programs designed for focused outcomes that equip graduates with desired skill sets. Engineering technology curriculum aims to produce proficient engineering technology graduates who meet demands of both national and international job markets. The curriculum conforms substantially to the Sydney Accord – the international accreditation body regulating local accrediting institutions of partnering countries -- and is in consonance with the essence of Graduates Attributes and Professional Competence defined by International Engineering Alliance (IEA). [See Appendixes A through C]

Curriculum is developed and reviewed by HEC's National Curriculum and Review Committee (NCRC).

2. Curriculum Development Methodology

2.1 Benchmarking

Curriculum for Automotive Engineering Technology is benchmarked to HEC's Undergraduate Policy and in accordance with NTC's Curriculum Framework. It conforms substantially to the standards laid out by the Sydney Accord, and the International Engineering Alliance pertaining to Engineering Technology programs.

The Scheme of studies clearly defines and differentiates the program from Automotive Engineering by contact hours spent in classrooms, laboratories, and industry.

Ideally, an engineering program is designed with classroom to practical training ratio of 70:30 contact hours emphasis on design aspects. Whereas for engineering technology programs, the ratio of contact hours is reversed to 30:70, providing more opportunity for hands-on and psychomotor training.

2.2 Curriculum Development Cycle

Curriculum development is a rigorous process and entails the following steps:

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC/HEC.
- A Preliminary Meeting of the NCRC, spanning three days, is held to establish framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A draft of the curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After the foreign expert's review and feedback, a Final NCRC Meeting, lasting up to three days, is held to finalize the NCRC Members recommendations, and prepare a final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of NCRC Meetings

Historical Timeline of NCRC meetings to develop Bachelor of Automotive Engineering Technology are enlisted below:

- Preliminary Meeting of NCRC [See Appendix D]
- Final Meeting of NCRC [See Appendix E]

3. Curriculum Details

Bachelor of Automotive Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in 7th & 8th Semesters)**	**Framework - B (SIT in 8th Semester Only)**
Program Type	Semester System	Semester System	Semester System
Program Duration	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years
Semester Duration	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams
Total Number of Courses	41	37	43**
Engineering Technology Domain Courses	28	25	30**
Non-Engineering Technology Domain Courses	13	12	13**
Total Credit Hours	124 – 136	129	129
Engineering Technology Domain Credit Hours	85	98	96
Percentage of Engineering Technology Domain Courses	74.42%	67.6%	69.8%
Non-Engineering Technology Domain Credit Hours	39	31	33
Percentage of Non-Engineering Technology Domain Courses	31.45%	32.4 %	30.2 %
No. of Credit Hours per Semester	15 – 18	15 – 17	15 – 17
** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical's: 3 contact hours per week for a minimum of 16 weeks for practical's.			

Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Computing	Computer Fundamentals	1+1=2	1+3=4	4/ 6**	6	2/ 3**	3
	Computer Programming	1+1=2	1+3=4				
	Computing Elective **	1+1=2	1+3=4				
Automotive Engineering Technology (Foundation)	Technical Drawing	0+2=2	0+6=6	20	20	8	8
	Workshop Practice	0+2=2	0+6=6				
	Introduction to Automotive Systems	2+1=3	2+3 =5				
	Automotive Production Technology	2+0=2	2+0 =2				
	Basic Electrical & Electronics	2+1=3	2+3=5				
	Automotive Engines	1+1=2	1+3=4				
	Engineering Mechanics	2+1=3	2+3=5				
	Thermo-Fluids Fundamentals	2+1=3	2+3=5				
Automotive Engineering Technology (Breadth)	Automotive Materials and Metallurgy	2+1=3	2+3=5	17	17	6	6
	Mechanics of Materials	2+1=3	2+3=5				
	Machines and Mechanisms	2+1=3	2+3=5				
	Computer Aided Drafting and Modeling	0+2=2	0+6=6				
	Breadth Elective-I	2+1=3	2+3=5				
	Breadth Elective-II	2+1=3	2+3=5				
Automotive Engineering Technology (Depth)	Automotive Chassis	2+1=3	2+3=5	15 / 27**	15	5 / 9**	5
	Automotive Transmission and Transaxle	2+1=3	2+3=5				
	Depth Elective-I	2+1=3	2+3=5				
	Depth Elective-II	3+0=3	3+0=3				
	Depth Elective-III	2+1=3	2+3=5				
	Depth Elective-IV**	2+1=3	2+3=5				
	Depth Elective-V**	2+1=3	2+3=5				

	Depth Elective-VI **	3+0=3	3+0=3				
	Depth Elective-VII **	3+0=3	3+0=5				
IDEE	IDTE-I	1+1=2	1+3=4	4	4	2	2
	IDTE-II	1+1=2	1+3=4				
Senior Design Project	Project Part-I	0+3=3	0+9=9	6	6	2	2
	Project Part-II	0+3=3	0+9=9				
Training	Supervised Industrial Training-(Optional)	0+16=16	0+16=16	16**		0	
	Supervised Industrial Training	0+16=16	0+16=16	16		0	
Total Credit Hours and Courses		**98**		CHr **98/96****		Courses **25/30****	

** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)

Non-Engineering Technology Domain Courses in

Recommended Schemes of Studies as per Framework

Knowledge Area	Sub Area	Name of Course	Credit Hours (Th+Lab)	Weekly Contact Hours (Th+Lab)	Total Credit Hours		Number of Courses	
					As per Scheme of Studies	As per Framework	As per Scheme of Studies	As per Framework
Humanities and Social Sciences	English (Expository Writing)	Functional English	3+0=3	3+0=3	5	6	2	2
		Technical Writing and Communication Skills	1+1=2	1+3=4				
	Culture	Islamic Studies & Professional Ethics	3+0=3	3+0=3	6	6	2	2
		Pakistan Studies	3+0=3	3+0=3				
	Social Sciences Electives	Elective-I	3+0=3	3+0=3	3 / 5**	6	1 / 2**	2
		Elective-II (Optional)	2+0=2**	2+0=2**				
Management Sciences	Management Sciences	Elective-I	3+0=3	3+0=3	5 / 7**	7	2/3**	3
		Elective-II	2+0=2	2+0=2				
		Elective-III (Optional)	2+0=2	2+0=2				
Natural Sciences	Math (Quantitative Reasoning)	Calculus and Analytical Geometry	2+0=2	2+0=2	6	6	3	2
		Differential Equations	2+0=2	2+0=2				
		Linear Algebra	2+0=2	2+0=2				
	Physics	Applied Physics	2+1=3	2+3=5	3	4	1	1
	Elective	Natural Science Elective	2+1=3	2+3=5	3	4	1	1
Total Credit Hours and Courses ** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)					Cr. Hrs. **31-33**		Courses **12 -13**	

<table>
<tr><th colspan="2">List of Elective Topics</th></tr>
<tr><td>Social Sciences Electives</td><td>Management Sciences</td></tr>
<tr><td>➢ Professional Ethics
➢ Logic and Critical Thinking
➢ Psychology (2+0)
➢ Elective Courses by HEI*</td><td>➢ Entrepreneurship
➢ Occupational Health, Safety and Environment
➢ Introduction to Industrial Management (2+0)
➢ Project Management (2+0)
➢ Elective Courses by HEI*</td></tr>
<tr><td>Technology Breadth Electives*</td><td>Technology Depth Electives*</td></tr>
<tr><td>➢ Engine Performance
➢ Engine Emissions and Control
➢ Automotive Electrical and Electronics
➢ Elective Courses by HEI*</td><td rowspan="5">➢ Fluid Power Technology
➢ Automotive HVAC Technology
➢ Automotive Service
➢ Hybrid and Electric Vehicles
➢ Operations Management (3+0)
➢ Quality Management (3+0)
➢ Economics for Technologists (3+0)
➢ Probability and Statistics (3+0)
➢ Elective Courses by HEI*</td></tr>
<tr><td>Computing Elective*</td></tr>
<tr><td>➢ Machine learning
➢ Internet of things
➢ Artificial intelligence
➢ Elective Courses by HEI*</td></tr>
<tr><td>Natural Science Elective*</td></tr>
<tr><td>➢ Chemistry
➢ Elective Courses by HEI*</td></tr>
<tr><td colspan="2">*Any related course can be included with approval of the HEI’s Statutory Bodies (maximum: 3 courses per elective knowledge area)</td></tr>
</table>

4. Admission Criteria

Criteria for admission in Bachelor of Automotive Engineering Technology program is defined in NTC's Program Accreditation Policy and Procedures Manual for Engineering & Other Technologies, Clause 3.2.4.1. The salient features for eligibility for admission are:

(1) At least 50% marks in DAE, FSc (Pre-engineering), or other equivalent qualifications such as A-Levels, ICS, and B.Sc. (Sports and Hafiz-e-Quran marks are not included), and
(2) Entrance Test

(3) Weightage:

- 70% for academics (DAE/FSc etc.)
- 30% for Entrance Test

5. Semester-wise Scheme of Studies

Semester-wise scheme of studies for Bachelor of Automotive Engineering Technology program, spanning 4 years, spread over 8 semesters, and totaling 129 credit hours is presented below, along with weekly contact hours for each course.

SEMESTER-I				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
AUH-111	Islamic Studies & Professional Ethics	Humanities and Social Sciences-I	3+0	3+0
AUE-111	Functional English	Expository Writing-I	3+0	3+0
AUQ-111	Calculus & Analytical Geometry	Quantitative Reasoning-I	2+0	2+0
AUN-111	Applied Physics	Natural Sciences-I	2+1	2+3
AUC-111	Computer Fundamentals	Computing-I	1+1	1+3
AUT-111	Technical Drawing	Automotive Engineering Technology Foundation-I	0+2	0+6
Subtotal			**11+4 =15**	**11+12 =23**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
AUH-122	Pakistan Studies	Art & Humanities–II	3+0	3+0
AUQ-122	Differential Equations	Quantitative Reasoning-II	2+0	2+0
AUN-122	Natural Science Elective	Natural Sciences-II	2+1	2+3
AUT-122	Workshop Practice	Automotive Engineering Technology Foundation-II	0+2	0+6
AUT-123	Introduction to Automotive Systems	Automotive Engineering Technology Foundation-III	2+1	2+3
AUT-124	Automotive Production Technology	Automotive Engineering Technology Foundation-IV	2+0	2+0
Subtotal			**11+4 =15**	**11+12 =23**

SEMESTER-III				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
AUH-211	Social Science Elective-I	Social Sciences-I	3+0	3=0
AUT-215	Basic Electrical & Electronics	Automotive Engineering Technology Foundation-V	2+1	2+3
AUT-216	Automotive Engines	Automotive Engineering Technology Foundation-VI	1+1	1+3
AUT-217	Engineering Mechanics	Automotive Engineering Technology Foundation-VII	2+1	2+3
AUM-211	Management Science Elective-I	Management Sciences-I	3+0	3+0
AUT-218	Thermo-Fluids Fundamentals	Automotive Engineering Technology Foundation-VIII	2+1	2+3
Subtotal			**13+4 =17**	**13+12 =25**
SEMESTER-IV				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
AUT-221	Mechanics of Materials	Automotive Engineering Technology Breadth-I	2+1	2+3
AUE-222	Technical Writing and Communication Skills	Expository Writing-II	1+1	1+3
AUQ-223	Linear Algebra	Quantitative Reasoning-III	2+0	2+0
AUT-222	Automotive Materials and Metallurgy	Automotive Engineering Technology Breadth-II	2+1	2+3
AUC-222	Computer Programming	Computing-II	1+1	1+3
AUT-223	Breadth Elective-I	Automotive Engineering Technology Breadth Elective-I	2+1	2+3
AUI-221	IDTE-I	Inter Disciplinary Technology Elective-I	1+1	1+3
Subtotal			**11+6 =17**	**11+18 =29**

SEMESTER-V				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
AUT-311	Automotive Chassis	Automotive Engineering Technology Depth-I	2+1	2+3
AUT-314	Machines and Mechanisms	Automotive Engineering Technology Breadth-III	2+1	2+3
AUT-316	Breadth Elective-II	Automotive Engineering Technology Breadth Elective-II	2+1	2+3
AUT-312	Depth Elective-I	Automotive Engineering Technology Depth Elective-I	2+1	2+3
AUM-312	Management Elective-II	Management Sciences-II	2+0	2+0
AUT-313	Project Part-I	Automotive Engineering Technology Domain Project	0+3	0+9
Subtotal			**10+7 =17**	**10+21 =31**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
AUT-323	Depth Elective-II	Automotive Engineering Technology Depth Elective-II	3+0	3+0
AUT-324	Automotive Transmission and Transaxle	Automotive Engineering Technology Depth-II	2+1	2+3
AUT-325	Computer Aided Drafting and Modeling	Automotive Engineering Technology Breadth-IV	0+2	0+6
AUT-326	Depth Elective-III	Automotive Engineering Technology Depth Elective-III	2+1	2+3
AUI-322	IDTE-II	Inter Disciplinary Technology Elective-II	1+1	1+3
AUT-327	Project Part-II	Automotive Engineering Technology Domain Project	0+3	0+9
Subtotal			**8+8 =16**	**8+24 =32**

SEMESTER-VII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs.** (Th+Lab)	
AUTT-411	**Supervised Industrial Training or Course Work**	**Automotive Engineering Technology Domain Industrial Training**	**16**	**40 (per Week)**
AUH-412 AUM-413	Social Sciences / Management Sciences Elective	Social Science-II / Management Sciences-III	2+0	2+0
AUT-412	Depth Elective-IV	Automotive Engineering Technology Depth Elective-IV	2+1	2+3
AUT-413	Depth Elective-V	Automotive Engineering Technology Depth Elective-V	2+1	2+3
AUT-414	Depth Elective-VI	Automotive Engineering Technology Depth Elective-VI	3+0	3+0
AUT-415	Depth Elective-VII	Automotive Engineering Technology Depth Elective-VII	3+0	3+0
AUC-413	Computing Elective-I	Computing-III	1+1	1+3
Subtotal			**13+3=16**	**13+9 =22**
SEMESTER-VIII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs.** (Th+Lab)	
AUT-421	**Supervised Industrial Training (Compulsory)**	**Automotive Engineering Technology Domain Industrial Training**	**16**	**40 (per Week)**
Subtotal			**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (When SIT conducted in both 7th and 8th Semester)			**64+65 = 129**	**64+179=243**
Theory vs Practical with respect t to Contact Hours			Theory Practical	64 (28.4%) 179 (73.6%)
Total Credit Hours & Contact Hours in Four Years (When optional courses conducted instead of SIT in 7th semester**)**			**77+52 = 129**	**77+148=225**
Theory vs Practical with respect to Contact Hours			Theory Practical	77 (34.2%) 148 (65.8%)

6. Course Codes

Course Code details are given below:

Each course has a unique three letter prefix, followed by a three-digit code

- Letters in the prefix are acronyms for course description, and the digits define the chronological position in the academic year, and sequence number in the program.
- The program spans over 4 years, usually with Spring and Fall 2 Semesters each year, with a possible Summer Semester if required.

Letters in Course Code prefix are defined below:

- First two letters pertain to the program (e.g., AU for Automotive)
- Third letter pertains to specifics of the course (e.g., T for technology, E for expository writing etc.)

Digits in course-code are defined in table below:

1st Digit	2nd Digit	3rd Digit
Denotes Year (1,2,3,4)	Denotes Semester (1,2,3…)	Denotes Sequence (1, 2, 3…)

Course Code Examples		
Sr.	**Course Code Prefix**	**Description**
1	AU**T**	Automotive Engineering Technology Foundation/ Breadth/ Depth
2	AU**E**	Expository Writing
3	AU**H**	Art & Humanities
4	AU**S**	Social Sciences
5	AU**Q**	Quantitative Reasoning
6	AU**N**	Natural Sciences
7	AU**C**	Computing
8	AU**M**	Management Sciences
9	AU**I**	Inter Disciplinary Technology Elective

7. Elective Courses

The lists of elective courses – grouped across depth and breadth categories – are presented below:

S. No.	Breadth Elective Courses	Cr. Hrs. (Th+Lab)
1.	Engine Performance	2+1 = 3
2.	Engine Emissions and Control	2+1 = 3
3.	Automotive Electrical and Electronics	2+1 = 3

S. No.	Depth Elective Courses	Cr. Hrs. (Th+Lab)
1.	Fluid Power Technology	2+1 = 3
2.	Automotive HVAC Technology	2+1 = 3
3.	Automotive Service	2+1 = 3
4.	Hybrid and Electric Vehicles	2+1 = 3
5.	Operations Management	3+0 = 3
6.	Economics for Technologist	3+0 = 3
7.	Probability and Statistics	3+0 = 3
8.	Quality Management	3+0 = 3

S. No.	Management Elective Courses	Cr. Hrs. (Th+Lab)
1.	Occupational Health, Safety and Environment	3+0 = 3
2.	Entrepreneurship	3+0 = 3
3.	Introduction to Industrial Management	2+0 = 2
4.	Project Management	2+0=2

S. No.	Social Science Elective Courses	Cr. Hrs. (Th+Lab)
1.	Logic and Critical Thinking	3+0 = 3
2.	Professional Ethics	3+0 = 3
3.	Psychology	2+0 = 2

8. Course Contents

The primary goal of this curriculum is to be substantially in compliance with international standards set by relevant agencies such as the International Engineering Alliance (IEA) and the Sydney Accord.

Program Learning Objectives (PLO's), Course Learning Objectives (CLO's) and Bloom's Taxonomy Levels are expected learning outcomes and are aligned to standards set by the Sydney Accord and the IEA.

Course Content

8.1 Islamic Studies & Professional Ethics

CODE & TITLE (AUH-111) **Islamic Studies & Professional Ethics**	CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Civilization-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recite** Holy Quran with correct pronunciation.	C-1	11
CLO-2	**Understand** basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).	C-3	11
CLO-3	**Understand** compilation of the Holy Quran and basic concepts of Hadith.	A-2	11
CLO-4	**Present** Islam as a complete code of life.	A-3	9

Course Outline

History of Islam: Compilation of the Holy Quran and Hadith, Fundamental doctrines of Islam i.e., Tawheed, oneness of Allah, Prophet hood, the day of Judgment, Revealed books, Ibadaat (worship) Philosophy of Ibadaat, Namaz, Zakat, Hajj & Sawm, Importance of preaching of Islam, its needs and effects, Difficulties in the ways of preaching of Islam, sectarianism, its causes and effects in Muslim society, definition of Right, classification of Right, importance of Rights, Khutba Hajjatul Wida (last address of the Holy Prophet (Peace and blessings be upon him), Seeratun-Nabi (Peace be upon him).

Life of Holy Prophet (Peace be upon him): The life of the Holy Prophet before and after prophet hood. The Hijra (Migration to Madina), Treaty of Al Madina, Makki and Madani life of Holy Prophet Muhammad (Peace be upon him), importance of peace and causes of terrorism.

Islam and Civilization: Definition of civilization, Impacts of Islamic civilization on the Sub-continents, international impacts of Islamic civilization, Impacts of Human thoughts, social and humanistic effects, Importance of Ethics, Human rights (Hoqooq Ul Ibad) with detail.

Knowledge and Islam: Definition of Knowledge, Classification of knowledge, Importance of technology in the light of Holy Quran and Sunnah, relevant verses of the Holy Quran about Technology (Baqara 28,30,33,201, Nahal:76, Jasia: 13, Araf: 32, Noor: 55 etc), Islamic and scientific knowledge.

Recommended Books

1. A Guidebook for Muslims, by Syed. Abul Hasan Ali Nadvi. (Latest Edition)
2. What is Islam? by Maulana Manzoor Nomani. (Latest Edition)
3. Hameed Ullah Muhammad, "Introduction to Islam"
4. Hussain Hamid Hasan, "An Introduction to the study of Islamic Law", Leaf Publication , Islamabad
5. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem. (Latest Edition).

Course Content

8.2 Functional English

COURSE CODE & TITLE (AUE-111) **Functional English**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing – EI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Exhibit** proficiency and accuracy in English and use it effectively as a tool to succeed in academic activities.	C-3	10
CLO-2	**Employ** basic reading skills to study and understand subjects meaningfully.	C-2	11
CLO-3	**Use** different genres of writing in academic activities.	C-4	10

Course Outline for Theory

Greetings, Reading Skills Importance & Strategies: Previewing, reading practice through variety of reading texts and comprehension exercises, Skimming & Scanning, Summarizing.

Types of Listening: active, content, critical, selective Problems in listening and coping strategies, listening skills and sub skills, Note Taking, Techniques for taking notes from lectures, from books, different forms paragraphs, points, figures, processes, tables, graphs, Vocabulary Development, Inferring meaning from context, Process of Writing and in formal Writing strategies.

Writing Correctly: sentence structure and punctuation, error correction, Paragraphs writing, Unity, adequate development and coherence in paragraphs.

Essays: Types of essays: narrative, descriptive, argumentative.

Structure of Essays: thesis statement and the paragraphs, informational and analytical reports, Letters: routine requests and intimation, invitation, thank you and condolence letters etc, Presentation skills

Recommended Books

1. Kakarla, Gupta, Pundir, Functional English for Communication, Sage.

Course Content

8.3 Calculus and Analytical Geometry

COURSE CODE & TITLE (AUQ-111) **Calculus and Analytical Geometry**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** techniques of differentiation and integration to solve problems.	C-3	1
CLO-2	**Use** vector calculus and analytical geometry in multiple dimensions to investigate technology problems.	C-3	2

Course Outline for Theory

Basic definition of derivative, differentiation of different functions, rule of differentiation, chain rule implicit differentiation, Applications: slope, equation of tangent and normal. maxima, minima and point of inflection. Indefinite integral, different technique or integration i.e., integration by parts, integration by substitution, by partial fraction, integration of different trigonometric identity. Define definite integral: Application of definite integral, i.e., Area under the curve. Area between the curve, mean value theorem, finding the volume by slicing, volume of solid revolution Disk and Washer method, moment and center of mass etc. Vector in space, vector calculus, Divergence, curl of vector field, Directional derivatives, multivariable function Partial derivatives, Spherical, polar, cylindrical coordinates. Vector in plane: Dot product and cross products, line and plane in space. Application: work, angle between two vectors, Area of triangle, Area of parallelogram etc.

Recommended Books

1. H. Anton, I. C. Bivens, S. Davis, "Calculus, Early Transcendental", John Wiley, New York 11th edition, 2016.
2. James Stewart, Essential Calculus, Cengage, 2nd Edition
3. G. B. Thomas, A. R. Finney, "Calculus", Pearson, USA, 14th edition 2017.
4. Erwin Kreyszig, Advanced Engineering Mathematics, Willey, 10th Edition

Course Content
8.4 Applied Physics

CODE and TITLE (AUN-111) **Applied Physics**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Natural Science-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental principles of physics.	C-2	1
CLO-2	**Solve** problems of mechanics, electricity and waves.	C-3	1
CLO-3	**Demonstrate** principles of physics using laboratory apparatus.	P-3	1

Course Outline

Mechanics: Definitions of Work, Energy & Power, Work Energy Theorem and its applications, Mechanical Energy of System, Conservation of Mechanical Energy, practice problems, Gravitational potential energy, Hooks Law & restoring force, Review of angular variables, K.E. Energy of Rotation and moment of Inertia, Torque and Newton's 2nd law of rotation, Work and Rotational K.E., Angular momentum, Angular Momentum for System of Particles.

Electricity: Basic terms & definitions; Electric Forces and Fields, Electric flux and Coulomb's Law, Electric field due to the Point and Various charges, Gauss' law and its application, Conductors in Electric Fields, Parallel Metal Plates, Capacitance, Resistance, Electric Potential and potential energy, Ohm's Law.

Waves and Oscillations: Periodic motion & Simple Harmonic Oscillation (SHO), Simple Pendulum, Transverse & Longitudinal Waves, Speed of a traveling Wave, Damped Harmonic Oscillator, EM waves.

Sample Lab Experiments

To investigate the properties of series combination of Capacitors. To determine the given resistance by leakage method using ballistic Galvanometer. To study the variation of Photoelectric current with intensity of incident beam. To determine the temperature coefficient of resistance of coil by wheat stone bridge. To study Ohm's law. To investigate the properties of Series Combination of Resistances. To investigate the properties of Parallel combination of Resistances. Practical Demonstration of Ampere Law. Practical Demonstration of Faraday Law. To demonstrate the function of transformer as Step Up and Step-Down Transformer.

Recommended Books

1. Halliday and Resnick and Walker, 2018, Fundamentals of Physics, Latest Edition, Wiley.
2. Hugh D. Young and R. A. Freedman, University Physics. (Latest Edition).
3. Raymond A. Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, (Latest Edition).

Course Content

8.5 Computer Fundamentals

COURSE CODE & TITLE (AUC-111) **Computer Fundamentals**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computer Science – I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** computer fundamentals.	C-2	1
CLO-2	**Dissemble** and assemble computer components.	P-4	1
CLO-3	**Demonstrate** use of application and productivity software.	C-3	5

Course Outline for Theory

Introduction to Computer: Functional Block Diagram, History, Evolution, Input Devices, Output Devices, Audio input/output, Storage Devices, Memory and Memory Management, Motherboard and components, CPU, GPU, Binary numbers and working of 8088 microprocessors, Cabinet, Power supply and UPS, Device Drivers, Internet and Networking, Operating Systems, Application and Productivity Software

Controllers: Keyboard, Interrupt & DMA Controller, Clock Generator & Bus Controller, Math Co-processor, Hard Disk Drive and Controller, Display Controller, Serial Interface, Parallel Interface & Printer Port, Universal Serial Bus (USB).

Lab Outlines

Introduction to various components of PC computer, Dissembling Computer Components, Assembling Computer Components, Assembling PC computers for customers with different needs, installing a motherboard and attach power supply, and all other connectors. Checking of power supply. Installing RAM and Hard disk. Use of different ports, Device Drivers, Networking, Internet, Intranet and Search Engines, Introduction to micro-programming, Use of Application and Productivity Software.

Recommended Books

1. Andrew S. Tanenbaum, 2013, Structured Computer Organization, Latest Edition, Pearson.
2. Minasi, Wempen, and Doctor, 2005, The Complete PC Upgrade and Maintenance Guide, Latest Edition, Sybex.

Course Content

8.6 Technical Drawing

COURSE CODE & TITLE (AUT-111) **Technical Drawing**		**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Automotive Technology Foundation-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Draw** geometric curves, simple machine parts, sections, develop surfaces and assembly drawings.		P-3	1
CLO-2	**Interpret** working drawings for components and assemblies.		C-3	9

Lab Outlines

Introduction to drawing instruments, safety guidelines, layout, Lettering, Free-hand Sketching, Scaling, and line types. Hands on practice of Geometric drawings, Drawing Sheet Planning, Orthographic Projections (1st and 3rd Angle). Practice projections and surface development. Practice and drawing of three views of different objects using orthographic projection. Conversion of orthographic projection into isometric view. Creating drawings of engineering fasteners like rivets, cotter joints, threads, etc. Introduction to Geometric Dimensioning and Tolerances. Practice of various Assembly Drawings.

Sample Experiments

- Introduction to drawing instruments and their uses and safety guidelines
- Introduction to Sheet Layout and Free-hand Sketching
- Introduction to Lines, Lettering and Scaling
- Practice of Dimensioning and lettering
- Hand on practice of Geometric drawings
- Practice on Sheet Planning
- Practice of Sectioning and its various types
- Creating drawings of engineering fasteners like rivets, cotter joint, threads etc.
- Practice Assembly Drawing
- Practice Assembly Drawings for instruction manuals
- Practice Installation Assembly Drawing
- Construction of multi view different types of Bearing
- To create the 2D drawing for screw jack
- To create the 2D drawing for different types of joint
- To create the 2D drawing for different types of coupling
- Development of prisms, cylinders, cones, pyramids
- To create the 2D drawing for connecting rod, Engine Piston, Shaft, Cams

Recommended Books

1. Bhutt, N.D., Engineering Drawing, Latest Edition, Charotar Publishing House, 2010.
2. Bertoline, Gary; Wiebe, Eric; Hartman, Nathan; Ross, William, McGraw-Hill Education, Latest Edition.

3. Parkinson, A.C., First Year Engineering Drawing, Latest Edition, Pitman Publishing.
4. Frederick E. Giesecke, Alva Mitchell, Henry C. Spencer, Ivan L. Hill, John T. Dygdon, James E. Novak, R O. Loving, Shawna E. Lockhart, Cindy Johnson, Marla Goodman, Technical Drawing with Engineering Graphics, Latest Edition.

Course Content

8.7 Pakistan Studies

COURSE CODE & TITLE (AUH-122) **Pakistan Studies**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Civilization – II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** Pakistan movement, political, and constitutional history of Pakistan.	C-2	11
CLO-2	**Recognize** importance of ethical commitments, compliance to international agreements, and their impact on foreign policy of Pakistan.	A-2	7
CLO-3	**Analyze** the contemporary problems faced by Pakistan in meeting Sustainable Development Goals of the UN.	C-4	6

Course Outline for Theory

Ideology of Pakistan ----- definition and elucidation, historical aspects: Muslim rule in the Sub-continent, its downfall and efforts for Renaissance. Ideology of Pakistan in the light of Speeches and statements of Allama Iqbal and Quaid i Azam Muhammad Ali Jinnah. Land and people of Pakistan - Geography, Society, Natural resources, Agriculture, Industry, and education with reference to characteristics, trends, and problems. Pakistan and Changing Regional Apparatus.

Regional Economic Cooperation (SAARC, ECO, SCO) and the Role of Pakistan Economic Challenges in Pakistan Non-Traditional Security Threats in Pakistan: Role of Non-State Actors Changing Security Dynamics for Pakistan: Challenges to National Security of Pakistan Political Evolution Since 1971 Foreign Policy of Pakistan Post 9/11 Ethnic Issues and National Integration, Pakistan's Energy Problems and their Effects Pakistan's Relations with Neighbors, Kashmir Issue, Economic Conditions of Pakistan, the Most Recent Economic Survey, the Previous and Current Budgets, and the Problems and Performance of Major Sectors of Economy, The Prevailing Social Problems of Pakistan and the Strategies to Deal with Them, Poverty, Education, Health and Sanitation.

Recommended Books

1. The Future of Pakistan, Cohen Stephen P. et al. Washington: Brookings Institute Press, 2011.
2. Modern South Asia: History, Culture, Political Economy, Jalal, Aisha and Bose, Sugata. New York: Routledge, 1998.
3. Kashmir in Conflict: India, Pakistan and the Unending War, Schofield, Victoria. New York: I.B.Tauria, 2003.
4. A Brief History of Pakistan, Wynbrandt, James. New York: Infobase Publishing, 2009.

Course Content

8.8 Differential Equations

COURSE CODE & TITLE (AUQ-122) **Differential Equations**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Solve** homogenous and non-homogenous differential equations of first and higher orders.	C-3	1
CLO-2	**Analyze** linear differential equations using Laplace Transform technique and power series methods.	C-4	1

Course Outline for Theory

Basic concept of differential equation, I.e., Definition, order, degree, and geometric meaning of Diff: equation. Solution of First order Diff Equation: Separable of equation, Exact Diff: Equation, integrating Factor, Linear ODEs. Second and higher order Differential Equation: Homogenous linear ODE with constant coefficient, Cauchy Euler Equation. Non homogenous Equation by undetermined coefficient, by variation of parameter and similar higher order Diff. equation. Finding Laplace and inverse Laplace of different functions, S- shafting theorem, solution of differential equation using Laplace transform. Basic concept of power series, Radius of convergence, convergence interval, using power series method to find the solution of Differential Equation.

Recommended Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, Willey 2014
2. W. E. Boyce, R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems, 10th edition", John Wiley & Sons, Inc., 2012
3. D. G. Zill, M. R. Cullen, "Differential Equations with Boundary-Value Problems", 10th edition, Brooks/Cole, 2013

Course Content

8.9 Workshop Practice

COURSE CODE & TITLE (AUT-122) **Workshop Practice**		**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Appreciate** health and safety aspects while performing workshop activities.		A-2	6
CLO-2	**Demonstrate** the use of tools and equipment in workshop practices.		P-4	1
CLO-3	**Develop** models of component using workshop tools and machines.		P-3	3

Course Outline for Theory

Basic introduction to fundamentals of safety precautions in workshop practices, machine operations, and tools utilization. Woodworking technology, tools, and applications for pattern making. Understanding and applications of different measuring and gauging instruments. Performing foundry operations such as forging and casting. Hands-on joining operations such as different welding processes, fastening, riveting and adhesive bonding. Basics of lathe & milling operations, drillings, and cutting, etc. Basics electrical connections and tools. Basic tools used in automotive service.

Lab Outlines

- To Understand of basic Safety guidelines, tools and gadgets
- To Familiarize with types of cutting tools and tool holders used with a standard centre lathe machine
- To Understand of pattern making procedure and perform wood working
- To Practice pattern making for different mechanical components
- To Practice boring operation on the lathe machine
- To produce internal threads on components using different methods
- To produce external threads on components using different methods
- To Identify and familiarization of various types of milling cutters
- To understand the parts and accessories of a universal milling machine.
- To manufacture a given component for the practice of Milling operations (side milling, end milling, slot milling, engraving) on a universal milling machine.
- To Familiarize with the parts, accessories, cutting tools and operations of a shaper machine
- To Join two metals parts using different mechanical fastening techniques and welding technology
- To Understand the Basic fundamental of foundry processes
- To produce a given mechanical components using casting, forging and finishing process

Recommended Books
1. Krar Steve F., Check Albert F., Machine Tools, Latest Edition, McGraw-Hill, 1998. 2. Workshop Technology by Hajira Chohdry, Latest Edition. 3. Chapman W.A.J. "Workshop Technology (Part I, II & III). 4. Manufacturing Technology By M.L Begeman, Hazel Hours, Latest Edition. 5. Fundamentals of Modern Manufacturing, Latest Edition By M.P. Groover HT John Wiley & Sons.

Course Content

8.10 Introduction to Automotive Systems

COURSE CODE & TITLE (AUT-123) **Introduction to Automotive Systems**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-III**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** different automotive systems, their main parts, and assemblies.		C-2	1
CLO-2	**Interpret** vehicle specifications and its components as given by the manufacturer.		C-3	1
CLO-3	**Understand** features and characteristics of modern vehicles.		A-3	11
CLO-4	**Identify** different automotive systems, components, interior and exterior parts, sub-assemblies, and assemblies.		P-2	1

Course Outline for Theory

Introduction: Introduction and Significance, Brief History of Automobiles, Automobiles and Human Ease of Transportation, Automobile Types and Usages, Service Tools.

Basic Configuration: Automotive Design Configuration, Working for Each Machine, Mechanism and Components, Automotive Effects on Environment.

IC Engine Working: Engine Types & Classification, Engine Cycles, Basic Engine Design, Fuel System, Ignition System, Lubrication and Cooling System, Power Generation, Engine Emissions.

Structure and Design: Automotive Chassis, Design & Importance, Materials for Chassis, Construction of Chassis and Applications.

Placement of Machines and Body Configuration: Assembly and Working, Body Design Basics, Wheels, tyres and Steering.

Drive and Performance: Automobile Drive and Performance, Suspension and Brakes.

Recommended Books

1. Introduction to Automotive Technology by J. R. Daines, P. R. Rickert & R. D. Brown.
2. Automotive Technology: A Systems Approach by J. Erjavec.
3. Automotive Technology by J. D. Halderman.

Course Content

8.11 Automotive Production Technology

COURSE CODE & TITLE (AUT-124) **Automotive Production Technology**	CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/DOMAIN **Foundation-IV**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Explain** basic manufacturing processes used in an automotive production facility.	C-2	1
CLO-2	**Understand** design considerations for the manufacturing processes of automotive components.	C-3	3
CLO-3	**Appreciate** use of modern manufacturing techniques.	A-3	11

Course Outline for Theory

Design Basics: Faces and Interaction of Design Process, Design Considerations, Design Tools and Resources, Standards and Codes, Economics, Safety and Product Reliability, Stress and Strength.

Manufacturing Processes: Forging, Sand Casting, Die casting, Welding, Soldering.

Machining Operation and Tools: Types of Drill and Lathe Machines, Conventional and Non-Conventional Machining, Classification of Conventional and Non-Conventional Machines, Time calculation for Lathe Operations (Turning, Step Turning, Facing, Machining), Time Calculation for Drilling Operation, Time Calculation for Face & End Milling Operation.

Sheet Metal Operations: Bulk deformation, shearing, rolling, Extrusion, Wire and Bar Drawing, Basic heat treatments.

Need for Non-Traditional Machining: Electrical, Electro-chemical, Thermal (Electric Discharge Machining, Electron Beam Machining, Laser Beam Machining, Plasma Arc Cutting), Mechanical (Abrasive Jet Machining, Ultra-sonic Machining).

Recommended Books

1. Fundamentals of Modern Manufacturing, Latest Edition, Mikell P. Groover.

Course Content

8.12 Basic Electrical and Electronics

COURSE CODE & TITLE (AUT-215) **Basic Electrical and Electronics**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-V**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the construction and working of motors, transformers, rectifiers and amplifiers.		C-2	1
CLO-2	**Solve** electric circuit problems using relevant principles.		C-3	1
Course Outline for Theory				
Basic concepts of voltage, current, resistance, capacitance, and inductance, Series and parallel circuits, series parallel combination calculations, ohm law, law of resistance, Kirchhoff's Laws, Construction and Working principles of DC Machines and their types, speed control of DC motors, working principles and applications of AC and servo motors, Construction and working principles of single and three phase transformers, Construction and application of various types of rectifiers.				
Sample Lab Experiment				
Find the Equivalent resistance of a series, parallel and series parallel combination of Resistors. Use of ohm, volt, Am-meters, resistor color coding, speed control of DC motor, turn ratio of transformer, half wave and full wave rectifiers, construction various types of amplifiers using BJT, measure gain and efficiency of an amplifier; Find the Equivalent resistance of a series, parallel and series parallel combination of Resistors				
Recommended Books				
1. Robert Boylestad, Introductory Circuit Analysis, Latest Edition, Pearson. 2. Thomas L. Floyd, Electronic Devices Latest Edition, Pearson. 3. Hughes and Drury, Electric Motors and Drives: Fundamentals, Types and Applications, Latest Edition, Pearson.				

Course Content

8.13 Automotive Engines

COURSE CODE & TITLE (AUT-216) **Automotive Engines**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Automotive Technology Foundation-VI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** types of engines, combustion process, ignition system, air and fuel delivery systems, and lubrication and cooling systems.	C-2	1
CLO-2	**Analyze** the importance of fuels, auxiliary systems and other design aspects on performance of engines.	C-4	2
CLO-3	**Assemble** and disassemble the engine of a vehicle using general purpose, and special service tools by following the Service Manual.	P-3	1

Course Outline for Theory

Introduction to Internal Combustion Engines: Classification of Internal Combustions Engines, Applications, Basic Engine Design parameters, Working Cycle, Fuel, Mixture Preparation, Ignition, Combustion Chamber Design, Method of Load Control, Engine Parts and their Basic Functions, Advantages & Disadvantages.

Construction and Operation of ICE: Constructional Details of Spark Ignition (SI) and Compression Ignition (CI) Engines. Working Principles. Two Stroke SI and CI Engines. Comparison of SI and CI Engines and Four Stroke and Two Stroke Engines. Engine Classification, Firing Order. Otto, diesel and dual cycles.

Fuel and Ignition: Combustion, Combustion Chambers, Combustion Chamber Design, Combustion in SI Engines - Stages of Combustion, Factors Affecting Flame Propagation, Knock in SI Engines, Variables Affecting Knocking, Injection in SI Engines, Carburetion - Types of Carburettors, Spark Plugs, Ignition System - Battery Coil, Magneto Coil, Electronic, Mixture Preparation Method, Method of Load Control, EFI, Combustion in CI Engines.

Cooling System: Types of Cooling, Applications, Advantages & Disadvantages, Functions of Automobile Cooling System, Parts of a Water-cooling System, Cooling System Operation, Air and Liquid Cooling Systems, Thermo Syphon and Forced Circulation and Pressurized Cooling Systems.

Fuels: Properties of Fuel, Fractional Distillation, Air Fuel Ratio Requirements, Conventional Fuel, Alternate Fuel, Gasoline/Petrol, Octane Number, Diesel Fuel, Octane Cetane No, Cetane Index, Typical Index, High Speed Diesel Fuel, Additives, Euro compliance.

Auxiliary Systems: Turbocharger, Super-Charger, Types of Super-Charging and Turbo-Charging - Relative Merits, Matching of Turbocharger.

Recommended Books

1. Ganesan.V., Internal Combustion Engines, Tata-McGraw Hill.
2. Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, Pearson Prentice Hall.
3. Maleev.V.M., Diesel Engine Operation and Maintenance, McGraw Hill.
4. William H. Crouse, Automotive Engines, McGraw Hill.

Course Content

8.14 Engineering Mechanics

COURSE CODE & TITLE (AUT-217) **Engineering Mechanics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VII**

After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Solve** problems of friction, kinematics, and kinetics of particles.	C-3	1
CLO-2	**Apply** equilibrium of forces and moments for 2-D and 3-D problems.	C-3	1
CLO-3	**Analyze** structures such as plain trusses, frames, and machines for reactive forces.	C-4	2
CLO-4	**Conduct** engineering mechanics experiments using laboratory equipment.	P-3	4
CLO-5	**Appreciate** practical aspects of mechanics including friction, velocity ratio, and mechanical advantage.	A-2	1

Course Outline for Theory

Force System, force, rectangular components, moment, couples, resultant of forces, equilibrium, mechanical systems, isolation, and equilibrium equations. Free body diagram, two force and three force members, plane trusses, method of joints, method of sections, frames and machine analysis, forces in beams and cables, friction, types of friction, dry friction, application of friction. Impulse and momentum, angular impulse and angular momentum, Instantaneous center of zero velocity, relative acceleration planar kinetics of rigid bodies. Force, mass, acceleration, equation of motion. Work and Energy relationship. Dynamics of particles and rigid body including kinematics and kinetics.

Sample Lab Experiments

Verify Hook's law, determination of static equilibrium by using coplanar concurrent forces, determination of reactions and moments in beams, tension in hanging ropes. Verification of Force Polygon Method for various Co-planer forces, relation of Coefficient of Friction of different solid materials, determination of Coefficient of Friction for various materials, Determination of Moment of Inertia of Fly Wheel. Determination of the Efficiency, velocity ratio, mechanical advantage of various systems such as screw jack worm and worm wheel, Pulleys and Tie and Jib crane. Determination of Linear and Angular speed. Determination of centrifugal force. Measurement of Angular Momentum.

Recommended Books
1. Meriam, J.L. And Kraige, L.G., Engineering Mechanics: Dynamics (Vol. 2). Latest Edition, John Wiley & Sons. 2. R. C. Hibbeler. Engineering Mechanics (Dynamics), Latest Edition, Prentice Hall. 3. Beer, F.P., Johnston Jr, E.R. And Oler, J.W., Vector Mechanics for Engineers, Latest Edition.

Course Content

8.15 Thermo-Fluid Fundamentals

COURSE CODE & TITLE (AUT-218) **Thermo-Fluid Fundamentals**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VIII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** fundamental laws of fluid mechanics, thermodynamics, and heat transfer.	C-2	1
CLO-2	**Apply** analytical approaches to solve problems related to open and closed systems, hydraulic machinery, and heat transfer equipment.	C-3	2

Course Outline for Theory

Basic Concepts of Thermodynamics: Energy, energy transfer, and general energy analysis. Properties of pure substances. Energy analysis of closed systems. Mass and energy analysis of control volumes. The second law of thermodynamics and entropy. Power and refrigeration cycles.

Introduction and Properties of Fluids: Fluid statics, Bernoulli and energy equations. Pipe and Pipe Networks. Mechanisms of Heat Transfer, Steady heat conduction, Convection, Radiation Heat Transfer and Heat Exchangers.

Sample Lab Experiments

- To investigate the first law and Second law of thermodynamic using heat Engines.
- Study of the two, four stroke petrol and four stroke diesel engines.
- Study of Steam Bench, Determination of Dryness Fraction of Steam using Steam Bench.
- To draw the pressure curves of a diffuser and determine the critical ratio of a nozzle.
- To calibrate the given pressure gauge & discuss its application.
- To demonstrate Bernoulli's law by using Bernoulli's principal demonstrator.
- Determine the friction factor and losses for internal flow in pipes.
- Measurement of viscosity of different fluids.
- To conduct the experimental demonstration of Fourier's law of heat conductions and determination of the Thermal conductivity "k" in a simple bar.
- To observe effect of cross-sectional area on heat transfer.
- To observe the insulating effect in a metallic bar of different diameter conductor.
- To obtain heat transfer coefficient (h) in free convection in flat surfaces.
- To calculate the efficiency of pinned exchangers.
- To calculate efficiency of finned exchangers.
- To obtain and plot the temperature distribution in a shell and tube heat exchanger for counter current and parallel flow.
- To calculate the Logarithmic mean temperature difference (LMTD) of a shell and tube exchanger.

Recommended Books
1. Y. A. Cengel, R. Turner and J. Cimbala, Fundamentals of Thermal-Fluid Sciences, Latest Edition, McGraw-Hill. 2. Massoud, M. Engineering Thermofluids, Thermodynamics, Fluid Mechanics, and Heat Transfer; 2007.

Course Content

8.16 Mechanics of Materials

COURSE CODE & TITLE (AUT-221) **Mechanics of Materials**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** mechanical behavior of materials under tensile, compressive, torsional, and combined loadings, and factors of safety.		C-2	1
CLO-2	**Solve** problems related to structural members under stress, strain, and deflection.		C-3	2
CLO-3	**Design** parameters of a shaft under torsional loading.		C-4	3

Course Outline for Theory

The concept of stress and strains under direct and transverse loading conditions. Stress-strain diagram, poison's ratio, Factor of safety. Understand the Mechanical properties of Different materials under various loading conditions. Failure due to axial loading in beams, bars, columns etc. Description of strength, resilience, toughness, and fracture under tensile and compressive loadings. Concept of area moment of inertia and polar mode of inertia. Torsion, design of shaft and its failure due to torsional loads. Determination of bending stresses and deflection in different types of beams under various loading conditions.

Lab Outline

- To perform the practical's relating to determine the behaviours of the materials under various loading conditions.
- To Investigate the various mechanical properties like strength, toughness, stiffness.
- To Determine of Brinell Hardness, Vicker hardness and Rockwell Hardness testing of different materials
- To determine the effects of creep, and fatigue on different materials.
- Determination of deflection of various types of beams under different loading conditions.
- Determination of Impact Energy using Charpy/Izod testing.
- To find the modulus of elasticity (E), modulus of rigidity (G).
- To determine shear stress (τ) for a given shaft specimen in torsion.

Recommended Books

1. Meriam, J.L. And Kraige, L.G., Engineering Mechanics: Dynamics (Vol. 2). John Wiley & Sons.
2. R. C. Hibbeler. Engineering Mechanics (Dynamics), Latest Edition., Prentice Hall.
3. Beer, F.P., Johnston Jr, E.R. And Oler, J.W., Vector Mechanics For Engineers.
4. Mechanics of materials – R. C. Hibbeler, Latest Edition.
5. Mechanics of Materials – Ferdinand Beer, E. Johnston, John DeWolf and David Mazurek, Latest Edition.
6. Mechanics of Materials – James M. Gere, Barry J. Goodno.

Course Content

8.17 Technical Writing and Communication Skills

COURSE CODE & TITLE (AUE-222) **Technical Writing and Communication Skills**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing – II**

After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic theories of communications.	C-2	10
CLO-2	**Present**, and report technical contents, both orally and in writing.	C-2	10
CLO-3	**Participate** in group discussions, ethically and professionally.	A-3	8

Course Outline for Theory

Importance, Theories, Barriers and components of communication, The seven C's of effective communication, Listening skills, Notes taking, Giving feedback, Active reading techniques, Skimming, General and careful reading, Planning, Drafting and editing, Emphasis and connections in writing, Technical and business vocabulary, Constructing formal sentences, Communication as a Tool For Effective Interpersonal Engagement, Communication barriers and their mitigation strategies, Preparing and presenting using modern tools.

Recommended Books

1. Murphy H. A., Hildebrandt H. W. and Thomas J.P. "Effective Business Communications". McGraw Hill, USA
2. Norman S. "We're in Business" Longman Group Ltd., UK 3. Thomson A. J. and Martinet A.V. "A practical English Grammar" Oxford University Press, UK.

Course Content

8.18 Linear Algebra

COURSE CODE & TITLE (AUQ-223) **Linear Algebra**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic definitions, properties, and theorems of linear algebra.	C-2	1
CLO-2	**Solve** systems of linear equations using matrices.	C-3	1

Course Outline for Theory

System of linear equations, row reduction and echelon forms, vector equations, the matrix equation ax=b. Solution sets of linear systems, applications of linear systems. Concept of matrices, types of matrices, operation on matrices i.e., addition, subtraction, multiplication, properties of matrix operation, the elementary row operation, echelon form, solution of linear system of equation by gauss elimination method, concept of consistent and inconsistent solution, polynomial interpolation. inverse of matrix using Gauss-Jordon method. Determinant of matrix: definition and properties of determinants and their theorem, concept of singular and nonsingular matrix, solution of non-homogenous linear system of equation using Cramer's rule. Introduction to linear transformation, daily life application i.e., cryptography example coding and decoding the messages, computer graphic.

Recommended Books

1. Bernard Kolman, Introductory Linear Algebra, Pearson, 9th Edition
2. Erwin Kreyszig, Advanced Engineering Mathematics, Willey, 10th Edition
3. D. C. Lay, S. R. Lay, J. J. McDonald, "Linear Algebra and Its Applications", Pearson Education 5th Edition
4. Gilbert Strang, Linear Algebra and its Applications, Cengage, 4th Edition

Course Content

8.19 Automotive Materials and Metallurgy

COURSE CODE & TITLE: (AUT-222) **Automotive Materials and Metallurgy**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** engineering materials in terms of nature, type, properties, behavior, bonding, crystal structure, along with sustainability and implications on the environment.	C-2	6
CLO-2	**Interpret** phase-diagrams and effects of heat treatments on microstructure of ferrous materials.	C-1	1
CLO-3	**Demonstrate** the mechanical properties of engineering materials using available laboratory equipment.	P-3	1
CLO-4	**Prepare** samples of metals and non-metals to analyze their microstructure with microscopes.	P-3	4

Course Outline for Theory

Properties of materials, classification of materials, Structure of materials, Crystal structure of metals, alloys, equilibrium diagrams, interpretation of phase diagrams of ferrous and non-ferrous materials, practical microscopy, Introduction to iron and steel making, hot and cold working of metals, heat treatment of plain carbon steels, surface hardening of steels, non-ferrous alloys, plastics, rubbers, ceramics, glasses and composites for automotive applications, Fiber-reinforced plastics (FRP), Material testing, causes of material failure, Corrosion and their control, Grades and standards of materials, choice of materials and processes, selection of materials.

Lab Outline

- To prepare the samples of metals & non-metals to analyze their microstructure by using microscopes to understand their behavior and structural conditions.
- To understand different composite manufacturing and characterization techniques.
- Determine various texture & coating, sputtering etc. techniques.
- To determine the various environmental effects (moisture, corrosion, thermal effects, emission etc) on automotive materials.

Recommended Books

1. Materials for Automobile Bodies, Latest Edition. Geoffrey Davies.
2. Materials Science and Engineering: An Introduction, Latest Edition. William D. Callister Jr., David G. Rethwisch.
3. An Introduction to Materials Engineering and Science by Brian S. Mitchell.
4. Materials for Engineers and Technicians, Latest Edition, William Bolton, R.A. Higgins, Newness.

Course Content

8.20 Computer Programming

COURSE CODE & TITLE (AUC-222) **Computer Programming**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computer-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Write** pseudo codes and a flow chart for problems.		C-3	1
CLO-2	**Write** computer programs using a high-level language.		C-3	5
CLO-3	**Illustrate** the use of arrays, classes, and other functions for an intermediate level program.		C-4	5

Course Outline for Theory

Basics: constants and variables, keywords, identifiers, data types, variables and their types, escape sequence, operators and statements.

Decision and Control: if statements, if-else-if statement, switch statement, for loop, while loop, do-while loop, nested loops, break statement.

Functions: defining a function, types of function, return statement, default argument, local and global variables, standard function and user defined functions, multifunction, arguments pass as reference or as a value.

Arrays: declaration, initialization, arrays and function, multidimensional arrays.

Structures: declaration, initialization, functions and structures, arrays of structure, nested structure, enumerations.

Classes: declaration, initialization, constructors, destructors, inline member function, static class member, friend function, defining and accessing object, arrays of class object, structure and classes, nested classes.

Inheritance: single inheritance, types of base classes, types of derivation, multiple inheritance containers.

Lab Outline

Hands on experience to the topics covered in theory.

Recommended Books

1. Kent Lee, 2015, Python Programming Fundamentals, Latest Edition, Springer.

Course Content

8.21 Automotive Chassis

COURSE CODE & TITLE (AUT-311) **Automotive Chassis**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** working of chassis systems.	C-2	1
CLO-2	**Demonstrate** testing and service of chassis systems.	P-3	1

Course Outline for Theory

Chassis Frame: Chassis systems, Types of Chassis frame, Space frame and Monocoque, Chassis Construction, C-Section, and Design aspect of chassis frame, Construction of frames.

Wheels and Tires: Tire types, Tyre standards, Rolling radius, Rolling resistance, Forces on Tyres, types of Wheels and their standards.

Suspensions and Steering: Types of suspension, Sprung and Un-sprung mass, types of dampers, Ride and Handling, Testing and Servicing of Suspension, Types of Steering system, Steering mechanism, Steering geometry, Rack and pinion steering box, Screw and sector steering box, Steering column, Power steering, Testing and servicing of Steering system.

Brakes: Car brakes, braking forces, braking distance, Types of brakes, Testing and Servicing of brakes.

Recommended Books

1. The Automotive Chassis: Engineering Principles, Latest Edition by J. Reimpell, H. Stoll & W. Betzler, SAGE International.
2. Automotive Engineering: Power Train, Chassis System and Vehicle Body, edited by D. A. Crola, Elsevier, Latest Edition.

Course Content

8.22 Machines and Mechanisms

COURSE CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN
(AUT-314) **Machines and Mechanisms**	(2+1) **32 Theory + 48 Lab**	**Breadth-III**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Explain** concepts of mechanics for operations of machine elements.	C-2	1
CLO-2	**Calculate** the kinematic characteristics of mechanisms such as linkages, cams, and gears used in automobiles.	C-3	SA–1
CLO-3	**Find** solutions using machine components for automotive applications meeting desired needs.	C-6	3
CLO-4	**Measure** automotive machine mechanisms with their performance parameters.	P-3	4
CLO-5	**Undertake** automotive technology projects related to machine elements, individually or in a group.	A-2	8

Course Outline for Theory

Simple Mechanism: Introduction, Types and classification of Kinematic Link, Structure, Difference between Machine and Structure, Kinematic Pair, Types of Constrained Motion, Chain, Types of Chain, Types of Joints in a Chain, Inversion of Mechanism, Quadric Cycle Chain, Inversion of Quadric Cycle Chain, Single Slider Crank Chain, Inversion of Single Slider Crank Chain, Double Slider Crank Chain, Inversion of Double Slider Crank Chain

Gear Trains: Introduction, Types of Gear Trains, Simple Gear Train, Compound Gear Train, Reverted Gear Train, Epicyclical Gear Train, Velocity Ratio of Epicyclical Gear Train, Compound Epicyclical Gear Train, Epicyclical Gear Train with Bevel Gears, Torque in Epicyclical Gear Trains.

CAMS: Introduction, Classification of CAMs and Followers, Follower Motion and Construction of CAMs profiles, Specified Contours, Tangent CAM with Reciprocating Roller Follower Circular arc CAM with Flat Faced Follower.

Balancing of Rotating Masses: Introduction, Balancing of Rotating Masses and wheels, Balancing of a single & multi rotating mass.

Lab Outline

1. To familiarize with different machine components Technology, tools and equipment.
2. To identify different automobile engines components and their use.
3. To find the mechanical advantage, velocity ratio and efficiency of simple gear train.
4. To find the mechanical advantage, velocity ratio and efficiency of worm wheel.
5. To analyze the CAM and follower motion
6. To Investigate and measure the Moment of inertia of flywheel.
7. To find the mechanical advantage, velocity ratio and efficiency of wheel and axle.
8. To find the mechanical advantage, velocity ratio and efficiency of winch.

9. To analyze the steering system and mechanism. 10. To investigate the Universal coupling apparatus / joints and motions.
Recommended Books
1. Thomas Bevan, The Theory of Machines, Prentice Hall Press. 2. John J. Uicker, Gordon R. Pennock, Joseph E. Shigley, Theory of Machines and Mechanisms, Oxford University Press. 3. Robert Ferrier McKay, The Theory of Machines, Palala Press. 4. J. A. Collins, Mechanical Design of Machine Elements and Machines, Pearson Press. 5. R. L. Norton, Design of Machinery, McGraw-Hill Education.

Course Content

8.23 Computer Aided Drafting and Modeling

COURSE CODE & TITLE (AUT-325) **Computer Aided Drafting and Modeling**	**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-IV**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Draw** general 2D and 3D objects using CAD software.	P-3	5
CLO-2	**Model** automotive components using CAD software with modern features like parametric modeling, animation, and rendering.	C-3	9

Course Outline for Theory

An overview of CAD, installing and configuring CAD. The drawing environment, Controlling and accelerating the drawing process, creating simple drawings, creating complex entities. Editing and plotting drawings: Editing drawing entities, changing the drawing display, printing and plotting the drawings, measuring different variables, designing shapes and text fonts. Create various 2D drawings such as bolts and nuts, Plummer block bearing, non-return valve, safety valve. Create isometric dimensional drawing of a connecting rod using isometric. Draw quarter sectional isometric view of a cotter joint etc. Draw 3D models by extruding simple 2D objects, dimensioning and naming of objects. Draw 3D assembly of flange coupling, universal coupling, assembly of knuckle joint, 3D assembly gib and cotter joint, assembly drawing of connecting rod.

Recommended Books

1. French, Thomas E.; Vierck, Charles J. Engineering Drawing and Graphic Technology, Latest Edition.
2. T. Jeyapoovan, Engineering Drawing and Graphics Using AutoCAD, Latest Edition, Vikas Publishing.
3. N.D Bhatt, Engineering Drawing, Latest Edition, Charotar Publishing House Pvt. Ltd.

Course Content

8.24 Automotive Transmission and Transaxle

COURSE CODE & TITLE (AUT-324) **Automotive Transmission and Transaxle**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the components, working principles, and performance of Transmission and Transaxle.		C-2	1
CLO-2	**Perform** basic calculations related to gears and gear ratios.		C-3	1
CLO-3	**Demonstrate** the basic service, maintenance, and diagnostics of Transmission and Transaxle		P-4	1

Course Outline for Theory

Understand the fundamentals, principle of operation and performance of various clutches and gear boxes. Gain knowledge about various hydrodynamic drives. Conceive various types of gear boxes used for Automotive transmission. Understand the principle of operation and performance of various hydrostatic drives. Understand the principle of operation and performance of various electric drives. Introduction, Gear Box Clutch, Hydrostatic drive, Hydro dynamic drive, Electric Drive.

Recommended Books

1. Singh Kirpal, Automobile Engineering Vol-1, Standard Publishers distributor's.
2. Newton and Steeds, Motor vehicles, lliffe Publishers.
3. Judge. A.W., Modern Transmission systems, Chapman and Hall Ltd.
4. Crouse. W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw-Hill.
5. Jack Erjavec, Rob Thompson, Automotive Technology A Systems Approach.
6. Vangleder, Fundamentals of Automotive Technology.

Course Content

8.25 Engine Performance

COURSE CODE & TITLE (AUT-22x) **Engine Performance**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** engine performance and diagnostic parameters.	C-2	1
CLO-2	**Analyze** engine performance in terms of emissions and fuel economy.	C-4	2
CLO-3	**Measure** engine performance parameters using available laboratory equipment.	P-3	4

Course Outline for Theory

General Engine Diagnosis: Ignition System Diagnostics & Repair Fuel, Air Induction & Exhaust Systems, Emissions Control Systems, Computerized Engine Controls, Hands on Diagnostics, Exhaust gas Analysis for gasoline and diesel engines.

Engine Performance parameters: Swept Volume, Clearance Volume, Compression Ratio, Brake Torque, Mean Effective Pressure, Power, Efficiency, Air / Fuel Stoichiometry Ratio, Mass Flow Rate of Air / Fuel, Calorific Value, Brake-Specific Fuel Consumption, Turbo-Charger Compressor Efficiency, Break Power, Indicated Horsepower. Use of Dynamoter.

Lab Outline

- Measure engine performance parameters using dynamometers
- Automotive fault diagnosis (ABS, alternator etc.) using OBD tool
- Use of Exhaust gas analyzer for monitoring NO_x, SO_x, CO, CO_2 levels.

Recommended Books

1. Jack Erjavec, Rob Thompson, Automotive Technology: A Systems Approach, Latest Edition.

Course Content

8.26 Engine Emissions and Control

COURSE CODE & TITLE (AUT-31x) **Engine Emissions and Control**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Breadth**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** sources of engine emissions and their mitigation using different technologies.	C-2	1
CLO-2	**Understand** impact of engine emissions on sustainability.	C-3	6
CLO-3	**Measure** engine emissions using laboratory equipment.	P-4	4
CLO-4	**Appreciate** the commitment and compliance with relevant international standards for engine emissions and control.	A-2	7

Course Outline for Theory

Introduction: Pollutant emissions, GHG Emissions and Fuel Technology, Power Train Efficiency, Vehicle Technology and Operational Parameters.

Emission Control Technologies: Engine Design Technologies for Emission Reduction, Fuel Injection, Exhaust Gas Recirculation, Intake Boosting, Intake Temperature Management, Combustion Chamber Design, Variable Valve Actuation

Fuel And Lubricant Technologies: Lubricating Oils, Alternative Fuels, Oil Additives.

Exhaust After Treatment Technologies: Oxidation Catalysts, Three-way Catalyst, NOx Adsorber Catalysts, Gasoline Particulate Filters.

Control, Diagnostics and Powertrain Technologies: Hybridization, On Board Diagnostic Systems, Controls.

Lab Outline

Conduct basic experiments to measure emissions for different fuels. Conduct basic experiments to measure emissions for different fuels. Determine environmental impact of emissions by automotives.

Recommended Books

1. W. W. Pulkrabek, Engineering Fundamentals of The Internal Combustion Engines, Latest Edition, Pearson Education, 2003.
2. J B Heywood, Internal Combustion Engine Fundamentals, Latest Edition, McGraw Hill, 2018.
3. R Stone, Introduction to Internal Combustion Engines, Latest Edition, Palgrave MacMillan, 2014.

Course Content

8.27 Automotive Electrical and Electronics

COURSE CODE & TITLE (AUT-31x) **Automotive Electrical & Electronics**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** working principles of vehicle electrical and electronic systems with their wire harnessing.		C-2	1
CLO-2	**Describe** instrumentation systems of the vehicle with their communication channels.		C-2	1
Course Outline for Theory				
Types of diagnostic tools, introduction to ECU, CAN Bus and OBD protocol, exhaust analyzer, introduction to vehicle ignition, battery, electronic braking and charging system, Gauges and warning devices, instrumentation and sensing, electronic fuel injection, power electronics, reading Service Manuals.				
Lab Outline				
Use of digital multimeter, OBD, CAN bus, instrumentation cluster, exhaust analyzer, and ECU tuning. Service Manuals of the vehicles, Special Service tools (SST).				
Recommended Books				
1. Tom Denton, 2017, Automobile Electrical and Electronic System Latest Edition, Routledge. 2. Barry Hollembeak, 2017, Today's Technician: Automotive Electricity and Electronics, Latest Edition, Cengage.				

Course Content

8.28 Fluid Power Technology

COURSE CODE & TITLE (AUT-xxx) **Fluid Power Technology**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental principles of fluid flow used in pneumatic and hydraulic machines.	C-2	1
CLO-2	**Interpret** PI&D diagrams and control circuits with proper symbols.	C-3	1
CLO-3	**Describe** simple repair and maintenance procedures of pneumatic and hydraulic components or systems in vehicles.	P-4	1
CLO-4	**Describe** the use of components in operation, measurement, and control of hydraulic and pneumatic technology.	P-3	3

Course Outline for Theory

The basic hydraulic theories are applied in practice, importance of good hydraulic filtration techniques, operation of pressure, flow and directional control valves and the applications in hydraulic circuits, hydraulic pumps and motors, hydraulic cylinder construction and sealing practices, basics of fluid power connectors and hose assemblies, good practice techniques and the different threads found in hydraulics, the basics of hydraulic circuit and P&ID diagrams applications, the different types of hydraulic control systems and the effect on energy usage maintenance and troubleshooting techniques, the characteristics, generation and preparation of air, identification of schematic symbols used in pneumatics, design of basic pneumatic schematic drawing from a given requirement, identification of various components and their operation used in pneumatics, use pneumatic components in circuits, the maintenance requirements of each component, safe work practices for hydraulics and pneumatics.

Lab Outlines

- To understand basic health and safety guidelines.
- To understand working principle of pumps and compressors.
- To familiarize with types of valves, electromechanical valves, regulators.
- To practice reading and design of pneumatic and hydraulic circuit schematics.
- Implementation of basic pneumatic and hydraulic circuits.

Recommended Books

1. Andrew Parr ,2013, Hydraulic and Pneumatics: A Technician and Engineer's Guide, Latest Edition, Elsevier.
2. Ian Turner, 2020, Engineering Application of Pneumatics and Hydraulics, Latest Edition, Taylor and Francis.

Course Content

8.29 Automotive HVAC Technologies

COURSE CODE & TITLE (AUT-xxx) **Automotive HVAC Technologies**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** HVAC systems of vehicles.	C-2	1
CLO-2	**Design** processes for heating, cooling, and load calculations to select HVAC systems for vehicles.	C-3	2
CLO-3	**Demonstrate** knowledge of sustainable solutions for automotive HVAC systems.	C-3	6
CLO-4	**Conduct** basic experiments of refrigeration and air conditioning using laboratory equipment.	P-3	1

Course Outline for Theory

Fundamentals of Refrigeration Cycles: Vapour Compression cycle, Vapour Absorption cycle, Types of Refrigerants, Refrigeration components and controls, Psychrometry, Air Conditioning Systems; Air Conditioning Equipment, components and controls, Duct Systems, Fans and Air Distribution Systems, Indoor Air Quality, Heating and Cooling Load Calculations, Energy efficient buildings, Automotive air conditioning system.

Maintenance and Repair of Domestic and Commercial Equipment: Maintenance of a new installation-sample scheduling, Types of air compressors, Compressor efficiency and operation, Capacity assessment, Leakage test, Factors affecting the performance and efficiency, compressor repair and checking the efficiency, Pneumatics, pneumatic control, descaling of condenser, purging or removing air from system; Refrigeration and Air conditioning Tools: List of tools and their applications, safety precautions.

Fans and Blowers: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

Sample Lab Experiments

Find the C.O.P. of refrigerator. Effect of condensing temperature on the performance of refrigerator. Calculate the efficiency of a refrigerator. Construction of pressure enthalpy diagram for a vapor compression System refrigeration and its performance measurement. To check the performance of a vapor compression system refrigerator by Varying the heat input to the evaporator. Representation of Properties of air on Psychometric charts. Air conditioning cycle on charts. Demonstration of domestic refrigerator. Demonstration of cooling tower. Demonstration of window type air conditioner. Demonstration of chiller AC plant. Study of different Phase Change materials.

Recommended Books

1. William C. Whitman , (2008), Refrigeration and Air Conditioning Technology , Latest Edition, Cengage Learning.
2. Miller and Miller, (2011), Air Conditioning and Refrigeration, Latest Edition, McGraw Hill.
3. Dick Wirz, (2017), Commercial Refrigeration for Air Conditioning Technicians, Latest Edition, Cengage Learning.
4. Edward G. Pita, (1989), Air Conditioning Principals and Systems, Latest Edition, Wiley & Sons.

Course Content

8.30 Hybrid and Electric Vehicles

COURSE CODE & TITLE (AUT-xxx) **Hybrid and Electric Vehicles**	CREDIT& CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Depth**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** different architectures and configurations for EVs and HEVs.	C-2	1
CLO-2	**Select** appropriate technologies of traction, transmission, storage, and control for EVs and HEVs.	C-3	2

Course Outline for Theory

Introduction: Configurations of EVs, Architecture of Hybrid Electric Vehicle Drive Trains, Power Flow in HEVs, Advantages and disadvantages of using series hybrid powertrain, Economic and Environmental Impact of EVs & HEVs.

Components of HEV powertrain: Motor / Generator & power converters, Turbocharged diesel engine, Battery & DC/DC converter, Regenerative Braking, Driver, Supervisory Control, Integration of the components.

Traction Motors: Types of traction motors for EVs / HEVs, Induction Motor Construction and Classification, Induction Motor Drives, Control and Applications in EVs/HEVs, Permanent Magnet synchronous Motor/Generator Configuration and Optimization, Permanent Magnet Motor, Switch Reluctance Motors, Speed Control, Power Loss Model, Driver Model.

Converters for EVs / HEVs: AC-DC rectifier, DC-AC Inverter for EV and HEV, Applications, Buck (Step-down) converter, Boost (Step-up) Converter, Buck-Boost Converter.

Energy storage: Energy Storage Systems, Types of Batteries and performance parameters, Battery Systems, Introduction to BMS, Charging and Discharging rate calculations.

Sample Lab Experiments

1. Battery performance measurements.
2. Motor performance measurement.
3. BMS trouble shooting
4. Controller Harnessing.

Recommended Books

1. J. M. Miller, Propulsion Systems for Hybrid Vehicles. Michael Faraday House, Six Hills Way, Stevenage Herts, SG1 2AY, United Kingdom: The Institution of Engineering and Technology, December 2003.
2. I. Husain, Electric and Hybrid Vehicles: Design Fundamentals. University of Akron, Ohio, USA: CRC Press, 2003.
3. M. Eshani, Y. Gao, S. E. Gay, and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design. CRC Press, 2004.
4. J. Larminie and j. Lovry, Electric Vehicle Technology Explained. West Sussex: John Wiley Sons Ltd, 2003.
5. H. B. Pacejka, Tyre and Vehicle Dynamics. Oxford: Butterworth Heinemann, 2002.

Course Content

8.31 Automotive Service

COURSE CODE & TITLE (AUT-xxx) **Automotive Service**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Depth**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the terminologies used in automotive service industry.	C-2	1
CLO-2	**Use** repair manuals, manage, and conduct vehicle service operations overall.	C-3	1
CLO-3	**Communicate** required service operations to customers, as well as to the service department.	A-3	9
CLO-4	**Demonstrate** professional ethics in service operations.	A-4	7

Course Outline for Theory

Overview of Automotive Service: Role of Service, Service staff (Manager, workshop controller, service advisor, maintenance technician, diagnostic technicians, body & paint shop staff), standard automotive workshop areas (mechanical shop, body & paint shop, service station, auto parts warehouse, reception, parking area, AC repair pit, training area, mess, engine overall shop, library etc.), 3S Dealership.

Service Operation Management: Standard Service Transaction, Customer Appointments, Work Control, Customer Reception, Reception Diagnosis, Repair Orders, Quality Control, Active Delivery, Follow-up Calls, Customer Database, workshop Control, Vehicle Security and Immobilizer Systems, use of Workshop Manuals, Wiring Diagrams, Understanding the Periodic Maintenance Procedures as per Manufacturer's standards, Service Fast Track Processes and workflow Management.

Development of Communication and Interpersonal Skills: Service Advisor's Role, Interpersonal Skills in Service Transactions, Positive First Impression, active listening and clear explanation, Complaint Handling, Business Strategies in after sales Industry, Manufacturer's Trainings for after sales Staff, Time Management, Technical Report, Service Bulletin, Warranty Reports.

Dealership Equipment Workshop and Compliance: Common tools, special service tools (SST), types of lifts, workshop equipment's, standard & quality control, certifications, Layout, health & safety requirements, flooring, Equipment Installation and Calibration. Legal Issues.

Lab Outline

1. Maintenance of cylinder head.
2. Starting Air Valve Cleaning and Maintenance.
3. Inspection and Maintenance of Exhaust and Intake Manifold.
4. To examine the piston and repair it if necessary.

5. To understand the basic procedure of testing of fuel injection pump.
6. To identify leakage fault on the Fuel Injection Pump, by using FIP Testing Bench.
7. To understand the maintenance of fuel injection pump with the help of machining process.
8. To study the defects, repairing, balancing and deflection measurement of crankshaft.
9. Understand repair and leakage of fuel tank.
10. To understand the working of fuel injector and radiator cap testing machine.
11. To know methods of cleaning, testing, repair and maintenance of intake and exhaust manifolds.
12. To remove the rust and other dirt from the fins and tube passages and accessories holes of radiator and oil cooler.
13. To perform visual inspection and see the soldering process in radiator and oil cooler.
14. To see and understand the leakage testing of radiator and oil cooler.
15. To observe and understand the vibration test of radiator and oil cooler.

Recommended Books

1. Tim Giles, Automotive Service Inspection, Maintenance, Repair.
2. Andrew A Rezin, Automotive Service Management-Principles into Practice, Pearson, 2009.
3. J. Erjavec, Automotive Technology: A Systems Approach.
4. ASE Test preparation, Automobile Certification Series-Service Consultant, Latest Edition, Cengage Learning, 2012.

Course Content

8.32 Operations Management

COURSE CODE & TITLE (AUM-21x) **Operations Management**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management**

After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the process, production, planning, quality operations and management techniques used in an industry.	C-2	1
CLO-2	**Solve** operation management problems related to inventory, quality, and productivity.	C-3	1
CLO-3	**Use** project management tools for a project in multi-disciplinary settings.	C-3	0
CLO-4	**Describe** industrial practices using operations management techniques by submitting reports.	A-3	9

Course Outline for Theory

Introduction: Management, Scientific Management, Operations Management, Process, 6M, Product and Service, Competitiveness, Strategy, Innovation and Productivity.

Production Operation & Management: Process Selection, Facility layouts, Work Design, Method Study, Time Motion study, Takt time, Location planning, Capacity and Demand Management, Forecasting, Aggregate planning, Master Scheduling, Line Balancing, MRP, ERP, Introduction to Toyota Production System (TPS).

Inventory Management: Stocks, Inventory policies, Economic order quantity, Inventory Models, JIT system, Management of waiting or queuing lines, Introduction to Supply chain management.
Project Management: Product life cycle, work break-down study, CPM, PERT.

Quality Management: Quality definitions, Product and Service quality, Quality Control and Quality Assurance, 7QC tools, Quality circles, Control Charts, Introduction to Statistical Process Control, Process capability, Lean tools, 5S, 3M, Quality cost, Six Sigma, TQM.

Recommended Books

1. William J. Stevenson, Operations Management, Latest Edition.
2. Jay Heizer, Barry Render; Operations Management, Latest Edition.
3. Elwood S. Buffa, Rakesh K. Sarin; Modern Production/Operations Management, Latest Edition.

Course Content

8.33 Economics for Technologists

COURSE CODE & TITLE (AUT-xxx) **Economics for Technologists**		**CREDIT & CONTACT HOURS:** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** financial terminologies used in engineering technology economics, and techno-economic decision making.		C-2	1
CLO-2	**Calculate** simple and compound interest amounts for one or more time periods.		C-3	1
CLO-3	**Use** software for engineering technology economics calculations pertinent to decision making.		C-3	5

Course Outline for Theory

Introduction: Macro and Microeconomics, Principles of Engineering Economics, Economic Decision making, Assets, liabilities, Equity, Supply, Price and Demand relationship, Factors of productions, laws of return.

Cost Analysis: Sunk & opportunity costs; fixed, variable, and incremental costs; recurring & nonrecurring costs; direct, indirect, and overhead costs; standard costs; breakeven analysis; unit cost of production; cost-benefit analysis; feasibility studies; value analysis in designing & purchasing, Life cycle cost analysis.

Time Value of Money: Simple interest; compound interest; cash flow diagrams; interest formulae; nominal versus effective interest rates; continuous compounding, Pay-back period method, Present and Future worth method, Uniform and Annual worth method, Equivalence of repeated cash flows, Net present value method, Internal Rate of Return (IRR), Choosing best alternatives.

Linear Programming: Optimization of Resources, Objective function, Mathematical statement of linear programming problems; graphical solution; simplex method.

Depreciation: Purpose of depreciation; types of depreciation; salvage value, depreciation calculation methods, economic life.

Recommended Books

1. Engineering Economy by Leland blank and Anthony Tarquin.
2. Engineering Economic Analysis by Newnan, Eschenbach, Lavelle.
3. Engineering economy by Paul Degarmo.
4. Project Management – A Managerial Approach. Jack R. Meredith & Samuel J. Mantel, Jr.
5. Project management body of knowledge "PMBOK".

Course Content

8.34 Quality Management

COURSE CODE & TITLE (AUT-xxx) **Quality Management**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** lean methodologies for the benefit of local industry.	C-3	6
CLO-2	**Use** statistical software for quality control tools.	C-3	5

Course Outline for Theory

Introduction to Quality: Definition and dimensions of quality, Quality control and Assurance, Cost of quality and its related indices, Vision, Mission and Quality Policy, Customer satisfaction and feedback system.

Statistical Process Control: Controls charts for mean standard deviation and proportion defective, process capability indices, Acceptance sampling, single and multiple sampling, introduction to six-sigma, DMAIC.

Japanese Production System: Principles and operating strategies, Takt-time, Quality circle, Kanban 5S, Pokayoka, Cost concept, 3M (Mura, Muri, Muda).

TQM: Pareto, Flow chart, Cause and Effect diagram, Failure Mode & Effect Analysis (FMEA), Improvement Strategies, Lean concepts and waste reduction methods, PDCA Cycle, KAIZEN, Quality Function Deployment (QFD), Introduction to Quality Management System (ISO).

Recommended Books

1. Total Quality Management: International Edition, 3/E, Dale H Besterfield, Pearson, 2015
2. Fundamentals of Quality Control and Improvement, Amitava Mitra, 4th ed WILEY, 2016.
3. Introduction to Statistical Quality Control, Douglas C Montgomery, 6th ed WILEY, 2009.

Course Content

8.35 Probability and Statistics

COURSE CODE & TITLE (AUT-xxx) **Probability and Statistics**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Calculate** descriptive statistics and visualize statistical data.		C-3	1
CLO-2	**Calculate** probability for discrete and continuous distributions.		C-3	1
CLO-3	**Use** statistical software for visualization and calculating statistical parameters.		C-3	5

Course Outline for Theory

Visualizing statistical data, measures of central tendency and dispersion, counting methods, Conditional probability, law of total probability, Bayes theorem, Skewness and Kurtosis, Random variables, Discrete and continuous probability distribution, Probability distributions, Expectation and Variance, Correlation and simple regression.

Recommended Books

1. Introduction to Probability and Statistics, Latest Edition, by William Mendenhall, Robert J. Beaver, Barbara M. Beaver.
2. An Introduction to Probability Theory and Its Applications, Latest Edition, by William Feller.
3. Applied statistics and probability for engineers, Latest Edition by Douglas C Montgomery.

Course Content

8.36 Occupational Health, Safety and Environment

COURSE CODE & TITLE (AUM-21x) **Occupational Health, Safety and Environment**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** societal, health, and safety issues relating to vehicle or automotive industry for meeting SDGs.	C-3	6
CLO-2	**Appreciate** the use of PPEs at the workplace.	A-3	6
CLO-3	**Explain** the ethical and legal requirements of the industry to protect health and the environment.	C-2	7

Course Outline for Theory

Introduction of Health, Safety & Environment: introduction & objectives of safety, importance of safety in an Automotive industry, accidents, types of accidents, effects of accidents, greenhouse gases, global warming.

Principles of Accident Prevention: hazards and its types, risk, sources of risk, risk assessment, risk matrix, personal protection equipment (PPEs), safety management and hierarchy of control, safety training, first aid and emergency procedures, ergonomics.

Fire Safety: chemistry of fire, fire triangle, types of fire, fire prevention and control, fire extinguishers, pass rule for fire extinguishers.

Environmental Acts: legal, humanitarian and economic reason for action, Pakistan health and safety act, OHSAS 18001, environmental management system ISO 14001, ISO standards for safety and health and environment.

Pollution and its Types: Atmospheric Pollution & types of Atmospheric pollution, Causes and Effects of Atmospheric Pollution on Human Health Available Technologies for Controlling Pollution, Industrial Waste, Solid Waste, Industrial Effluents and Waste Gases, Waste treatment plants, Noise Pollution, Measurement of Noise level, Effect of excessive noise on human health, Remedial Measures.

Recommended Books

1. Safety at Work, Latest Edition by John Ridley, Butter Worths Publishers.
2. K. G. Lockyer Factory & Production Management, Pitman Publishing (1974).
3. Holt A.S.J Principle of Health & Safety at work. (2015), The Caverdisk Press Limited. UK 1999.
4. Patty F.A "Industrial Hygiene & Toxicology, Latest Edition, Vol-04 General Principles", Willy publishers.
5. Barbara J. Peters and George A. Peters Automotive Vehicle Safety, Latest Edition, SAE International and Taylor 2002.

Course Content

8.37 Entrepreneurship

COURSE CODE & TITLE (AUM-21x) **Entrepreneurship**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** principles of entrepreneurship.		C3	2
CLO-2	**Identify** markets to test and experiment entrepreneurial concepts.		C4	4
CLO-3	**Evaluate** business models, revenues, and marketing strategies.		C5	4
Course Outline for Theory				
A global social movement, practicing entrepreneurship, developing an entrepreneurial mindset, Generating New Ideas, Using Design Thinking, Testing and Experimenting in Markets, Building Business Models, Creating Revenue Models, Bootstrapping for Resources, Financial Statements and Projections for Startups.				
Recommended Books				
1. Neck, Neck, and Murray, 2018, Entrepreneurship: the practice and mindset, Latest Edition, Sage Publishers.				

Course Content

8.38 Introduction to Industrial Management

COURSE CODE & TITLE (AUM-31x) **Introduction to Industrial Management**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic finance and project management terminologies.	C-2	1
CLO-2	**Interpret** financial statements, reports, budgets, balance sheets, production planning, and quality documentation of the industry.	C-3	10
CLO-3	**Apply** engineering technology management principles and practices to projects in a multidisciplinary environment.	C-3	8

Course Outline

Introduction: Definition of Management, Scientific Management, Behavioral Management, Engineering and Technology Management, Automotive Service Management, Customer and Client difference, Teamwork, Motivation, Leadership, 7 habits of Leaders from Stephen R. Covey.

Basic Finance Terminologies: Asset, Liability, Equity, Profit, Cost, Price, Cash flow, Revenue, accounting and bookkeeping, Balance sheet, Shares and Stocks, Annual Report, CAPEX, OPEX, B2B, B2C.

Industrial Management: Investment appraisal, Planning and forecasting, Strategies and Decision making, Organization and its structures, Staffing and Controlling, Product and Technology Life cycles, Spare parts inventory management, Automotive Service Industry, Dealership, 3S, Automotive Aftermarket, Marketing, Quality management, Standardization.

Project Management: Project proposal process; project planning, organization and control; role of project manager; Professional ethics and conduct; types of contracts; Motivating project performance.

Recommended Books

1. C. Machado, J. P. Davim, 2019, Entrepreneurship and Organizational Innovation, Springer.
2. Lucy C. Morse • Daniel L. Babcock, Managing Engineering and Technology, Latest Edition, Pearson.
3. M. Fernandez, 2020, Industrial Engineering; Operations Management.
4. Colin Barrow, Practical Financial Management- A guide to budgets, balance sheets and business finance, Latest Edition, Kogan Page Ltd.
5. C. Machado, J. P. Davim, 2018, Organizational Behavior and Human Resource Management, Springer.

Course Content

8.39 Project Management

COURSE CODE & TITLE: (AUM-31x) **Project Management**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/DOMAIN** **Management Science**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the basic functions of management, with a special focus on project management.	C-2	11
CLO-2	**Apply** different knowledge areas of project management	C-3	11
CLO-3	**Employ** ICT technologies in project management, such as MS-Project and Primavera	P-3	5

Course Outline

Introduction to Management: History of management, functions and functional areas of management, levels of management, managerial skills, types of organizations, managerial control, principles of management. Introduction to Project Management: Definition of Project and Project Management, knowledge areas of project management, project life cycle, project characteristics, project constraints, project organization structure. Project Quality Management: History of Quality Management, defining quality, relationship between project management and quality management, Quality Management Frameworks.

Project Stakeholder Management: The roles of project manager and project sponsor, project team selection, skills, and competencies of project manager, building and managing successful project teams, stakeholder management .Project Cost Estimating and Budgeting: Cost components and methods for cost estimation in projects, cost control in projects, life cycle cost, cost scheduling and forecasting, project resource allocation and levelling, estimation of outstanding work, elements of budgets and estimates, earned value management.

Project Risk Management: Defining risk and uncertainty, business and project risk, probability and impact of risk, risk management process. Project Time Management: Introduction to project scheduling, Critical Path Method, network representation of projects, critical activities, and critical path, project Gantt Chart. Project Closure: Project evaluation, project and project management success, success criteria for projects, project audits, project termination process. Project Management Tools: Introduction and use of project management tools like MS Project and Primavera.

Recommended Books

1. Harold Kerzner, Project Management: A System Approach to Planning Scheduling and Controlling, John Willey, 11th Edition
2. Jack R. Meredith and Samuel J. Mantel, Jr. John, Project Management: A managerial approach, Wiley and Sons, Inc., 7th Edition
3. John M. Nicholas and Herman Steyn, Project Management for Engineering and Technology: Principles and Practice, Elsevier Publications, 3rd Edition
4. Paul Gardiner, Project Management: A Strategic Planning Approach, Palgrave Macmillan, 2nd Edition

Course Content

8.40 Logic and Critical Thinking

COURSE CODE & TITLE (AUH-21x) **Logic and Critical Thinking**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** key concepts and tools of logic and critical thinking.	C-2	9
CLO-2	**Apply** critical thinking approaches in situations involving perceiving, analyzing, solving problems, and avoiding fallacies.	C-3	11

Course Outline for Theory

Introduction to the Study of Logic: Definitions, Concepts of Logic & Critical Thinking. Scope and Impact, Intellectual Moral Virtues. Basic Principles of Logic: Structure of an Argument, Valid/Invalid versus Sound/Unsound argumentation, Deduction versus Induction, Three classical Aristotelian Laws of Logic, Principle of sufficient reason; Deductive reasoning- Syllogism, Linear ordering, Tree diagrams; and Inductive Reasoning - Valid and invalid arguments. Fallacies.

Thinking: Thinking process while working towards goals, making decisions and analyzing issues. Thinking tools and their applications. (e.g., facts and opinions, verification of sources and credibility of authorities etc.); Theoretical Frames (e.g., Scientific Methods/Approach etc.) and Formal Tool (e.g., PMI, STAR method, Shewhart Cycle, Socratic Method, RW & D, Quality Thinking- Paul & Elder Framework etc.)

Thinking Critically: Critical Thinking standards: clarity, precision, accuracy, relevance, consistency, logical correctness, completeness, and fairness.

Barriers to Critical Thinking: Egocentrism, sociocentrism, unwarranted assumptions and stereotypes, relativist thinking, and wishful thinking. Critical Thinking Approach: Thinking actively, using questions for probing situations, evaluating our evidence and their types, Impartial versus adversarial critical thinking.

Critical Thinking in Everyday Life: Problem Solving: Defining a problem, attitudes towards problems-general and desired, Problem-solving process, case studies on problem analysis Perceiving: Defining perception and its prominence in succeeding through life, Critical thinking and perception, Evaluating the differences in perception (through tests, optical illusions etc.), Perception processes, Factors governing perception, Difficulties / errors in perception process (perceptual errors).

Believing and Knowing: Believing versus knowing, values and their types, identifying one's values in life; defining and classifying beliefs, Accuracy scale for evaluating thoughts, thinking patterns and organizing concepts, Ways to Organize Thoughts, Types of causal relationships – causal chains, contributory and interactive causes.

Recommended Books

1. Vaughn Lewis, The Power of Critical Thinking, Oxford University Press, Latest Edition.
2. Paulsen David W., Cederblom Jerry: Critical Reasoning, Wadsworth, Latest Edition.
3. Restall Greg; Logic: An Introduction, Routledge, Latest Edition.

Course Content
8.41 Psychology

COURSE CODE & TITLE (AUH-41x) **Psychology**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Sciences**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** various types and science of psychology.	C-1	7
CLO-2	**Describe** different aspects of behavioral psychology.	C-2	7
CLO-3	**Adapt** and adjust in different work environment, and with different personalities.	A-4	8

Course Outline

Introduction to Psychology, the science of Psychology, The origins of psychology, The fundamental of psychological theories , Early Behavioral psychology, Human development and language, Cognitive psychology (perception, perceive the world) , Clinical psychology (self and others), Social psychology , Variation in personalities (Intelligence and personality) , sports psychology , stress , lifestyle , Anxiety & Depression , Emotions & Motivation.

Recommended Books

1. Introduction to Psychology by Charles Stangor.
2. Psychology for Beginners by Max Krone.

Course Content

8.42 Professional Ethics

COURSE CODE & TITLE (AUH-21x) **Professional Ethics**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the basic concepts of personal and professional ethics	C-2	8
CLO-2	**Respond** to ethical dilemmas using common ethical values	A-2	8
CLO-3	**Adopt** ethical principles at various professional levels.	A-3	8

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional and historical definitions; origin of professional ethics, profession and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically. Value of Ethics: Values in professional ethics, central responsibility of engineering professionals, ethics in different fields of work, IEEE code of ethics, ethical code for engineering professionals, global issues in professional ethics, ethics in manufacturing and marketing, intellectual property rights, business ethics and corporate governance. Ethical Dilemmas: Common ethical dilemmas, resolution of ethical dilemmas, possible actions in response to dilemmas, probable consequences of these actions.

Recommended Books

1. Charles E. Harris, Engineering Ethics Concepts & Cases, Cengage, 5th Edition, Cengage 2014
2. Mike W. Martin, Roland Schinzinger, Ethics in Engineering, McGraw-Hill, New York, 2005 4th Edition
3. Stephan r. Covey, The Seven Habits of Highly effective people

9. Supervised Industrial Training

9.1 Background

Supervised Industrial Training (SIT) refers to students supervised hands-on experience in an environment where engineering technology is practiced, familiarizing them with professional engineering work prior to graduation. The training curriculum consists of minimum 16 weeks of continuous industrial training, comprised of 8 hours per day, 5 working days per week. A Bachelor of Engineering Technology student shall undergo mandatory SIT during the 8th semester (16 weeks), or 7th and 8th semesters (16 weeks mandatory and 16 weeks in 7th semester optional), after he/ she has passed all subjects up to the 6th semester.

SIT covers a range of activities, such as design implementation, production processes, laboratory experiments, on-site field works and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve Program Learning Outcomes that cover Engineering Technologists Graduate Attributes in line with the Sydney Accord. While SIT provides practical exposure to engineering processes and helps developing professional skills required for an Engineering Technologist, it also offers an opportunity to the prospective employers to assess potential skills of a future employee.

9.2 Objectives

Through the SIT, students will:

a. Learn to apply engineering technology knowledge learned in classroom environment in real industrial situations.
b. Be provided exposure to professional practices in the industries.
c. Understand the role and responsibilities and code of ethics that Engineering Technologists should uphold.
d. Develop awareness about general workplace behavior and build interpersonal skills.
e. Maintain professional work records and reports.
f. Learn to write reports and network with probable future employers to increase employability.

9.3 Responsibility of HEI: Placement in SIT Program

During 7th (Optional) and 8th semester, Bachelor of Automotive Engineering Technology students will be undergoing continuous SIT of 16 (or 32) weeks. This training shall be arranged by HEIs in leading industry, and preferably should sign am MoU for the SIT. A designated Administrator/Coordinator of HEI shall complete all necessary documentation, preferably 12 weeks prior to the commencement of the training, and issue Training Schedule for 16 (or 32) weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in 7th (optional) and 8th semester according to a scheduled timeline.

9.4 Responsibilities of Students

a. Bachelor of Automotive Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) credit hours. One week's training of 8 hours daily for 5 days (40 contact hours) will be counted as 1 credit hour. Accordingly, 16 weeks (One semester) will help earn students 16 credit hours.

c. Total contact hours per semester are: 16 weeks per semester x 5 working days per week x 8 hours per day = 640. If an HEI opts SIT in 2 semesters (7th and 8th), these credit hours and contact hours will be doubled.
d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI and the student.
e. Students must observe safety & security rules of the Organization where they receive Training.
f. Students must wear specified working dress during training.
g. Students must obey all rules and regulations of the organization.
h. Students must observe working timings of the training Organization. Students may be allowed 10 days leave during Training period of 16 (or 32) for genuine reasons. The leave shall only be availed to cater for emergency/s, with prior sanction from the training Administrator/Coordinator.
i. Leave will be deducted from training hours and required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.
k. Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

Every HEI should appoint a focal person as SIT Administrator/Coordinator for each program who will monitor progress randomly through site visits, phone calls or emails to the industrial organization's counter-part focal person. Progress reports will be maintained after coordination with training supervisor(s) as well as the students.

The purpose of monitoring of SIT by Training Administrator/Coordinator are:

a. To ensure the training organization is providing suitable and appropriate training to students.
b. To obtain feedback on students' performance and training progress through discussion with training supervisor(s).
c. To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.
d. To discuss the possibility of students' job placement with the training organization.
e. To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

Students are discouraged to change placement during the training period from one organization to another.

a. However, written permission may be granted by the training Administrator/Coordinator, if new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.
b. After getting written permission from the Training Administrator/Coordinator, a fresh approval should be applied for the new placement.

9.7 Daily Training Logbook

All training activities must be recorded on daily basis in the Training Logbook [See Appendix F]. Students must get it signed, on daily basis, by on-the-job Trainer.

The Training logbook must reflect:

a. The student's learning experience during the industrial training
b. Training records and evidence of supervised training, with evidence of participation of student, on- the-job Trainer and HEI's training Administrator/Coordinator.
c. Part of professional practice in engineering profession where incidence and evidence are properly documented.
d. Information that becomes a source of reference in preparing the Industrial Training Report [See Section 8.8].
e. The Logbook must be submitted along with the Industrial Training Report.

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe student's learning and development in technical knowledge, engineering practices and professional skills acquired through practical experience. The Industrial Training Report should also reflect student's ability in communication skills and understanding of engineering practices. Students should seek advice from their on-the-job Trainer on site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT in form of an Industrial Training Report. A properly prepared Report can portray their practical experience precisely in an orderly manner. The Report must be prepared according to the format and the guidelines below:

9.9.1 Contents of Industrial Training Report

(a) Table of Contents

This section of the report shall consist of:

i. Headings
ii. Sub-headings
iii. Page numbers

Every appendix requires a title, and each page needs to be numbered accordingly.

(b) Background & Profile of the Training Organization

Brief and concise description of the organization in which the student is undertaking the SIT. The main items are:

i. Backgrounds/profile of the organization
ii. Vision and Mission
iii. Organogram.
iv. Title and position of the supervisor in charge
v. Other necessary information only (not more than three pages)

(c) Schedule of Duties Performed as Trainee

This section briefly describes the time, duration and types of duties performed during the training. The description must follow the schedule of the training, i.e., in chronological order (for 16/32 weeks). The days when the student was not on duty must be properly recorded with cogent reasons.

(d) Experience During SIT

In this section, the student must fully describe the industrial training experience gained. Some suggested areas include:

i. Project (s) carried out, if any.
ii. Supervisory works
iii. Problems encountered
iv. Problems solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

Students provide an overall assessment in this section and arrive at a conclusion with regards to the SIT undergone. Content may include:

i. Types of major work performed during SIT
ii. Different modules of SIT
iii. Comments whether SIT met the training objectives
iv. Suggestions and recommendations for improvement of the SIT

(f) References

A complete list of the references used in the report must be included according to standard referencing format.

(g) Appendixes

Appendixes are additional information appended to support the main text of the Report. A copy of the letter of permission from the Training Organization must be attached as an appendix. Other suggested appendixes are:

i. Investigation and project report during SIT
ii. Technical drawings, so far these are not secret documents or proprietary etc.
iii. Any other document that adds to the Report

(h) Figures and Tables

All figures, tables and similar content must be captioned, labeled, and mentioned in the main text of the Report.

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.

Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendixes must be in continuation of page numbers of the main Report.

9.9.2 Format of the Report

(a) General

i. Students are advised to start writing the SIT Report as soon as training commences to ensure a timely completion and submission.
ii. Do not include irrelevant materials, e.g., brochures from the organizations, or any publicity materials in the report.
iii. The Report must be typewritten on plain white A4 size paper, with 12-point Times New Roman font type and line spacing of 1.5.

(b) Abstract or Preface

The Report should start with an abstract of maximum 2 pages, and should briefly describe:

i. Description of Organization providing SIT
ii. Summary of the Report
iii. Acknowledgements

9.10 SIT Assessment

Assessment of the SIT should be based on the following parameter:

i.	On-the-Job Trainer Report	(20% marks)
ii.	HEI's Training/ Advisor Report through visits or survey	(10% marks)
iii.	Industrial Training Report	(50% marks)
iv.	Viva voce	(20% marks)

It is also be noted that:

i. Minimum 50% marks are required to pass the SIT.
ii. Students are advised to be diligent in writing their Report.
iii. The Report must be of good quality and portray in full the industrial experience and knowledge gained.
iv. The Report should not be in the form of short notes and figurative form.
v. If the Report is not satisfactory, students shall rewrite the Report until it is deemed satisfactory.

9.11 Completion of Industrial Training

i. Upon completion of a 16- or 32-week continuous SIT, a Confirmation Letter to this effect must be obtained from the training organization and/or probable employer.

ii. The Confirmation Letter must be submitted to the Industrial Training Administrator/Coordinator, together with the (1) On-the-Job Trainer's Report, (2) Student Feedback Form, and (3) Industrial Training Report for grading.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.org)

A Sydney Accord program provides:
SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline and awareness of relevant social sciences.
SK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed consideration and use of models applicable to the sub-discipline.
SK3: A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline.
SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline.
SK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations using the technologies of a practice area.
SK6: Knowledge of engineering technologies applicable in the sub-discipline.
SK7: Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development (represented by the 17 UN-SDGs).
SK8: Engagement with the current technological literature of the discipline and awareness of the power of critical thinking.
SK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

APPENDIX B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to have the following attributes:
Engineering Technology Knowledge: **SA1:** An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems, or methodologies.
Problem Analysis **SA2:** An ability to Identify, formulate, research literature and analyze Broadly Defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization.
Design/Development of Solutions **SA3:** An ability to design solutions for broadly- defined Engineering Technology problems and contribute to the design of systems, components, or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Investigation **SA4:** An ability to conduct investigations of broadly defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.
Modern Tool Usage **SA5:** An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modelling, to Broadly Defined Engineering Technology problems, with an understanding of the limitations.
The Engineering Technologist and Society **SA6:** An ability to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Engineering Technology practice and solutions to broadly defined Engineering Technology problems.
Environment and Sustainability **SA7:** An ability to understand and evaluate the sustainability and impact of Engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts.
Ethics: **SA8:** Understand and commit to professional ethics and responsibilities and norms of Engineering Technology practice.
Individual and Teamwork **SA9:** An ability to Function effectively as an individual, and as a member or leader in diverse teams.

Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong Learning: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to demonstrate the following competencies:
Comprehend and apply universal knowledge: **TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems, or methodologies.
Comprehend and apply local knowledge: **TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems, or methodologies that is specific to the jurisdiction of practice.
Problem analysis: **TC3:** Identify, clarify, and analyze broadly defined problems using the support of computing and information technologies where applicable.
Design and development of solutions: **TC4:** Design or develop solutions to broadly defined problems considering a variety of perspectives.
Evaluation: **TC5:** Evaluate the outcomes and impacts of broadly defined activities.
Protection of society: **TC6:** Recognize the foreseeable economic, social, and environmental effects of broadly defined activities and seek to achieve sustainable outcomes (represented by the 17 UN-SDGs).
Legal, regulatory, and cultural: **TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety during all activities.
Ethics: **TC8:** Conduct activities ethically.
Manage engineering activities: **TC9:** Manage part or all of one or more broadly defined activities.
Communication and Collaboration: **TC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders during all activities.
Continuing Professional Development (CPD) and Lifelong learning: **TC11:** Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.

Judgement: **TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly defined activities.
Responsibility for decisions: **TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities.

APPENDIX D: Proceedings of Preliminary Meeting of NCRC

1. The preliminary Meeting of National Curriculum Revision Committee (NCRC) was held on March 02-04, 2022, at University of Engineering and Technology (UET), Taxila.

2. Welcome session started with recitation of the Holy Quran. The session was chaired by Engr. Prof. Dr. Inayat Ullah Khan, Vice Chancellor, UET Taxila. The Vice Chancellor elaborated importance of curriculum development for engineering technology programs, keeping a sharp focus on practical aspects so that it is futuristic, market-demand driven, addresses societal needs, is aligned with NTC, is aligned with HEC undergraduate policy, and substantially follows guidelines of the Sydney Accord.

3. Mr. Hafiz Ghulam Muhammad represented NTC. He highlighted the agenda of this meeting, and general procedure to be followed in the Meeting.

4. In the second session, Engr. Prof. Dr. Inayat Ullah Khan explained the procedure and execution of agenda in the NCRC. Then he invited the Members to nominate a Convener, a Co-Convener, and a Secretary of the NCRC. After discussion, the Members nominated Engr. Prof. Dr. Syed Mushahid Hussain Hashmi as Convenor, Engr. Prof. Dr. Shahid Maqsood as Co-Convener, and Dr. Muhammad Shehryar Manzoor as Secretary.
   The following nominated members represented various HEIs in the NCRC for Bachelor of Automotive Engineering Technology.

Sr.	NCRC Members	Role
1	Prof. Dr. Syed Mushahid Hussain Hashmi NED University of Engineering and Technology, Karachi.	Convener
2	Prof. Dr. Shahid Maqsood University of Engineering and Technology, Peshawar.	Co- Convener
3	Dr. Muhammad Shehryar Manzoor University of Engineering and Technology, Taxila.	Secretary
4	Prof. Dr. Abdul Aziz Mazhar Institute of Space Technology, Islamabad.	Member
5	Prof. Dr. Sheikh Kamran Afaq HITEC University, Taxila.	Member
6	Prof. Dr. Riffat Asim Pasha University of Engineering and Technology, Taxila.	Member
7	Prof. Dr. Shahab Khushnood Wah Engineering College.	Member

Sr.	NCRC Members	Role
8	Dr. Jawad Aslam SMME, National University of Science and Technology.	Member
9	Prof. Dr. Shahid Khalil National Skills University Islamabad.	Member
10	Dr. Mumtaz Ahmed Qaisrani Khwaja Fareed University of Engineering and Information Technology, Rahim Yar Khan.	Member
11	Dr. Alamgir Akhtar Khan Muhammad Nawaz Shareef University of Agriculture, Multan.	Member
12	Prof. Dr. Abdul Shakoor University of Engineering and Technology, Peshawar.	Member
13	Dr. Ali Hussain Kazim University of Engineering and Technology, Lahore.	Member
14	Engr. Ayaz Ali Mandan Benazir Bhutto Shaheed University of Technology and Skill Development, Khairpur Mirs.	Member
15	Dr. Syed Ali Raza Shah Baluchistan University of Engineering and Technology, Khuzdar.	Member
16	Prof. Dr. Muzaffar Ali University of Engineering and Technology, Taxila.	Member
17	Dr. Abid Hussain University of Engineering and Technology, Taxila.	Member

5. The Convenor, Engr. Prof. Dr. Syed Mushahid Hussain Hashmi, chaired the meeting and emphasized developing a curriculum that reflects the Sydney Accord, and provides a unified framework for degrees under the title “Bachelor of Automotive Engineering Technology”.

6. Once objectives were agreed upon, these were assigned to Subcommittees that reviewed, discussed, and submitted the following resolutions:

    a. to develop a curriculum at par with international standards.
    b. to define PEOs, PLOs, CLOs, along with Taxonomy levels, course contents, and assessment criteria (formative and summative), aligned with undergraduate programs for each course.

c. to suggest latest books, and other reading and reference materials (local and international) for each course.
d. to devise course contents that are uniform across other disciplines and avoid overlapping.
e. to ensure that curriculum is futuristic and addresses the needs of society.
f. To recommend intake criteria for this program.

7. In the next session, Members discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction, learning environment, assessment, and operational framework.

8. After long deliberations, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses, and weightage of theory vs practicals of the Bachelor of Automotive Engineering Technology program.

9. Furthermore, the list of courses (core and elective), and semester-wise breakup of courses were finalized.

10. Admissions and intake criteria were discussed; it was decided to adopt admission criteria defined in NTC's "Accreditation and Procedure Manual for Engineering and Other Technologies".

11. Supervised Industrial Training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for the 8th Semester, and optional for 7th Semester, depending on the capacity of the HEI.

12. In line with the experience and expertise of NCRC Members, courses of various domains were distributed among Sub-Committees.

    a. These Sub-Committees were assigned responsibility to define PEOs, PLOs, CLOs, along with Taxonomy levels, course contents, and assessment criteria (formative and summative), aligned with other undergraduate programs for each course.
    b. to suggest the latest books, and other reading and reference materials (local and international) for each course.

13. The following groups were constituted with separate Convenors and Secretaries:

List of Groups for curriculum desig

Curriculum Design Committee (CDC) **Subject Groups**		
Group-I: Automotive		
Name	**Designation**	**Role**
Prof. Dr. Mushahid Hussain Hashmi	Professor	Convener
Dr. Muhammad Shehryar Manzoor	Associate Professor	Co-Convener
Dr. Jawad Aslam	Assistant Professor	Secretary
Group II: Solid Mechanics		
Name	**Designation**	**Role**
Prof. Dr. Riffat Asim Pasha	Professor	Convener

Prof. Dr. Abdul Shakoor	Professor	Member
Prof. Dr. Kamran Afaq	Professor	Member
Prof. Dr. Abdul Aziz Mazhar	Professor	Member
Dr. Abid Hussain	Assistant Professor	Secretary
Group III: Thermo-fluids		
Name	**Designation**	**Role**
Prof. Dr. Shahab Khushnood	Professor	Convener
Prof. Dr. Muzaffar Ali	Professor	Co- Convener
Dr. Ali Hussain Kazim	Associate Professor	Member
Dr. Mumtaz Ahmed Qaisrani	Assistant Professor	Secretary
Group IV: Pneumatics and Hydraulics		
Name	**Designation**	**Role**
Prof. Dr. Shahid Masood	Professor	Convener
Dr. Jawad Aslam	Assistant Professor	Secretary
Group V: Quality / Management Sciences		
Name	**Designation**	**Role**
Dr. Syed Ali Raza Shah	Dean	Convener
Dr. Alamgir Akhtar Khan	Associate Professor	Co- Convener
Prof. Dr. Shahid Khalil	Professor	Member
Engr. Ayaz Ali Mandan	HoD	Secretary
Note : Each group has also the mandate to recommend the electives subjects in their respective groups		

14. After conclusion of the Preliminary Meeting, the Groups submitted the proposed course contents for theory and labs, along with PEOs, PLOs, and CLOs, list of recommended books, list of experiments for each course.

15. The first draft was compiled by Dr. Muhammad Shehryar Manzoor, Secretary NCRC, and distributed to Members for review.

APPENDIX E: Minutes of Final NCRC Meeting

1. The Final Meeting of the NCRC was held on 23-05-2022 to 25-05-2022 at the Superior University, Lahore.
2. The inauguration session was started with recitation of Holy Quran, and chaired by Honorable Chairman NTC, Engr. Prof. Imtiaz Hussain Gilani. He appreciated the efforts put in by Members and applauded their valuable contribution for a national cause in setting standards for quality-education in Automotive Engineering Technology. The Chair NCRC also extended his gratitude to Members, and briefed them of the objectives, and arrangements for the Final Meeting of NCRC.

3. Mr. Hafiz Ghulam Muhammad represented NTC.

The following Members attended the meeting:

Sr.	NCRC Members	Role
1	Prof. Dr. Syed Mushahid Hussain Hashmi NED University of Engineering and Technology, Karachi.	Convener
2	Prof. Dr. Shahid Maqsood University of Engineering and Technology, Peshawar-KPK.	Co- Convener
3	Dr. Muhammad Shehryar Manzoor University of Engineering and Technology, Taxila.	Secretary
4	Prof. Dr. Abdul Aziz Mazhar Institute of Space Technology, Islamabad.	Member
5	Prof. Dr. Sheikh Kamran Afaq HITEC University, Taxila.	Member
6	Prof. Dr. Riffat Asim Pasha University of Engineering and Technology, Taxila.	Member
7	Prof. Dr. Shahab Khushnood Wah Engineering College.	Member
8	Dr. Jawad Aslam SMME, National University of Science and Technology.	Member
9	Prof. Dr. Shahid Khalil National Skills University Islamabad.	Member
10	Dr. Mumtaz Ahmed Qaisrani Khwaja Fareed University of Engineering and Information Technology, RahimYar Khan.	Member

Sr.	NCRC Members	Role
11	Dr. Alamgir Akhtar Khan Muhammad Nawaz Shareef University of Agriculture, Multan.	Member
12	Prof. Dr. Abdul Shakoor University of Engineering and Technology, Peshawar.	Member
13	Dr. Ali Hussain Kazim University of Engineering and Technology, Lahore-Punjab.	Member
14	Engr. Ayaz Ali Mandan Benazir Bhutto Shaheed University of Technology and Skill Development, Khairpur Mirs.	Member
15	Dr. Syed Ali Raza Shah Balochistan University of Engineering and Technology, Khuzdar.	Member
16	Prof. Dr. Muzaffar Ali University of Engineering and Technology, Taxila.	Member
17	Dr. Abid Hussain University of Engineering and Technology, Taxila.	Member

4. After the introductory session, deliberations on the agenda of the second meeting formally commenced which was headed by Convener Engr. Prof. Dr. Syed Mushahid Hussain Hashmi, Co-Convener Engr. Prof. Dr. Shahid Maqsood, and Secretary Dr. Muhammad Shehryar Manzoor.

5. Various issues were deliberated upon by Members of NCRC in Sub-Committees, and finalized the following:

    a. Curriculum preface, mission, vision, preamble, rationale, scope, course scheme etc.
    b. Bench marking of Recommended Scheme of Studies, Engineering Technology domain and non-Engineering Technology domain courses, in consonance with framework and list of Electives as defined earlier.
    c. Approved semester-wise break-up of courses, credit hours, and allocation of Breadth and Depth courses.
    d. Recommended sample course profiles and contents.
    e. Recommended sample weekly lecture plan and laboratory work for Foundation and Breath courses.

6. The final draft was compiled by Secretary Dr. Muhammad Shehryar Manzoor.

7. After review by Members, and with the approval of Convener Engr. Prof. Dr. Syed Mushahid Hussain Hashmi and Co-Convener Engr. Prof. Dr. Shahid Maqsood, it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

Student Details:
Name:
Roll Number:
Address:
Email:

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

On-the-job Trainer Name:
On-the-job Trainer Contact Number:

Daily Training Log

Please specify training information by descriptive statements, tables, sketches, figures, photographs, and so forth. Feel free to incorporate attachments wherever necessary.

Training Week: _____

Date	Time	Training Log

Declaration:

I, _____ Roll Number_____, do hereby declare that all information provided above is true and correct to the best of my knowledge.

_____
Student signature with date

_____ _____
Organization Supervisor signature with date HEI Coordinator signature & date

APPENDIX G: Supervised Industrial Training Report Sample Format

Sample table of content for supervised industrial training report is provided so that students can develop an understanding of what is expected of them when making the submission. Students are encouraged to expand upon the content presented below. A declaration page validating the originality of work duly signed by the student and the trainee is also to be attached at the beginning of the submitted report.