CURRICULUM

OF

BS ELECTRONICS

(Revised 2024)



Department of Electronics
University of Peshawar

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Introduction

Electronics is an important discipline that finds its use in many applications. Continual advances in electronics in the areas of materials, processes, signal processing, devices and circuits have been leading to rapid advances in the existing applications of electronics as well as in the emergence of new applications. To harness the full potential of developments in electronics and further advance the technologies related to electronics, it is important to have strong BS Electronics program to educate and train individuals in this key discipline of science. Keeping in mind the overall objectives to be achieved through this program of study, the curriculum of BS Electronics has been developed.

Learning Objectives:

The curriculum is designed to enable the students to learn, understand, and apply the fundamental and advanced concepts of electronics. This curriculum should be taught in such a manner that it produces scientists with sufficient hands-on skills and problem-solving mindset, to contribute effectively to the profession. To derive the maximum benefits from this curriculum, the students should be provided ample opportunities to polish their communication skills, exhibit ethical behavior and effective leadership, and prepare themselves to be a responsible professional of the society.

Expected Outcomes:

Following the Outcome Based Education (OBE) approach and focusing on the learning of the students, the proposed curriculum has been designed to produce graduates with the following attributes and outcomes:

Learning Outcome 1 – Knowledge: Ability to apply knowledge of mathematics and sciences in the field of electronics.

Learning Outcome 2 – Analysis: Ability to identify scientific problems, as well as to analyze and interpret data

Learning Outcome 3 – Design and Problem Solving: Ability to formulate or design electronic systems as well as to solve problems related to the discipline

Learning Outcome 4 – Technical Skills: Ability to use the techniques, skills, and modern scientific tools necessary for professional practice

Learning Outcome 5 – Teamwork: Ability to function effectively in multidisciplinary teams

Learning Outcome 6 – Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities

Learning Outcome 7 – Communication Skills: Ability to communicate effectively both verbally and in writing

Learning Outcome 8 – Impact on Society: Ability to understand the impact of scientific solutions in a global and societal context

Learning Outcome 9 – Lifelong Learning: Ability to recognize importance and engagement in lifelong learning

Learning Outcome 10 – Leadership: Ability to demonstrate effective leadership and decision-making skills.

Curriculum Revision of BS Electronics Degree

The curriculum for the BS Electronics Degree is revised under the HEC Undergraduate Education Policy (Version 1.1) effective from Fall 2023.

As per HEC Undergraduate Education Policy (Version 1.1) effective from Fall 2023, an Undergraduate Degree Program with a Single Major is focused on one disciplinary specialization and comprises a minimum of 124 credit hours including the requirements of field experience/internship and capstone project.

The breakup of credit hours is as follows:
i. General Education (Gen Ed) courses: 34 credit hours
ii. Major (Disciplinary): minimum 72 credit hours
iii. Interdisciplinary/Allied courses: minimum 12 credit hours
iv. Field Experience/Internship: 3 credit hours
v. Capstone Project: 3 credit hours

General Education Courses: All the undergraduate/equivalent degree programs shall be comprised of a mandatory set of 34 credit hours for general education courses as prescribed in this policy.

Field Experience/Internship: The field experience of six to eight weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field. This is a mandatory degree award requirement of 3 credit hours for all undergraduate/equivalent degree programs.

Capstone Project: The capstone project (preferably undertaken after the fourth semester) must be supervised and graded by a faculty member as per the protocols prescribed by the department concerned. This is a mandatory degree award requirement of 3 credit hours for all undergraduate/equivalent degree programs.

The standard prescribed range to qualify for the Undergraduate Degree is 124-148 credit hours with a normal range of 15-18 credit hours in each semester. The university may however offer maximum of 21 credit hours in a semester where there is a program specific requirement of the same provided that the total number of credit hours for the Undergraduate Degree program with a Single Major must not exceed beyond 148 credit hours.

The detail of Revised BS Electronics Degree Program is given below.

Duration:

Total duration:	Four (4) calendar years
Total number of semesters:	Eight (8)
Duration of a semester:	Sixteen (16) to eighteen (18) weeks

Credit Hours:

The breakup of credit hours of BS Electronics Degree is as under:

No.	Course Category	CR
1	General Education (Gen Ed)	34
2	Major (Disciplinary)	84 / 88
3	Interdisciplinary/Allied	15
4	Field Experience/Internship	3
5	Final Year Design Project (Capstone Project)	3
Total		**139 / 143**

Non-Credit Courses:

Two non-credit courses of Mathematics, i.e., Pre-Calculus – I and Pre-Calculus – II of 3 credit hours each, will be offered to those students who have not studied Mathematics at HSSC/Equivalent level. These courses should be completed in the first year after admission, i.e., within the first two semesters.

Breakup of Credit Hours of BS Electronics Degree

No.	Course Code	Course Title	Lec	Lab	CR
General Education (Gen Ed) Courses					
1		Arts and Humanities	2	0	2
2		Natural Sciences	2	1	3
3		Social Sciences	2	0	2
4		Functional English	3	0	3
5		Introduction to Expository Writing	3	0	3
6	MATH-103	Quantitative Reasoning – I	3	0	3
7	STAT-101	Quantitative Reasoning – II	3	0	3
8	ISL-101	Islamic Studies (OR) Religious Education/Ethics	2	0	2
9	PST-231	Ideology and Constitution of Pakistan	2	0	2
10	CS-101	Applications of Information and Communication Technologies (ICT)	2	1	3
11	BA-441	Entrepreneurship	2	0	2
12	GEC-242	Civics and Community Engagement	2	0	2
13	PST-121	Pakistan Studies	2	0	2
14	ISL-102	Fehm-e-Quran – I	0	1	1
15	ISL-109	Fehm-e-Quran – II	0	1	1
		General Education Total	**30**	**4**	**34**

No.	Course Code	Course Title	Lec	Lab	CR
Major (Disciplinary) Courses					
1	ELEC-111	Circuit Theory – I	3	1	4
2	ELEC-112	Solid State Electronics	3	0	3
3	ELEC-201	Basic Electronics	3	1	4
4	ELEC-202	Circuit Theory – II	3	1	4
5	ELEC-203	Computer Programming	2	1	3
6	ELEC-211	Signals and Systems	3	1	4
7	ELEC-212	Digital Logic Design	3	1	4
8	ELEC-301	Electronic Circuit Design	3	1	4
9	ELEC-302	Microprocessor System Design	3	1	4
10	ELEC-303	Instrumentation and Measurements	3	1	4
11	ELEC-304	Linear Control Systems	3	1	4
12	ELEC-311	Electromagnetic Field Theory	3	0	3

13	ELEC-312	Communication Systems	3	1	4
14	ELEC-313	Integrated Circuits	3	0	3
15	ELEC-314	Embedded System Design	3	1	4
16	ELEC-315	Power Electronics	3	1	4
17	ELEC-401	Data Communication and Networks	3	1	4
18	ELEC-402	Digital Signal Processing	3	1	4
19	ELEC-XXX	Elective – I	3	0 / 1	3 / 4
20	ELEC-XXX	Elective – II	3	0 / 1	3 / 4
21	ELEC-411	Microwave Electronics	3	1	4
22	ELEC-XXX	Elective – III	3	0 / 1	3 / 4
23	ELEC-XXX	Elective – IV	3	0 / 1	3 / 4
		Major (Disciplinary) Total	**68**	**16/20**	**84/88**

No.	Course Code	Course Title	Lec	Lab	CR
Interdisciplinary/Allied Courses					
1	MATH-131	Calculus and Analytical Geometry	3	0	3
2	MATH-231	Differential Equations	3	0	3
3	MATH-232	Complex Variables and Transforms	3	0	3
4	STAT-203	Probability and Probability Distributions – I	3	0	3
5	MATH-224	Linear Algebra	3	0	3
		Interdisciplinary/Allied Total	**15**	**0**	**15**

No.	Course Code	Course Title	Lec	Lab	CR
Field Experience/Internship					
1	ELEC-403	Field Experience/Internship	0	3	3

No.	Course Code	Course Title	Lec	Lab	CR
Final Year Design Project (Capstone Project)					
1	ELEC-412	Final Year Design Project	0	3	3

Lists of General Education Courses from Arts and Humanities, Natural Sciences and Social Sciences

No.	Course Code	Course Title	Lec	Lab	CR
List of Courses from Arts and Humanities					
1	Phil-311	An Introduction to Philosophy (Department of Philosophy)	2	0	2
2	Phil-321	Logic – I (Department of Philosophy)	2	0	2
3	AH-101	Fables, Wisdom Literature, and Epic	2	0	2
4	HIST-106	Introduction to History (Department of History)	2	0	2
Any other approved course of the University of Peshawar from Arts and Humanities.					

No.	Course Code	Course Title	Lec	Lab	CR
List of Courses from Natural Sciences					
1	PHYS-109	Applied Physics (Department of Physics)	2	1	3
Any other approved course of the University of Peshawar from Natural Sciences.					

No.	Course Code	Course Title	Lec	Lab	CR
List of Courses from Social Sciences					
1	PSY-114	Introduction to Psychology – I (Department of Psychology)	2	0	2
2	PSY-245	Introduction to Social Psychology (Department of Psychology)	2	0	2
3	ECON-311	Principles of Microeconomics (Department of Economics)	2	0	2
4	ECON-321	Principles of Macroeconomics (Department of Economics)	2	0	2
5	ECON-432	Intermediate Microeconomics (Department of Economics)	2	0	2
6	ECON-442	Intermediate Macroeconomics (Department of Economics)	2	0	2
7	BA-322	Management (Institute of Management Studies)	2	0	2
8	BA-324	Principles of Marketing (Institute of Management Studies)	2	0	2
9	SOC-111	Introduction to Sociology (Department of Sociology)	2	0	2

10	SW-682	Project Planning and Management (Department of Social Work)	2	0	2
Any other approved course of the University of Peshawar from Social Sciences.					

Scheme of Studies for BS Electronics Degree

No.	Course Code	Course Title	Category	Lec	Lab	CR
FIRST YEAR						
FIRST SEMESTER						
1	MATH-131	Calculus and Analytical Geometry	Int. Disc.	3	0	3
2		Functional English	Gen. Ed.	3	0	3
3	CS-101	Applications of Information and Communication Technologies (ICT)	Gen. Ed.	2	1	3
4		Course from Natural Sciences	Gen. Ed.	2	1	3
5	MATH-103	Quantitative Reasoning – I	Gen. Ed.	3	0	3
6	ISL-101	Islamic Studies (OR) Religious Education/Ethics	Gen. Ed.	2	0	2
		Semester Total		15	2	17
SECOND SEMESTER						
1	ELEC-111	Circuit Theory – I	Major	3	1	4
2	ELEC-112	Solid State Electronics	Major	3	0	3
3	MATH-231	Differential Equations	Int. Disc.	3	0	3
4		Introduction to Expository Writing	Gen. Ed.	3	0	3
5	STAT-101	Quantitative Reasoning – II	Gen. Ed.	3	0	3
6	PST-231	Ideology and Constitution of Pakistan	Gen. Ed.	2	0	2
		Semester Total		17	1	18
		First Year Credit Hours		**32**	**3**	**35**

No.	Course Code	Course Title	Category	Lec	Lab	CR
SECOND YEAR						
THIRD SEMESTER						
1	ELEC-201	Basic Electronics	Major	3	1	4
2	ELEC-202	Circuit Theory – II	Major	3	1	4
3	ELEC-203	Computer Programming	Major	2	1	3
4	MATH-232	Complex Variables and Transforms	Int. Disc.	3	0	3
5		Course from Social Sciences	Gen. Ed.	2	0	2
6	ISL-102	Fehm-e-Quran – I	Gen. Ed.	0	1	1
		Semester Total		13	4	17

FOURTH SEMESTER						
1	ELEC-211	Signals and Systems	Major	3	1	4
2	ELEC-212	Digital Logic Design	Major	3	1	4
3		Course from Arts and Humanities	Gen. Ed.	2	0	2
4	BA-441	Entrepreneurship	Gen. Ed.	2	0	2
5	GEC-242	Civics and Community Engagement	Gen. Ed.	2	0	2
6	ISL-109	Fehm-e-Quran – II	Gen. Ed.	0	1	1
7	PST-121	Pakistan Studies	Gen. Ed.	2	0	2
		Semester Total		14	3	17
		Second Year Credit Hours		**27**	**7**	**34**

No.	Course Code	Course Title	Category	Lec	Lab	CR
THIRD YEAR						
FIFTH SEMESTER						
1	ELEC-301	Electronic Circuit Design	Major	3	1	4
2	ELEC-302	Microprocessor System Design	Major	3	1	4
3	ELEC-303	Instrumentation and Measurements	Major	3	1	4
4	ELEC-304	Linear Control Systems	Major	3	1	4
5	STAT-203	Probability and Probability Distributions – I	Int. Disc.	3	0	3
		Semester Total		15	4	19

SIXTH SEMESTER						
1	ELEC-311	Electromagnetic Field Theory	Major	3	0	3
2	ELEC-312	Communication Systems	Major	3	1	4
3	ELEC-313	Integrated Circuits	Major	3	0	3
4	ELEC-314	Embedded System Design	Major	3	1	4
5	ELEC-315	Power Electronics	Major	3	1	4
6	MATH-224	Linear Algebra	Int. Disc.	3	0	3
		Semester Total		18	3	21
		Third Year Credit Hours		**33**	**7**	**40**

No.	Course Code	Course Title	Category	Lec	Lab	CR
FOURTH YEAR						
SEVENTH SEMESTER						
1	ELEC-401	Data Communication and Networks	Major	3	1	4
2	ELEC-402	Digital Signal Processing	Major	3	1	4
3	ELEC-XXX	Elective – I	Major	3	0 / 1	3 / 4
4	ELEC-XXX	Elective – II	Major	3	0 / 1	3 / 4
5	ELEC-403	Field Experience/Internship		0	3	3
		Semester Total		12	5 / 7	17/19

EIGHTH SEMESTER						
1	ELEC-411	Microwave Electronics	Major	3	1	4
2	ELEC-XXX	Elective – III	Major	3	0 / 1	3 / 4
3	ELEC-XXX	Elective – IV	Major	3	0 / 1	3 / 4
4	ELEC-412	Final Year Design Project		0	3	3
		Semester Total		9	4 / 6	13/15
		Final Year Credit Hours		**21**	**9/13**	**30/34**
		Total Program Credit Hours		**113**	**26/30**	**139/143**

BS Electronics Elective Courses

No.	Course Code	Course Title	Lec	Lab	CR
Major (Disciplinary) Elective Courses					
1	ELEC-404	VLSI Design	3	1	4
2	ELEC-405	Industrial Electronics	3	1	4
3	ELEC-406	Introduction to Robotics	3	1	4
4	ELEC-407	Industrial Automation	3	1	4
5	ELEC-408	Optoelectronics	3	0	3
6	ELEC-409	Laser and Fiber Optics	3	0	3
7	ELEC-410	Advance Computer Programming	3	1	4
8	ELEC-413	Optical Communication Systems	3	0	3
9	ELEC-414	Biomedical Instrumentation	3	1	4
10	ELEC-415	Nanotechnology	3	0	3
11	ELEC-416	Linear Integrated Circuits	3	1	4
12	ELEC-417	Antennas and Wave Propagation	3	0	3
13	ELEC-418	Transmission Lines and Antennas	3	0	3
14	ELEC-419	Artificial Intelligence	3	0	3
15	ELEC-420	Pattern Recognition	3	1	4
16	ELEC-421	Digital Image Processing	3	1	4
17	ELEC-422	Information and Coding Theory	3	0	3
18	ELEC-423	Wireless Communication	3	0	3
19	ELEC-424	Satellite Communication	3	0	3
20	ELEC-425	Renewable Energy	3	0	3

DETAIL OF BS ELECTRONICS COURSES
First Semester

Course Name: **Calculus and Analytical Geometry**
Credit hours: 3 (3+0)
Course Code: MATH-131
Prerequisites: None

Course Objectives:
This course is designed to teach the concepts of Calculus and Analytic Geometry, and the Applications of these concepts to the solution of Engineering Problems.

Course Content:
Introduction to Functions, Introduction to Limits, Derivatives and their Applications, Integral Calculus with Applications, Vector Algebra, Vector Calculus, Introduction to Analytical Geometry, Straight Line in R3 Planes, Cylindrical and Spherical Coordinates, Surfaces, Cylinders and Cones, Spheres, Spherical Trigonometry.

Recommended Books:
1. George B. Thomas and Ross L. Finney, "Calculus and Analytic Geometry," 9th Edition, Addison-Wesley, 1995.
2. George F. Simmons, "Calculus with Analytic Geometry," 2nd Edition, McGraw-Hill, 1996.
3. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, "Calculus," 3rd Edition, Pearson Education, 2002.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, "Thomas' Calculus," 12th Edition, Pearson Education, 2014.

Course Title: **Functional English**
Credit hours: 3 (3+0)
Prerequisites: None

Course Objectives:
To enhance language skills and develop critical thinking.

Course Content:
Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling.

Recommended Books:
1. A. J. Thomson and A. V. Martinet, "A Practical English Grammar," Exercises 1 and 2, 4th Edition, Oxford University Press, 1986.
2. M.-C. Boutin, S. Brinand and F. Grellet, "Writing: Intermediate," Oxford Supplementary Skills, Pages 20-27 and 35-41, Fourth Impression, Oxford University Press, 1993.

3. B. Tomlinson and R. Ellis, “Reading: Upper-Intermediate,” Oxford Supplementary Skills, Third Impression, Oxford University Press, 1992.

Course Name: Applications of Information and Communication Technologies (ICT)

Credit hours: 3 (2+1)
Course Code: CS-101
Prerequisites: None

Course Objectives:

Main objective of the course is to build an appreciation for the fundamental concepts in computing and to become familiar with PC productivity software.

Course Content:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computers, Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft-Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex. Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Common Services available on Internet, Introduction to MS Word, MS Excel, MS PowerPoint.

Recommended Books:

1. J. Campbell, M. Ciampa, S. Freund, M. Frydenberg and S. Sebok, “Discovering Computers: Digital Technology, Data, and Devices,” 17th Edition, Cengage Learning, 2022.
2. P. K. Sinha and P. Sinha, “Computer Fundamentals,” 8th Edition, BPB Publications, 2020.
3. B. K. Williams and S. C. Sawyer, “Using Information Technology: A Practical Introduction to Computers & Communications,” 11th, McGraw-Hill Education, 2015.
4. T. O’Leary, L. O’Leary and D. O’Leary, “Computing Essentials 2024,” 29th Edition, McGraw-Hill Education, 2023.

5. K. Wilson, “Computer Fundamentals: The Step-by-step Guide to Understanding Computers,” Elluminet Press, 2021.
6. J. Cox and J. Lambert, “Microsoft Word 2010 step by step,” Microsoft Press, 2010
7. N. Muir, “Microsoft PowerPoint 2013 Plain & Simple,” Microsoft Press, 2013.
8. C. Frye, “Microsoft Excel 2010 Step by Step,” Microsoft Press, 2010.
9. M. Vermaat, E. Monk, S. Sebok, S. Freund, S. Cable, J. Starks, “Shelly Cashman Series Microsoft Office 365 & Office 2019 Introductory,” Cengage, 2019.

Course Name: **Quantitative Reasoning – I**

Credit hours: 3 (3+0)
Course Code: MATH-103
Prerequisites: None

Course Objectives:

Since ancient times, numbers, quantification, and mathematics have played a central role in scientific and technological development. In the 21st century Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues an individual now faces in daily life. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to the importance of mathematical skills in different professional settings, social and natural sciences. These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities.

Course Content:

Numbers & the Universe: Understanding our World through numbers, dealing with very big and small numbers & their applications, Understanding uncertainty and its applications.
Financial Issues: Money management (profit, loss, discount, zakat, simple interest, compound interest and taxation), Money management in practical life scenarios like investments and federal budget.
Exploring Expressions: Practical scenarios involving expressions, equating two expressions in one variable & using it to solve practical problems, Social and economic problems involving expressions.
Sets and Venn diagrams: Practical scenarios involving sets and Venn diagrams, Ven diagrams and their applications in different disciplines.
Exploring Graphical Information: Investigating relationships between variables, exploring tools to find relationship between variables, Resources and population growth, Dealing with Economical, environmental and social issues.
Building blocks of a plane: Graphical and analytical approaches to solve a problem, Applications of graphical & analytical approaches in social & economic problems.
Exploring inequalities: Understanding inequalities around us, dealing with

practical problems involving inequalities in different disciplines.
Comparing quantities: Golden ratio in sculptures, Comparison of statements and their use in social and economic problems, Number patterns and their applications.

Recommended Books:

1. J. Bennett and W. Briggs, "Using and Understanding Mathematics: A Quantitative Reasoning Approach," 7th Edition, Pearson, 2018.
2. R. F. Blitzer, "Precalculus," 7th Edition, Pearson, 2021.
3. R. N. Aufmann, J. Lockwood, R. D. Nation and D. K. Clegg, "Mathematical Thinking and Quantitative Reasoning," Brooks Cole, 2007.
4. F. Demana, B. Waits, G. Foley, D. Kennedy and D. Bock, "Precalculus Graphical, Numerical, Algebraic," 10th Edition, Pearson, 2018.
5. J. Stewart, L. Redlin and S. Watson, "Precalculus: Mathematics for Calculus," 7th Edition, Cengage Learning, 2015.
6. GRE Math Review, https://www.ets.org/s/gre/pdf/gre_math_review.pdf
7. OpenAlgebra.com, A free math study guide with notes and YouTube video tutorials.

Course Name: Islamic Studies/Religious Education/Ethics

Credit hours: 2 (2+0)
Course Code: ISL-101
Prerequisites: None

Course Objectives:

To provide Basic information about Islamic Studies, to enhance understanding of the students regarding Islamic Civilization, to improve Students skill to perform prayers and other worships, to enhance the skill of the students for understanding of issues related to faith and religious life.

Course Content:

Introduction to Quranic Studies, Basic Concepts of Quran, History of Quran, Uloom-ul –Quran, Study of Selected Text of Holly Quran, Verses of Surah Al-Baqara Related to Faith (Verse No-284-286), Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18), Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11), Verses of Surah al- Furqan Related to Social Ethics (Verse No.63-77), Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154), Study of Selected Text of Holly Quran Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.), Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment, Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14), Seerat of Holy Prophet (S.A.W), Life of Muhammad Bin Abdullah (Before Prophet Hood), Life of Holy Prophet (S.A.W) in Makkah, Important Lessons derived from the life of Holy Prophet in Makkah, Seerat of Holy Prophet (S.A.W), Life of Holy Prophet (S.A.W) in Madina, Important Events of Life of Holy Prophet in Madina, Important Lessons derived from the life of Holy Prophet in Madina. Introduction To Sunnah, Basic Concepts of Hadith, History of Hadith, Kinds of Hadith, Uloom-ul-Hadith, Sunnah & Hadith, Legal

Position of Sunnah, Selected Study from Text of Hadith, Introduction to Islamic Law & Jurisprudence, Basic Concepts of Islamic Law & Jurisprudence, History & Importance of Islamic Law & Jurisprudence, Sources of Islamic Law & Jurisprudence, Nature of Differences in Islamic Law, Islam and Sectarianism. Islamic Culture & Civilization, Basic Concepts of Islamic Culture & Civilization, Historical Development of Islamic Culture & Civilization, Characteristics of Islamic Culture & Civilization, Islamic Culture & Civilization and Contemporary Issues, Islam & Science, Basic Concepts of Islam & Science, Contributions of Muslims in the Development of Science, Quran & Science, Islamic Economic System, Basic Concepts of Islamic Economic System, Means of Distribution of wealth in Islamic Economics, Islamic Concept of Riba, Islamic Ways of Trade & Commerce. Political System of Islam, Basic Concepts of Islamic Political System, Islamic Concept of Sovereignty, Basic Institutions of Govt. in Islam, Islamic History, Period of Khlaft-E-Rashida, Period of Ummayyads, Period of Abbasids, Social System of Islam, Basic Concepts of Social System of Islam, Elements of Family, Ethical Values of Islam.

Recommended Books:

1. M. Hamidullah, “The Emergence of Islam,” Islamic Research Institute, International Islamic University, Islamabad, 1993.
2. M. Hamidullah, “The Muslim Conduct of State,” Islamic Book Trust, Kuala Lumpur, 2012.
3. M. Hamidullah, “Introduction to Islam,” Apex, 1980.
4. H. H. Ḥassān, “An Introduction to the Study of Islamic Law,” Adam, 2010.
5. A. Hasan, “Principles of Islamic Jurisprudence,” Islamic Research Institute, International Islamic University, Islamabad, 1993.
6. M. W. Ullah, Z. Shah, “Muslim Jurisprudence and the Quranic Law of Crimes,” Peace Publication, 2016.
7. H. S. Bhatia, “Studies in Islamic Law, Religion and Society,” Deep & Deep Publications, New Delhi, 1989.
8. M. Zia-ul-Haq, “Introduction to Al Sharia Al Islamia,” Allama Iqbal Open University, Islamabad, 2001.

Second Semester

Course Name: **Circuit Theory – I**
Credit hours: 4 (3+1)
Course Code: ELEC-111
Prerequisites: None

Course Objectives:
To provide a comprehensive understanding of fundamental principles, analysis techniques, and applications in electrical engineering, spanning from basic circuit elements and laws to advanced topics in AC circuit analysis and operational amplifier circuits. This course is so designed that if taught properly, it will produce scientists with problem-solving mindset, to contribute effectively to the profession. Furthermore, the labs are designed in such a way that the students get hands-on skills in analyzing and designing basic electric circuits and become capable enough to do a culminating mini project. In this course, the students have the option to use MATLAB to conduct some of the experiments and analyze data.

Course Content:
Basic Concepts of Charge, Current, Voltage, Power, Energy and Circuit Elements. Basic Laws: Ohm's law, Nodes, branches, loops, Kirchhoff's laws, Series Resistors and Voltage Division, Parallel Resistors and Current Division, Wye-Delta transformations. Analysis Methods: Nodal and Mesh. Circuit Theorems: Superposition, Source Transformation, Thevenin's, Norton's, Maximum Power Transfer. Operational Amplifiers: Basic Introduction, Ideal Op-Amp, Inverting and Non-Inverting Amplifiers, Summing and Difference Amplifiers, Cascaded Op-Amp Circuits. Capacitors and Inductors: Series and Parallel Connections of Capacitors, Inductors, Series and Parallel Connections of Inductors. Sinusoids and Phasors: Sinusoids, Phasors, Phasor Relationships for Circuit Elements, Impedance and Admittance, Kirchhoff's Laws in the Frequency Domain, Impedance Combinations. Sinusoidal Steady-State Analysis: Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformation, Thevenin's and Norton's Equivalent Circuits, Op Amp AC Circuits. AC Power Analysis: Instantaneous and Average Power, Maximum Average Power Transfer, Effective or RMS Value, Apparent Power and Power Factor, Complex Power, Conservation of AC Power, Power Factor Correction. Frequency Response: Transfer Function, The Decibel Scale, Bode Plots, Series Resonance, Parallel Resonance, Passive Filters, Active Filters.

Lab Outline:
Lab content should be in accordance with the course outlines.

Recommended Books:

1. C. K. Alexander and M. N. O. Sadiku, "Fundamentals of Electric Circuits," 7th Edition, McGraw-Hill, 2021.
2. W. H. Hayt, J. Kemmerly and S. M. Durbin, "Engineering Circuit Analysis," 10th Edition, McGraw-Hill, 2023.

3. J. D. Irwin and R. M. Nelms, “Basic Engineering Circuit Analysis,” 12th Edition, John Wiley & Sons, 2020.
4. R. L. Boylestad, B. A. Olivari, “Introductory Circuit Analysis,” 14th Edition, Pearson, 2024.

Course Name: **Solid State Electronics**

Credit hours: 3 (3+0)
Course Code: ELEC-112
Prerequisites: None

Course Objectives:

To teach fundamental concepts of solid-state Physics, Quantum mechanics and quantum effects. To impart knowledge of semiconductor materials and their devices. To understand the electrical behavior of semiconductor devices under varying excitation conditions.

Course Content:

Semiconductor crystal lattices, planes and directions. Introduction to Quantum Mechanics, Schrodinger’s wave equation, electron in free space, infinite and step potential function, extensions of wave theory to atoms. Allowed and forbidden energy bands, electrical conduction in solids, effective mass theorem, Boltzmann transport theory and distribution function, space lattices, atomic bonding, impurities and imperfection in solids, energy band structure. generation, recombination and carrier lifetimes, carrier transport phenomena, high field transport, impact ionization, Carrier diffusion, drift and high field effect, mobility and conductivity, velocity saturation, Hall effect with applications to electronic devices, graded impurity distribution, homo-junction and hetero-junction properties of semiconductor devices and theories underlying the static/dynamic characteristics of semiconductor devices. Optical absorption, luminescence, photoconductivity, direct and indirect recombination, photoconductive devices, quasi Fermi level, Haynes-Schokley experiment.

Recommended Books:

1. B. Streetman and S. Banerjee, “Solid State Electronic Devices,” 7th Edition, Pearson, 2014.
2. S. M. Sze and K. K. Ng, “Physics of Semiconductor Devices,” 3rd Edition, Wiley- Interscience, 2006.

Course Name: **Differential Equations**

Credit hours: 3 (3+0)
Course Code: MATH-231
Prerequisites: Calculus and Analytical Geometry

Course Objectives:

To introduce basic techniques pertaining to matrices and formulation/solution of differential equations.

Course Content:

Basic concepts of ordinary differential equation, General and particular solutions, Initial and boundary conditions, Linear and nonlinear differential equations, Solution of first order differential equation by separable variables and its applications in our daily life situations, the techniques like change of variable, homogeneous, non-homogeneous, exact, non-exact, linear and nonlinear Bernoulli could be used in case of complications. Solution of second order differential equation by theory of operators and its applications as forced and free oscillations, The extension of second order solution criteria to higher order differential equations, Solution of the system of differential equations by theory of operators and its applications in our daily life situations, Laplace solution of ordinary differential equations. Basic concepts, Linear and nonlinear p.d. equations, Quasi linear and Quasi nonlinear p.d. equations, Homogeneous and non-homogeneous p.d. equations, Solutions of p.d. equations, Boundary and initial conditions as Dirichlet condition, Neumann condition, Robbins/Mixed condition, Classification of p.d. equations as Elliptic, Parabolic and Hyperbolic. Analytic solution by separation of variables of the Steady-state Two-Dimensional Heat equation/Laplace equation and Unsteady-State One-Dimensional Heat equation/Diffusion equation with homogeneous and non-homogeneous boundary conditions. D'Alembert's solution of two-dimensional wave equation with homogeneous and nonhomogeneous boundary conditions.

Recommended Books:

1. M. L. Abell and J. P. Braselton, "Modern Differential Equations," 2nd Edition, Harcourt College Publishers, 2001.
2. C. R. Wylie and L. C. Barret, "Advanced Engineering Mathematics," 6th Edition, McGraw-Hill, 1995.
3. Erwin. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons., 2011.
4. M. R. Speigal, "Theory and Problems of Laplace Transforms," 2nd Edition, McGraw-Hill, 1986.

Course Name: **Introduction to Expository Writing**

Credit hours: 3 (3+0)

Prerequisites: Functional English

Course Objectives:

To enable students to analyze basic communication skills and use them effectively in oral and written English, develop skills as reflective and self-directed learners, critically evaluate and review various types of texts and summarize them, develop analytical and problem-solving skills to address various community-specific challenges, intellectually engage with different stages of the writing process, such as: brainstorming, mind mapping, free writing, drafting and revision, etc.

Course Content:

Week 1: Introduction to the basics of the writing process, Introduction to the steps of essay writing, Students practice prewriting activities like brainstorming, listing, clustering and free writing, Students practice outlining of the essay

Compulsory Readings

1. Organizing an Essay, Accessed at: https://courses.lumenlearning.com/englishcomp1v2xmaster/chapter/organizing-an-essay/.

Week 2: Students' reflection on learning process, group discussion about learning styles based on the reading material provided to students, Introduction to personalized learning, Students practice goal setting and create a learning plan.

Compulsory Readings

1. Learning Preferences and Strengths, Accessed at: https://opentextbc.ca/studentsuccess/chapter/learning-preferences-and-strengths/.
2. Examine Applicable Strategies, Accessed at: https://opentextbc.ca/studentsuccess/chapter/examine-applicable-strategies/.

Week 3: Introduction to the structure and significance of oral presentations, class discussion about content selection and slide preparation for oral presentations, peer review through a gallery walk.

Compulsory Readings

1. Planning the Presentation, Accessed at: https://opentextbc.ca/studentsuccess/chapter/planning-the-presentation/.

Week 4: Introduce authentic reading (DAWN newspaper and non-specialist academic books/texts), Conduct classroom reading activities (using strategies skimming, scanning, SQW3R, previewing, annotating, detailed reading and note-taking) using standard tests (TOEFL and IELTS), Assign books/articles/reports for their individual home assignments, Share model review reports and annotated bibliographies.

Compulsory Readings

1. U. L. Oh, Talking to kids about xenophobia, National Geographic, 2020. Retrieved from: https://www.nationalgeographic.com/family/2020/05/talking-to-kids-about-xenophobia-coronavirus/.
2. Book Reviews, Accessed at: https://writingcenter.unc.edu/tips-and-tools/book-reviews/.

Week 5: Showing short documentaries to students on global environmental issues, Student-led brainstorming on local versus global issues, Teacher-led introduction to the unit assignment (using assignment sheet), Readings (or other input sources - video, social media) from local news on possible community

issues, letters to editor and op-eds, identify research problems, begin drafting research questions based on the problems identified.

Compulsory Readings

1. U. L. Oh, Talking to kids about xenophobia, National Geographic, 2020. Retrieved from: https://www.nationalgeographic.com/family/2020/05/talking-to-kids-about-xenophobia-coronavirus/.
2. Book Reviews, Accessed at: https://writingcenter.unc.edu/tips-and-tools/book-reviews/.

Week 6: Facilitating students on developing research questions in groups, Draft interview or survey questions for community research (in English or L1), In-class role-plays of interviews with community members, Engaging students in critical reading and reflection on the issues found in different communities

Compulsory Readings

1. Community Engagement Toolkit for Planning, Guiding principles, 2017, [pp 7-24].
2. Developing Community Engagement Plan [pp 13-29].
3. Examples of good and bad research questions, Accessed at: https://www.yourdictionary.com/articles/examples-good-bad-research-questions.

Week 7: In-class work on understanding interview information, how to present interview or survey information, Refining the research questions, designing a detailed research plan in groups, dividing the tasks and deciding the timeline for the completion of the project, Exposure to interview questions and interviewing techniques to develop an in-depth understanding of the issues, Continued group work on report outline.

Week 8: In-class lecture and group work on analyzing information, Discussion based on translating the data from the source language to the target language (English), sharing the experience of field work in class orally.

Week 9: Teacher feedback on outline of report (globally to entire class and individually to groups as needed), Revisions to oral report in groups, Engaging students in individual structured reflective writing based on their experience of working on the project, Sharing their reflective writing to learn about each other's points of view

Week 10: Think-pair-share the findings (group similar issues), Individual writing of reflection on the community engagement project and their role in the group, Brainstorm using creativity for dissemination - cartoons, advertisements for university magazine or beyond, creating posts for FB, Summarizing/ converting the report to a letter to the editor to highlight the problems explored and their possible solutions (homework - connecting activity for week 11 - Unit 5)

Week 11: Teacher-directed instruction on genres (types) of writing focusing on

letter-writing, Model-practice-reflect: Introduce types of letters comparing the use of formal and informal vocabulary and phrases in each type, Introduce the format and purpose of the letter-to-editor explaining with the help of an actual letter from a local newspaper, Group reading of sample letters-to-editor selecting ones that deal with issues familiar to the students

Compulsory Readings

1. Mind Mapping, Accessed at: https://www.ayoa.com/ourblog/what-is-mind-mapping-and-how-can-you-use-it/.
2. Hellen Hall, Reverse Outlines Reverse Outlines: Take A part Your Paper to Put it Back Together Right, 2012. Accessed at: https://www.semanticscholar.org/paper/Reverse-Outline-s-Reverse-Outlines-%3A-Take-Apart-to-Hall/c0373e42616395ea9edf5d5bd5cbe6eb1bb923e2

Week 12: Invite a guest lecturer (local newspaper editor or faculty from journalism) to talk about what issues are currently raised in letters-to-editors and what are editors' criteria to accept letters for publication, Work in groups to continue reviewing letter samples, analyzing the structure of letters, Each group identifies an issue they want to write about and give a brief oral presentation to the class

Week 13: Submit the first draft of letters (to the teacher and peer-review group), In-class peer review of drafts using a checklist focusing on content and structure, DUE: First draft letter (to teacher and peer review group)

Week 14: Groups revise first draft of letter, Differentiate among revision, proofreading and evaluation (as sub stages of finalizing documents), Discuss critically the draft-letter and implement the 'revision' phase of writing, Reading of (DAWN) newspaper and sharing important letters (to editors) on local issues,

Week 15: Groups revise second draft of letter, Explicit instruction (paragraph structure, syntax, diction, grammar, and mechanics), Classroom discussion/debrief of activity, Discuss critically and finalize the draft-letter as the last phase of writing

Course Name: **Quantitative Reasoning – II**

Credit hours: 3 (3+0)
Course Code: STAT-101
Prerequisites: Quantitative Reasoning – I

Course Objectives:

This course provides an in-depth development of fundamental concepts of calculus and linear algebra, with a particular emphasis on the underlying foundations of mathematics. The use and understanding of proof and abstract ideas will allow students to develop analytical skills which will form a base for further study in fundamental mathematics, as well as providing a foundation for a wide range of quantitative areas such as actuarial studies, computer science, economics, physics and statistics.

Course Content:

Short introduction to metric spaces in the context of the calculus of functions of several variables, generalization of the real analysis theory to multivariable functions including limits and continuity, double integrals, Fubini's theorem, integrability of continuous functions, partial derivatives, gradients and directional derivatives, differentiation of multivariable functions, extreme values, vector functions, curves and parametrizations, infinite series, convergence tests, power series, Taylor series.

Recommended Books:

1. R. F. Blitzer, "Algebra and Trigonometry," 7th Edition, Pearson, 2021.
2. M. Sullivan, "College Algebra," 11th Edition, Pearson, 2019.
3. S. Ross, "A First Course in Probability," 10th Edition, Pearson, 2019.
4. S. M. Ross, "Introduction to Probability Models," 13th Edition, Academic Press, 2023.
5. F. Safier, "Schaum's Outline of Precalculus," 4th Edition, McGraw Hill Education, 2019.
6. E. Mendelson, "Schaum's Outline of Calculus," 7th Edition, McGraw Hill Education, 2021.
7. GRE Math Review, https://www.ets.org/s/gre/pdf/gre_math_review.pdf
8. OpenAlgebra.com, A free math study guide with notes and YouTube video tutorials.

Course Name: Ideology and Constitution of Pakistan

Credit hours: 2 (2+0)
Course Code: PST-231
Prerequisites: None

Course Objectives:

To provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic or Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them function in a socially responsible manner.

Course Content:

1. Introduction to the Ideology of Pakistan:

- Definition and significance of ideology.
- Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).
- Contributions or founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.

- Contributions or women and students in the freedom movement for separate homeland for Muslims of British India.

2. Two-Nation Theory:

- Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
- Role of communalism and religious differences.

3. Introduction to the Constitution of Pakistan:

- Definition and importance of a constitution.
- Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
- Overview of constitutional developments in Pakistan.

4. Constitution and State Structure:

- Structure of Government (executive, legislature, and judiciary).
- Distribution of powers between federal and provincial governments.
- 18th Amendment and its impact on federalism.

5. Fundamental Rights, Principles of Policy and Responsibilities:

- Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28).
- Overview of Principles of Policy (Articles 29-40).
- Responsibilities of the Pakistani citizens (Article 5).

6. Constitutional Amendments:

- Procedures for amending the Constitution.
- Notable constitutional amendments and their implications.

Recommended Books:

1. “The Idea of Pakistan” by Stephen P. Cohen.
2. “Ideology of Pakistan” by Javed Iqbal.
3. “The Struggle for Pakistan” by I. H. Qureshi.
4. “Pakistan the Formative Phase” by Khalid Bin Sayeed.
5. “Pakistan: Political Roots and Development” by Safdar Mahmood.
6. “Ideology of Pakistan” by Sharif-ul-Mujahid.
7. “The Struggle for Pakistan: A Muslim Homeland and Global Politics” by Ayesha Jalal.
8. “Jinnah, Pakistan and Islamic Identity: The Search for Saladin” by Akbar S. Ahmed.
9. “The Making of Pakistan: A Study in Nationalism” by K. K. Aziz.
10. “Pakistan: A New History” by Ian Talbot.
11. “Pakistan in the Twentieth Century: A Political History” by Lawrence Ziring.
12. “The Constitution of Pakistan 1973”. Original.
13. “Constitutional and Political Development of Pakistan” by Hamid Khan.
14. “The Parliament of Pakistan” by Mahboob Hussain.
15. “Constitutional Development in Pakistan” by G. W. Choudhury.

Third Semester

Course Name: **Basic Electronics**
Credit hours: 4 (3+1)
Course Code: ELEC-201
Prerequisites**:** Solid State Electronics

Course Objectives:

To gain a comprehensive understanding of diodes, bipolar junction transistors (BJTs), and field-effect transistors (FETs), learning how to apply these components in designing circuits, amplifying signals, rectifying power, and exploring specialized electronic applications. This course is so designed that if taught properly, it will produce scientists with problem-solving mindset, to contribute effectively to the profession. Furthermore, the labs are designed in such a way that the students get hands-on skills in analyzing and designing the basic electronic circuit systems and become capable enough to do a culminating mini project. In this course, the students have the option to use MATLAB to conduct some of the experiments and analyze data.

Course Content:

Semiconductor diodes: n-type and p-type materials, semiconductor pn-junction diode, its forward and reverse bias conditions, Diode Shockley's Equation for diode, ideal vs practical diodes, Resistance levels, Three diode equivalent circuits (Models), load line analysis, Half wave, full wave, and bridge rectifiers. Clippers, Clampers, Zener diode, Voltage Multiplier, Practical Applications of diode (Not in detail but just familiarization), BJT construction, its operation, Common base configuration and its characteristics, Common emitter configuration and its characteristics. Common collector configuration and its characteristics. Limits of operation of a BJT, BJT DC biasing: operating point, Fixed bias configuration, Emitter bias configuration, Voltage-divider bias configuration, Collector feedback configuration, Emitter follower configuration, Common base configuration (Bias point of view), Miscellaneous bias configurations, Design operations, Multiple BJT networks, Current mirrors, Current source circuits, PNP Transistors in emitter biasing and voltage-divider biasing circuits. Transistor switching networks, Practical applications (Not in detail but just familiarization), BJT AC analysis: BJT re model in Fixed bias configuration, BJT re model in voltage-divider bias, BJT re model in emitter bias configuration, BJT re model in emitter-follower configuration, BJT re model in common base configuration, BJT re model in collector feedback configuration, Approximate hybrid equivalent circuit, Field Effect Transistors: construction and characteristics of JFET, Transfer characteristics, Depletion-type MOSFET Enhancement-type MOSFET, FET biasing: Fixed bias configuration, Self-bias configuration, Voltage-divider biasing, common gate configuration, FET amplifiers: JFET small signal model, small signal model in Fixed bias configuration, small signal mode in Self bias configuration. Small signal model in Voltage-divider configuration, Operational amplifiers: DC analysis of differential amplifier, Practical Op-Amp circuits: Inverting amplifier, non-inverting amplifier, unity follower, Voltage summing, Voltage subtraction, Voltage buffer, Linear-

Digital ICs: 311 comparator, 339 comparator, 555 timer IC as an astable/clock and monostable/one-shot multi-vibrator circuit. Power Supplies (Voltage Regulators): Discrete Transistor Voltage Regulator, IC Voltage Regulators, Just Familiarization with Schottky barrier diode, varactor diode, Solar cell, photodiode, photoconductive cell, and IR emitter, Liquid Crystal Display, Thermistor and Tunnel diode.

Lab Outline:

Lab content should be in accordance with the course outlines.

Recommended Books:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory," 11th Edition, Pearson Education, Inc, 2013.
2. A. Malvino, "Electronic Principles," 9th Edition, McGraw Hill, 2021.
3. A. S. Sedra, K. C. Smith, "Microelectronics Circuits," 7th Edition, Oxford University Press, 2014.
4. D. A. Neaman, "Microelectronics Circuit Analysis and Design," 4th Edition, McGraw-Hill, 2010.

Course Name: **Circuit Theory – II**

Credit hours: 4 (3+1)
Course Code: ELEC-202
Prerequisites: Circuit Theory – I

Course Objectives:

To develop a comprehensive understanding of circuit theory and analysis techniques, including first and second-order circuits, Laplace transform applications, and two-port network parameters, enabling proficiency in analyzing and designing electrical circuits and systems. This course is so designed that if taught properly, it will produce scientists with problem-solving mindset, to contribute effectively to the profession. Furthermore, the labs are designed in such a way that the students get hands-on skills in analyzing and designing the basic electric circuit systems and become capable enough to do a culminating mini project. In this course, the students have the option to use MATLAB to conduct some of the experiments and analyze data.

Course Content:

First-Order Circuits: The Source-Free RC Circuit, The Source-Free RL Circuit, Singularity Functions, Step Response of an RC Circuit, Step Response of an RL Circuit, First-Order Op Amp Circuits. Second-Order Circuits: Finding Initial and Final Values, The Source-Free Series RLC Circuit, The Source-Free Parallel RLC Circuit, Step Response of a Series RLC Circuit, Step Response of a Parallel RLC Circuit, General Second-Order Circuits, Second-Order Op- Amp Circuits, Duality. Applications of the Laplace Transform: Circuit Element Models, Transfer Functions, S-domain Circuit Analysis of First-Order and Second-Order Circuits. Two-Port Networks: Impedance Parameters, Admittance Parameters, Hybrid Parameters, Transmission Parameters, Relationships between Parameters.

Lab outline:
Lab content should be in accordance with the course outlines.

Recommended Books:
1. C. K. Alexander and M. N. O. Sadiku, “Fundamentals of Electric Circuits,” 7th Edition, McGraw-Hill, 2021.
2. W. H. Hayt, J. Kemmerly and S. M. Durbin, “Engineering Circuit Analysis,” 10th Edition, McGraw-Hill, 2023.
3. J. D. Irwin and R. M. Nelms, “Basic Engineering Circuit Analysis,” 12th Edition, John Wiley & Sons, 2020.
4. R. L. Boylestad amd B. A. Olivari, “Introductory Circuit Analysis,” 14th Edition, Pearson, 2024.

Course Name: **Computer Programming**
Credit hours: 3 (2+1)
Course Code: ELEC-203
Prerequisites: Applications of Information and Communication Technologies (ICT)

Course Objectives:
To introduce the fundamental concepts of structured and object-oriented programming.

Course Content:
Overview of computer programming and languages used for programming. Fundamental Programming Constructs: data types, variables, basics of input and output, loops and decisions. Functions, structures, arrays and strings, pointers. Structured and Modular Programming. Program Development: analyzing problems, designing algorithm/solution, and translating algorithms into programs. Object oriented programming and software development: objects, classes, operator overloading, encapsulation, inheritance and polymorphism. Exception handling, testing and debugging designed solution.

Lab outline:
Lab work will be in accordance with the course outline.

Recommended Books:
1. R. Lafore, “Object-Oriented Programming in C++,” 4th Edition, Prentice Hall 2002.
2. B. Stroustrop, “The C++ Programming Language,” 4th Edition, Addison-Wesley Professional, 2013.
3. J. Hanly and E. Koffman, “Problem Solving and Program Design in C,” 8th Edition, Pearson, 2015.
4. P. Dietel and H. Deitel, “C++: How to Program,” 10th Edition, Pearson, 2016.
5. P. Laurence, “C++: The Ultimate Crash Course to Learning the Basics of C++,” CreateSpace Independent Publishing Platform, 2017.

6. Y. Kanetkar, “Basic Programming in C++,” BPB Publications, 2004.

Course Title: **Complex Variables and Transforms**

Credit Hours: 3 (3+0)
Course Code: MATH-232
Prerequisites: Differential Equations

Course Objectives:

To introduce the concepts of complex variables, Laplace transform, Fourier transform, and use of transforms in the solution of engineering problems.

Course Content:

Introduction to complex number systems, Argand‘s diagram, modulus and argument of a complex number, polar form of a complex number, De Moivre‘s theorem and its applications, complex functions, analytical functions, harmonic and conjugate, harmonic functions, Cauchy-Riemann. Introduction to complex number systems, Argand‘s diagram, modulus and argument of a complex number, polar form of a complex number, De Moivre‘s theorem and its applications, complex functions, analytical functions, harmonic and conjugate, harmonic functions, Cauchy-Riemann equations, line integrals, Green‘s theorem, Cauchy‘s theorem, Cauchy‘s integral formula, singularities, poles, residues, contour integration and applications; Laplace transform definition, Laplace transforms of elementary functions, properties of Laplace transform, periodic functions and their Laplace transforms, inverse Laplace transform and its properties, convolution theorem, inverse Laplace transform by integral and partial fraction methods, Heaviside expansion formula, solutions of ordinary differential equations by Laplace transform, applications of Laplace transforms; series solution of differential equations, validity of series solution, ordinary point, singular point, Forbenius method, indicial equation, Bessel‘s differential equation, its solution of first kind and recurrence formulae, Legendre differential equation and its solution, Rodrigues formula; Fourier transform definition, Fourier transforms of simple functions, magnitude and phase spectra, Fourier transform theorems, inverse Fourier transform, solutions of differential equations using Fourier transform.

Recommended Books:

1. M. L. Abell and J. P. Braselton, “Modern Differential Equations,” 2nd Edition, Harcourt College Publishers, 2001.
2. C. R. Wylie and L. C. Barret, “Advanced Engineering Mathematics,” 6th Edition, McGraw-Hill, 1995.
3. E. Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley and Sons, 2011.
4. M. R. Speigal, “Theory and Problems of Laplace Transforms,” 2nd Edition, McGraw-Hill, 1986.

Course Name: **Fehm-e-Quran – I**
Credit hours: 1 (0-1)
Course Code: ISL-102
Contact Hours: 3 per week
Weeks: 15-16 (45-48 hours)

Course Objectives:

By the end of this course, students will be able to understand basic Quranic vocabulary and sentence structures, gradually progressing from simple nominal phrases to present-tense sentences. They will build a strong foundation for comprehending longer verses with clarity, recognizing key particles, pronouns, plurals, and common compounds through extensive practice. Learners will identify various Quranic sentence styles, such as emphatic, negative, interrogative, and oath-based forms, while strengthening awareness of essential expressions and idioms. Ultimately, students will be equipped to independently understand 30–40% of a typical page of the Holy Quran.

Course Content:

Weeks	Lectures (1.5 hrs)	Units	Lessons	Assignments/Home Task	Linguistic Rules
1.	1.	1	1-6	Writing the meaning of Quranic words Lesson 1-8	Proper Noun Masculine & Feminine
	2.	1	9-14	Writing the meaning of Quranic words 9-14	Two kinds of plural Concept of (و) "And" Common Noun
2.	1.	1	15-17	Writing the meaning of Quranic words, phrases & translation of Sentences 15-17	Demonstrative Noun (This & That for Masculine (هذا- هذه) Demonstrative Noun (This & That for Feminine) (ذلك- تلك)
	2.	1	18-19 & Revision (Unit 1)	Writing the meaning of Quranic words , phrases & translation of Sentences 17-19 Quiz	Laam for emphasis (لام التأكيد) Superlative Degree like أكبر Revision of all Quranic Sentences
3.	1.	Unit 2	1-3	Writing the meaning of Quranic words, phrases & translation of Sentences 1-3	Emphatic Particle إن Preposition "For" (اللام) Preposition (في)
	2.	2	4-6	Writing the meaning of Quranic words, phrases & translation of Sentences 4-6	Preposition (على- من- إلى)
4.	1.	2	7- 9	Writing the meaning of Quranic words & translation of Sentences 7-9	Preposition (الباء) Absolute Negation Particle Exceptive Particle (لا النافية للجنس)(ما النافية) (إلا)
	2.	2	10-13 & Revision (Unit 2)	Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 Quiz	Subordinating Conjunction(أن), Was (كان), Vocative Particle(حرف النداء)

5.	1.	Unit 3	1-2	Writing the meaning of Quranic phrases 1-2	Quranic Adjective Compounds (صفة وموصوف)
	2.	3	3-5	Writing the meaning of Quranic phrases & translation of sentences 3-5	Quranic Possessive Construction (مضاف ومضاف إليه)
6.	1.	3	6 -7	Writing the meaning of Quranic phrase translation of sentences 6-7	Quranic Possessive Construction (مضاف ومضاف إليه)
	2.	3	8-10 & Revision (Unit 3)	Writing the meaning of Quranic phrase & translation of sentences 8-10 Quiz	Active Participle (اسم الفاعل), Passive Participle (اسم المفعول), Dual (مثنى)
7.	1.	Unit 4	1-2	Writing the meaning of Quranic phrase & translation of sentences 1-2	Personal Pronoun He(هو المنفصل) Possessive Pronoun His ـه المتصل)
	2.	4	3-4	Writing the meaning of Quranic phrase & translation of sentences 3 -4	Possessive Pronoun with prepositions like في بيته Pronoun "His" with prepositions like له، منه، فيه
8.	1.	4	5-8	Writing the meaning of Quranic sentences 5-8	Personal Pronoun You(أنت المنفصل) Possessive Pronoun Your ك المتصل) Possessive Pronoun with prepositions like في بيتك Pronoun "your" with prepositions like لك، منك، فيك
	2.	Mid Term			

9.	1.	4	9-12	Writing the meaning of Quranic phrases & sentences 9-12	Personal Pronoun She(هي المنفصل) Possessive Pronoun Her ها المتصل) Possessive Pronoun with prepositions like في بيتها Pronoun "Her" with prepositions like لها،
	2.	4	13-16	Writing the meaning of Quranic phrases & sentences 13-16	Personal Pronoun I (أنا المنفصل) Possessive Pronoun Her ي المتصل) Possessive Pronoun with prepositions like في بيتيPronoun "My" with prepositions like لي
10.	1	4	17 & Revision Unit 4	Revision of all Quranic sentences of Unit 4 Quiz	Adverb (حال)
	2.	Unit 5	1-2	Writing the meaning of Quranic phrases & sentences 1-2	Masculine Plural جمع المذكر السالم و جمع المذكر السالم المسبوق بحرف الجر
11.	1.	5	3-4	Writing the meaning of Quranic phrases & sentences 3-4	Possessive Construction with Plurals جمع المذكر السالم المسبوق بالإضافة
	2.	5	5-6	Writing the meaning of Quranic phrases, sentences & verses 5-6	Personal Pronoun They (هم المنفصل) Possessive Pronoun Their هم المتصل)
12.	1.	5	7-8	Writing the meaning of Quranic phrases, sentences & verses 7-8	Possessive Pronoun with prepositions like في بيتهمPronoun "Their" with prepositions like لهم
	2.	5	9-11	Writing the meaning of Quranic phrases, sentences & verses 9-11	Personal Pronoun You (أنتم المنفصل) Possessive Pronoun Your كم المتصل) Possessive Pronoun with prepositions

					like في بيتكم
13.	1.	5	12-14	Writing the meaning of Quranic phrases & sentences & verses 12-14	Pronoun "Your" with prepositions like لكم Personal Pronoun We (نحن المنفصل) Possessive Pronoun Our نا المتصل)
	2.	5	15-16	Writing the meaning of Quranic sentences & verses 15-16	Possessive Pronoun with prepositions like في بيتنا Pronoun "Our" with prepositions like لنا
14.	1.	5	17-18	Writing the meaning of Quranic sentences & Verses 17-18	Demonstrative Pronoun These, Those (هؤلاء- أولئك)
	2.	5	19-23	Writing the meaning of Quranic sentences & Verses 19-23	(ما / إلا، إن / إلا، إنما، ليس، ما ، أ/أم، أن، بل، كأن) (ألا، أليس، اليوم، يومئذ، سبحان، مابينهما، قل، إذن، بئس، نعم، كلا، ما أدراك، حسب، أعلم ب، مصير، مرجع، دينا(تمييز)
15.	1.	5	Revision Unit 5	Quiz	
	2.	5	1-3 (till Page 16)	Writing the meaning of Quranic Verbs &Translation of Quranic Sentences & Verses (1-3)	Introduction of Present Tense(فعل مضارع) & Verbal Sentence (جملة فعلية) Present Tense الفعل المضارع صيغة المفرد يعلم
16.	1.	6	3 (From Page 17) & 4 -5	Translation of Quranic Sentences & Verses 3-5	Present Tense الفعل المضارع صيغة المفرد يعلم
	2.	6	6	Translation of Quranic Sentences & Verses	Present Tense الفعل المضارع صيغة الجمع يعلمون

Recommended Books:

1. Ubaid ur Rahman, "Muallim ul Quran (Volume 1, 2 & 3)".

Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his/her answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

Fourth Semester

Course Name: **Signals and Systems**
Credit hours: 4 (3+1)
Course Code: ELEC-211
Prerequisites: Complex Variables and Transforms

Course Objectives:
To provide understanding on classification of signals and systems. Teach the time and frequency domain analysis techniques for continuous and discrete time signals and linear systems.

Course Content:
Continuous-time and discrete-time signals; periodic signals, even and odd signals, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems; linear time-invariant (LTI) systems, difference equation, complex frequency analysis (s-domain) causality, BIBO stability, convolution and correlation, Discrete Time Fourier Transforms, time and frequency characterization of signals and systems, the sampling theorem, aliasing, sampling the discrete time signals, z-transform, analysis and characterization of LTI systems using z-transform, introduction to analog filter design.

Lab outline:
Lab work will be in accordance with the course outline.

Recommended Books:

1. A. V. Oppenheim, A. S. Willsky, S. H. Nawab, "Signal and Systems," 2nd Edition, Prentice Hall, 1998.
2. S. Haykin and B. V. Veen, "Signals and Systems," 2nd Edition, Wiley, 2002.
3. M. J. Roberts, "Fundamentals of Signals and Systems," McGraw-Hill, 2007.
4. B. P. Lathi, "Linear Systems and Signals," 2nd Edition, Oxford, 2004.
5. J. H. McClellan, R. W. Schafer, M. A. Yoder, "DSP First," 2nd Edition, Pearson Education, Inc., 2016.

Course Name: **Digital Logic Design**
Credit hours: 4 (3+1)
Course Code: ELEC-212
Prerequisites: Basic Electronics

Course Objectives:
To introduce the fundamentals of digital logic design, number systems and conversion, combinational logic circuits, sequential logic circuits, simple as possible computer series (SAP-1 to SAP-3).

Course Content:
Number systems, conversion between different number systems, logic gates,

SOP and POS expressions, Demorgan's theorems, Karnaugh maps, simplification of Boolean expressions using Boolean algebra and Karnaugh maps, and implementation of different combinational circuits using only Nand gate and only Nor gate, CMOS and TTL technologies introduction, internal structure of different logic gates using CMOS and TTL technologies, Designing steps of the combinational logic circuits, designing of Adder, Subtractor, 4-bit and 8-bit adder/subtractor, Encoders, Decoders, Multiplexers and DeMultiplexers, Latches, FlipFlops, different types of shift registers, Different types of synchronous and synchronous counters, SAP-1 hardware architecture and programming, SAP-2 hardware architecture and programming, SAP-3 Programming model, architecture and programming.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. T. Floyd, "Digital Fundamentals," 11th Edition, Pearson, 2014.
2. Malvino and J. Brown, "Digital Computer Electronics", 3rd Edition, McGraw Hill, 2011.
3. M. Moris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog," 6th Edition, Pearson, 2017.
4. Mano, Kime and Martin, "Logic & Computer Design Fundamentals," 5th Edition, Pearson, 2016.
5. Brown and Vranesic, "Fundamentals of Digital Logic with Verilog Design," 3rd Edition, McGraw Hill, 2014.

Course Name: **Entrepreneurship**

Credit hours: 2 (2+0)
Course Code: BA-441
Prerequisites: None

Course Objectives:

To develop a comprehensive knowledge of fundamental entrepreneurial concepts, skills, and processes to lay the foundation for entrepreneurial thinking and action with an understanding of the nature of business formation, growth, & execution. To develop an understanding of the theoretical and practical aspects of Entrepreneurship literature. Foster self-awareness and recognize personal, social, and financial aspects related to entrepreneurial activities, allowing students to identify their unique aptitude for entrepreneurship. Explore the contributions of notable entrepreneurs to global society and the economy, gaining insights into the diverse entrepreneurial landscape and the impact of successful entrepreneurial ventures. To prepare an analysis of the financial requirements and build a financial strategy for the new venture, including incremental appreciation of the equity base. Equip learners with the competency to leverage personal skills and characteristics effectively in entrepreneurial ventures, enabling them to identify and capitalize on opportunities in both business and life. Develop the ability to identify and critically analyze issues in entrepreneurship practices, considering

patterns in both employment and self-employment scenarios. To research the potential of a viable business idea and understand the risks associated. To develop a comprehensive business plan for their venture idea.

Course Content:

Introduction to and the definition of the concept of Entrepreneurship, The Nature of Entrepreneurship, Why to become an Entrepreneur?; The role of Entrepreneurship in the economic development, The Entrepreneurial Process, How Entrepreneurs think Structurally, Bricolage, Effectuation, and Cognitive Adaptability; The intention to ACT Entrepreneurially, The characteristics and qualities of Entrepreneurs, Education, Age, and Work History of Entrepreneurs; Areas of essential entrepreneurial skill and ability such as creative and critical thinking, innovation, and risk-taking ability, Role Models and Support Systems, Moral-Support Network, and Professional-Support Network; Causes for Interest in Corporate Entrepreneurship/Intrapreneurship, Managerial versus Entrepreneurial Decision Making; Opportunity identification, evaluation, and exploitation, Creativity, Trends, and Sources of New ideas, Methods of Generating Ideas, Creative Problem-solving techniques; Innovative idea generation techniques for entrepreneurial ventures, Innovation and Opportunity Recognition; New Entry, Generation of a New Entry Opportunity, Resources as a Source of Competitive Advantage, Assessing the Attractiveness of a New Entry Opportunity; E-Commerce and Business Start-Up; Planning as Part of the Business Operation What is the Business Plan?, Who Should Write the Plan?, Scope and Value of the Business Plan- Who reads the Plan? How Do Potential Lenders and Investors Evaluate the Plan?; Presenting the Plan Various Information Needs, Using the Internet as a Resource Tool, Writing the Business Plan; The Marketing Plan, Industry Analysis, Understanding Marketing Plan, Characteristics of a Marketing Plan, The Marketing Mix, Target market identification and segmentation, 4 Ps of Marketing, Developing marketing strategy, Branding; The Financial Plan, Basic concepts of income, saving, and investments, Basic concepts of assets, liabilities, and equity, Operating and Capital Budgets, Forecasting Sales, Pro Forma Income Statements, Pro Forma Cash Flow, Pro Forma Balance Sheet, Break-Even Analysis; Basic concepts of revenue and expenses, Overview of cashflows, Overview of banking products including Islamic modes of financing, Sources of funding for startups (Angel financing, debt financing, equity financing); Teambuilding and effective leadership for startups, characteristics and features of effective teams, Using External Parties to Help Grow a Business, Joint Ventures, Acquisitions, Franchises; Business Plan Presentations.

Recommended Books:

1. D. F. Kuratko “Entrepreneurship: Theory, Process, Practice,” 12th Edition, Cengage Learning, 2023.
2. B. Barringer and R. Ireland, “Entrepreneurship: Successfully Launching New Ventures,” 6th Edition, Pearson, 2018.
3. B. J. Bird, “Entrepreneurial Behavior,” 1st Edition, Scott Foresman & Co., 1989.
4. R. Hisrich, M. Peters and D. Shepherd, “Entrepreneurship,” 10th Edition, McGraw Hill, 2016.
5. S. Spinelli and R. Adams, “New Venture Creation: Entrepreneurship for the

21st Century," 10th Edition, McGraw Hill, 2015.
6. E. Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses," Random House Audio, 2011.
7. S. Read, S. Sarasvathy, N. Dew and R. Wiltbank, "Effectual Entrepreneurship," 2nd Edition, Routledge, 2016.

Course Name: **Civics and Community Engagement**

Credit hours: 2 (2+0)
Course Code: GEC-242
Prerequisites: None

Course Objectives:

To provide students with fundamental knowledge about civics, society, citizenship, and community engagement. To learn about the essentials of civic society, government, civic responsibilities, inclusivity, and effective ways to participate in shaping the society which will help them apply theoretical knowledge to the real-world situations to make a positive impact on their communities.

Course Content:

1. Civics and Citizenship
- 1.1. Concepts of civics, citizenship, and civic engagement.
- 1.2. Foundations of modern society and citizenship.
- 1.3. Types of citizenship: active, participatory, digital, etc.

2. State, Government, and Civil Society
- 2.1 Structure and functions of government in Pakistan.
- 2.2 The relationship between democracy and civil society.
- 2.3 Right to vote and the importance of political participation and representation.

3. Rights and Responsibilities
- 3.1 Overview of Fundamental Rights and Liberties of Citizens under the Constitution of Pakistan 1973.
- 3.2 Civic responsibilities and duties.
- 3.3 Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.)

4. Community Engagement
- 4.1 Concept, nature, and characteristics of a community.
- 4.2 Community development and social cohesion.
- 4.3 Approaches to Effective Community Engagement.
- 4.4 Case studies of successful community-driven Initiatives.

5. Advocacy and Activism
- 5.1 Public discourse and public opinion.
- 5.2 Role of advocacy in addressing social issues.
- 5.3 Social Action Movements.

6. Digital Citizenship and Technology
- 6.1 The use of digital platforms for civic engagement.
- 6.2 Cyber ethics and responsible use of social media.

6.3 Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.

7. Diversity, Inclusion, and Social Justice

7.1 Understanding diversity in society (ethnic, cultural, economic, political, etc.).

7.2 Youth, women, and minorities' engagement in social development.

7.3 Addressing social inequalities and injustices in Pakistan.

7.4 Promoting inclusive citizenship and equal rights for societal harmony and peaceful coexistence.

8. Suggested Practical Activities (Optional)

As part of the overall learning requirements, the course may have one or a combination of the following practical activities:

i. **Community Storytelling:** Students can collect and share stories from community members. This could be done through oral histories, interviews, or multimedia presentations that capture the lived experiences and perspectives of diverse individuals.

ii. **Community Event Planning:** Students can organize a community event or workshop that addresses a specific issue or fosters community interaction. This could be a health fair, environmental cleanup, cultural festivals, or educational workshops.

iii. **Service-Learning:** Students can collaborate with a local nonprofit organization or community group. They can actively contribute by volunteering their time and skills to address a particular community need, such as tutoring, mentoring, or supporting vulnerable populations.

iv. **Cultural Exchange Activities:** Students can organize a cultural exchange event that celebrates the diversity within the community. This could include food tastings, performances, and presentations that promote cross-cultural understanding.

Recommended Books:

1. A. Vary, "Civics Today: Citizenship, Economics, & You," 6th Edition, McGraw-Hill Education, 2009.
2. W. Kymlicka and W. Norman, "Citizenship in Diverse Societies," 1st Edition, Oxford University Press, 2000.
3. J. Youniss and P. Levine, "Engaging Youth in Civic Life," Vanderbilt University Press, 2009.
4. K. Mattson, "Digital Citizenship in Action: Empowering Students to Engage in Online Communities," 2nd Edition, ISTE, 2024.
5. R. F. Kronick "Community Engagement: Principles, Strategies and Practices," Nova Science Publishers, Inc., 2018.
6. D. Gershon "Social Change 2.0: A Blueprint for Reinventing Our World," High Point/Chelsea Green, 2009.
7. A. Breed and T. Prentki, "Performance and Civic Engagement," Springer International Publishing, 2018.
8. F. Clingerman and R. B. Locklin, "Teaching Civic Engagement," Oxford University Press, 2016.
9. L. S. Henriksen, K. Strømsnes and L. Svedberg, "Civic Engagement in Scandinavia," Springer International Publishing, 2019.

10. M. Indrawan, J. B. Luzar, H. Hanna and T. Mayer, “Civic Engagement in Asia: Transformative Learning for a Sustainable Future,” Springer Nature Singapore, 2022.
11. K. J. Kennedy, “Civic Engagement in Changing Contexts: Challenges and Possibilities for Democracy,” Springer Singapore, 2022.
12. A. Lyons and L. McIlrath, “Higher Education and Civic Engagement: Comparative Perspectives,” Palgrave Macmillan, 2012.
13. G. Olson and L. Worsham, “Education as Civic Engagement: Toward a More Democratic Society,” Palgrave Macmillan, 2012.
14. S. Robertson, “Social Media and Civic Engagement: History, Theory, and Practice,” Springer International Publishing, 2018.

Course Name: **Fehm-e-Quran – II**

Credit hours: 1 (0-1)
Course Code: ISL-109
Contact Hours: 3 per week
Weeks: 15-16 (45-48 hours)

Course Objectives:

By the end of this course, students will directly comprehend hundreds of Quranic sentences and verses, gaining the ability to understand 80–85% of each page of the Holy Quran. They will develop proficiency in essential and advanced Arabic linguistic concepts, including common thematic verses and distinctions between verb forms such as present, past, and imperative. Learners will progress toward independently understanding longer Quranic passages along with their interpretations, strengthening both linguistic skill and overall comprehension.

Course Content:

Weeks	Lectures	Units	Lessons	Assignments/Home Task	
1.	1.	6	6	Understanding & Translation of Verses	Present Tense صیغۃ جمع مذکر غائب مثل یعبدون
	2.	6	7-8	Understanding & Translation of Verses	Present Tense صیغۃ جمع مذکر غائب مثل یعبدون
2.	1.	6	9-10	Understanding & Translation of Verses	Present Tense صیغۃ مفرد مذکر مخاطب (تعبد) وجمع مذکر مخاطب (تعبدون)
	2.	6	11-12	Understanding & Translation of Verses	Present Tense صیغۃ جمع مذکر مخاطب (تعبدون)

					صيغة المتكلم (أعبد)
3.	1.	6	13	Understanding & Translation of Verses	Present Tense صيغة جمع المتكلم (نعبد)
	2.	6	14-15	Understanding & Translation of Verses	Negative Imperative صيغة المفرد وصيغة الجمع , لا تعبدْ، لا تعبدوا
4.	1.	6	16-17	Understanding & Translation of Verses	Conditional Sentences & masdar moawal (مصدر موؤل)
	2.	6	18-19	Understanding & Translation of Verses	Laam uttaleel (لام التعليل) & Laam ul jhood(لام الجحود)
5.	1.	6	20-21	Understanding & Translation of Verses	Present with object pronouns & Passive Voice
	2.	6	Revision (Unit 6)	Quiz	
6.	1.	Unit 7	1 (sec 1-3)	Understanding & Translation of Verses	Past Tense صيغة المفرد الغائب
	2.	6	1 (Sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
7.	1.	6	1 (Sec 5-6)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
	2.	6	1 (Sec 7-9)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
8.	1.	7	Revision	Understanding & Translation of Verses QUIZ	Past Tense صيغة المفرد للغائب
	2.	MID TERM			
9.	1.	7	2 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
	2.	7	2 (sec 3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
10.	1.	7	2 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
	2.	7	2 (sec 6-7)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
11.	1.	7	3 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدنا

	2.	7	3 (sec 2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدنا
12.	1.	7	3 (sec 3-4)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدنا
	2.	7	3 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدنا
13.	1.	7	4 (sec 1-2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب عبدتم
	2.	7	4 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب عبدتم
14.	1.	7	5-6	Understanding & Translation of Verses Quiz	Past Tense صيغة المتكلم والمخاطب عبدتُ ، عبدتَ
	2.	7	7	Understanding & Translation of Verses	Past Tense صيغة المؤنث للغائب عبدتْ
15.	1.	7	8	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول للمفرد
	2.	7	9	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول الجمع
16.	1.	8	1-4	Understanding & Translation of Verses	Imperative Verb for singular فعل الأمر للمفرد
	2.	7	5-8	Understanding & Translation of Verses	Imperative Verb for plural فعل الأمر للجمع

Recommended Books:

1. Ubaid ur Rahman, “Muallim ul Quran (Volume 3, 4 & 5)”.

Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his/her answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

Course Name: **Pakistan Studies**

Credit hours: 2 (2+0)
Course Code: PST-121
Prerequisites: None

Course Objectives:

To provide students with a comprehensive exploration of Pakistan’s identity, spanning geographical, historical and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military interventions. The

aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

Course Content:

1. Introduction to Pakistan:

- Geographical location and significance.
- Historical background: Ancient civilizations in the region.
- Factors leading to the creation of Pakistan.

2. Political History of Pakistan:

- Formative phase.
- Military interventions and democratic transitions.

3. Geography of Pakistan:

- Physiography: Mountains, plains, plateaus, deserts, valleys and coastal areas.
- River systems: Indus River and its tributaries.
- Climatic regions of Pakistan.

4. Society and Culture of Pakistan:

- Socio-cultural diversity.
- Languages and literature of Pakistan.

5. Economic Development of Pakistan:

- Agriculture and industrial sectors of Pakistan.
- Economic Challenges of Pakistan

6. Contemporary Issues:

- Foreign relations of Pakistan.
- Security challenges: terrorism, extremism, and regional conflicts.
- Environmental problems and sustainable development (SDGs).
- Media and social change.

Recommended Books:

1. “Jinnah of Pakistan” by Stanley Wolpert.
2. “The Sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan” by Ayesha Jalal.
3. “The struggle for Pakistan” by Ishtiaq Husain Qureshi.
4. “Pakistan, the Formative Phase, 1857-1948” by Khalid B. Sayeed.
5. “Pakistan Studies: A Book of Readings" by Sikandar Hayat.
6. “Constitutional and Political History of Pakistan” by Hamid Khan.
7. “Trek to Pakistan” by Ahmad Saeed and Kh. Mansur Sarwar.
8. “Pakistan: A Modern History” by Ian Talbot.
9. “Politics in Pakistan: The Nature and Direction of Change”' by Khalid B. Sayeed.
10. “Physical Geography of Pakistan” by Umar Jahangir.
11. “A Geography of Pakistan: Environment, People, and Economy” by Fazle Karim Khan.
12. “Pakistan’s Foreign Policy: An Historical Analysis” by S. M. Burke.
13. “Separatism in East Pakistan” by Rizwan Ullah Kokab.

14. “Being Pakistani: Society, Culture and the Arts” by Raza Rumi.
15. “Pakistan's Cultural Heritage: Socio-Economic and Technological Aspects” edited by Abdul Jabbar Khan.
16. “Language and Politics in Pakistan” by Tariq Rahman.
17. “Sociology” by Horton and Hunt.
18. “Pakistan in the Twentieth Century: A Political History” by Lawrence Ziring.
19. “Economic Development of Pakistan” by Ishrat Husain.
20. “Issues in Pakistan’s Economy” by S. Zaidi.

Fifth Semester

Course Name: **Electronic Circuit Design**
Credit hours: 4 (3+1)
Course Code: ELEC-301
Prerequisites: Basic Electronics

Course Objectives:
To introduce the fundamentals of electronic circuits design, construction and working of the BJT, FET and MOSFET, design and working of small signal amplifiers, the types and working of Power Amplifiers and analysis of cascaded amplifiers, the basics of Op-Amp and its application circuits, the design and working of different types of Oscillators.

Course Content:
Transistor as an amplifier, Transistor as a switch, Transistor equivalent models, Single-stage amplifier, cascading, multistage gain calculations, Biasing techniques, Fixed bias, voltage divider bias, collector to base bias, emitter bias, Designing of a small signal amplifier, gain of small signal amplifiers, thermal stability, voltage gain, current gain and power gain, Different types and working of Power Amplifiers, Class A, Class B, Class AB and Class C power amplifiers, Construction and working of MOSFET, Biasing of MOSFET, basic logic gates using MOSFETs, Operational Amplifier and its basic circuits, Applications of Op-Amp, summer, subtractor, integrator, Feedback concept, feedback amplifiers, Oscillators, Conditions for oscillation, Types of Oscillators, Wien bridge, Phase shift Oscillator, Colpitts, Hartley and Crystal Oscillators circuit design and working, Applications of BJT, MOSFET, OP-Amp and Oscillators.

Lab outline:
Lab contents will be in accordance with the course outline.

Recommended Books:

1. T. L. Floyd, D. M. Buchla and G. D. Snyder, “Electronics Fundamentals: Circuits, Devices, and Applications,” 9th Edition, Pearson, 2021.
2. R. L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory,” 11th Edition, Pearson, 2014.
3. D. A. Neaman, “Microelectronics Circuit Analysis and Design,” 4th Edition, McGraw-Hill, 2010.
4. J. Millman, C. Halkias, and C. D. Parikh, “Integrated Electronics,” 2nd Edition, McGraw Hill, 2009.

Course Name: **Microprocessor System Design**
Credit hours: 4 (3+1)
Course Code: ELEC-302
Prerequisites: Digital Logic Design

Course Objectives:

To introduce the hardware architecture and programming of Intel series of Microprocessors, the Pinouts and the Pin Functions, Clock Circuitry, Bus Buffering and Latching, Bus Timing of 8086 series, the Ready and the Wait State, Minimum Mode Versus Maximum Mode. Memory Devices, Address Decoding, interfacing and operation of different Peripheral devices.

Course Content:

Study of Intel series of Microprocessors, 8088 to Pentium-4, and their comparative study. The 8088/8086, Microprocessors Pinouts and the Pin Functions, Clock Circuitry, Bus Buffering and Latching, Bus Timing, Ready and the Wait State, Minimum Mode Versus Maximum Mode. Memory Devices, Address Decoding, 8088/8086 Memory Interface, Dynamic RAM Controllers, Memory Testing. Basic I/O Port Address Decoding, The 8255A Programmable Peripheral Interface, the 8279 Programmable keyboard/Disp1ay Interface, 8254 Programmable Interval Timer. Basic Interrupt Processing, Hardware Interrupts, The Interrupt Structure, 8259A Programmable Interrupt Controller. Introduction to DMA, the 8257_5 DMA Controller, and DMA Processed Printer Interface. Analog to Digital Conversion Basics, Major Considerations for Data Acquisitions systems. Analog to Digital Converters, ADC Performance Parameters, ADC Code Sample & Hold Circuits, Analog Multiplexes, Analog Signal Isolation, Designing of a Data Acquisition system. Introduction to Digital Communications, Serial Communications Interface Adapters, The825 IA Communications Interface Adapter, The RS_232C Interface Standard, Current Loops, Data Transmission Methods, Modems, IEEE 488, General Purpose Instrumentation Bus (GPIB), NEC 7210 GPIB Communication Interface.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. B. B. Brey, “The Intel Microprocessors,” 8th Edition, Pearson Education, 2011.
2. R. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085,” 6th Edition, Penram International Publishing, 2014.
3. D. V. Hall, “Microprocessor and Interfacing,” Revised 2nd Edition, Tata McGraw-Hill, 2005.
4. C. M. Gilmore, “Microprocessors: Principles and Applications,” 2nd Edition, McGraw Hill, 1995.

Course Name: **Instrumentation and Measurements**

Credit hours: 4 (3+1)
Course Code: ELEC-303
Prerequisites: Circuit Theory-I, Basic Electronics

Course Objectives:

This course is designed to introduce and understand the principles and methods

of measurements, also, to study instruments for the measurement of electrical and non-electrical quantities.

Course Content:

Basic Principle of Measurement; Terminologies and Principles of different Measurement Techniques; Static and Dynamic Characteristics of Instruments; Error Theory; Statistical Analysis; Probability of Errors; Types of Units; Systems of Units; Electrical and Magnetic Units; International System of Units; Other Systems of Units; Conversion of Units; Standards of Measurements; Standard for Mass, Length and Volume; Time and Frequency Standards; Electrical Standards; Standards of Temperature and Luminous Intensity; IEEE Standards; Electromechanical Indicating Instruments; Construction and Working of Different DC and AC Meters; Thermoinstruments; Transducers; Sensors and Condensers; Types of Signal Conditioning; Measurement Displays; Recording Frequency Meters; Phase Meters; Digital Voltmeter; Oscilloscope; Bridge Measurements; Instruments for Measuring Physical Quantities; Modern Instrumentation Techniques; Signal Generators; Power and Energy Meters; High-Voltage Measurements. Advanced instrumentation techniques; microprocessor-based instrumentation; analog-to-digital and digital-to-analog converters; PC-based instrumentation systems: interfacing techniques, data acquisition software, and virtual Instruments; intelligent instrumentation systems.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. D. Helfrick and W. D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques,” Prentice Hall, 1992.
2. S. Morris and R. Langari, “Measurement and Instrumentation, Theory and Application,” Elsevier Publishing, 2016.
3. K. James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control,” 1st Edition, Newnes, 2000.
4. M. Schwartz and O. Manickum, “Programming Arduino With LabVIEW: Build Interactive and Fun Learning Projects With Arduino Using Labview,” Packt Publishing, 2015.
5. A. Prakash, L. R. Gupta, R. Singh, A. Gehlot and R. Beri, “Biomedical Sensors Data Acquisition with LabVIEW: Effective Way to Integrate Arduino with LabVIEW,” BPB Publication India, 2020.
6. K. B. Klaassen and S. Gee, “Electronic Measurement and Instrumentation,” Cambridge University Press, 1996.
7. R. Malaric, “Instrumentation and Measurement in Electrical Engineering,” Brown Walker, 2011.

Course Name: **Linear Control Systems**

Credit hours: 4 (3+1)

Course Code: ELEC-304

Prerequisites: Complex Variables and Transforms, Signals and Systems

Course Objectives:

To give students a comprehensive understanding of control systems engineering, including system modeling, stability analysis, and controller design, with practical experience in MATLAB-based simulation, speed and position control of DC motors. This course is so designed that if taught properly, it will produce scientists with problem-solving mindset, to contribute effectively to the profession. Furthermore, the labs are designed in such a way that the students get hands-on skills in analyzing and designing a controller for a system with desired performance characteristics and become capable enough to do a culminating mini project.

Course Content:

Importance and applications of control systems, Control system definition, general structure of a control systems, open loop and closed loop control systems, analysis and design objectives, functional block diagrams, Concept of mathematical modelling, concept of transfer function and its features, Transfer function of nth order dynamical system described by differential equation, Transfer functions of RLC networks, transfer functions of OP-AMP circuits, transfer functions of translational mechanical systems, Transfer function of rotational mechanical systems, Transfer function of DC servomotor, Introduction, basic concepts of state-space, state-space modelling of electrical networks, Block diagram reduction technique for finding transfer function , rules for block diagram reduction, Signal Flow Graphs (SFGs), Mason's Rule, SFGs and state equations, Introduction to time response analysis of control systems, Poles, Zeros, and system response-qualitative behavior Unit-response of first order systems, transient response specifications of first order systems, analysis of second-order system, transient response specifications of second-order system, effect of damping ratio on the performance of second order system. Underdamped second-order systems, system response with additional poles and zeros, Introduction to stability analysis, BIBO stability, Asymptotic stability, zero-input stability, absolute and relative stability, relationship of stability with the poles of the system, Introduction, definition of steady state error, derivation of steady-state error, steady-state error of unity feedback systems, system TYPE of unity feedback systems, Steady-State Error Specifications, Steady-State Error for Disturbances, Steady-State Error for Non-unity Feedback System, Root Locus Techniques Introduction, basic concepts of root locus, properties of root locus, angle and magnitude condition of root locus, Rules for sketching the root locus, basic concept of frequency response, plotting frequency response, Bode plots, Stability analysis using bode plots, Nyquist criterion, stability via Nyquist diagram, Control system design by root locus, Design of control systems using frequency response.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. N. S. Nise, "Control System Engineering," 8th Edition, John Wiley & Sons, 2019.

2. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, “Design of Feedback Control Systems,” 5th Edition, Oxford University Press, 2010.
3. K. Ogata, “Modern Control Engineering,” 5th Edition, Prentice Hall, 2015.
4. C. H. Hopis “Linear Control System,” 6th Edition, CRC Press, 2013.
5. B. C. Kuo, “Automatic Control Systems,” 8th Edition, John Wiley & Sons, 2003.

Course Name: **Probability and Probability Distributions – I**

Credit hours: 3 (3+0)
Course Code: STAT-203
Prerequisites: None

Course Objectives:

This course introduces fundamental concepts of probability theory and random variables, essential for understanding uncertainty and randomness in engineering systems. Through lectures, problem-solving sessions, and practical applications, students will gain a solid foundation in probabilistic modeling and analysis techniques relevant to electronics engineering.

Course Content:

Set theory, basic concepts of probability, conditional probability, independent events, Baye's formula, discrete and continuous random variables, distributions and density functions, probability distributions (binomial, Poisson, hyper geometric, normal, uniform and exponential), mean, variance, standard deviations, moments and moment generating functions, linear regression and curve fitting, limits theorems, stochastic processes, first and second order characteristics, applications.

Recommended Books:

1. A. Leon-Garcia, “Probability, Statistics, and Random Processes for Electrical Engineering,” 3rd Edition, Pearson, 2007.
2. J. S. Milton and J. C. Arnold, “Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences,” 4th Edition, McGraw Hill, 2002.
3. W. M. Mendenhall and T. L. Sincich, “Statistics for Engineers and the Sciences,” 6th Edition, Chapman and Hall/CRC, 2015.
4. R. D. Yates and D. J. Goodman, “Probability and Stochastic Processes,” 2nd Edition, Wiley, 2004.

Sixth Semester

Course Name: **Electromagnetic Field Theory**

Credit hours: 3 (3+0)

Course Code: ELEC-311

Prerequisites: Applied Physics

Course Objectives:

To teach concepts and mathematical methods to understand and analyze electromagnetic fields and waves.

Course Content:

Stationary electrics fields: Basic laws and concepts of electrostatics, Differential form of electrostatic laws. Stationary magnetics fields: Statics magnetic field laws and concepts, Differential forms for magneto statics and the use of potential, Magnetic field energy. Maxwell's equations: Large-scale and differential forms of Maxwell's equations, Examples of use of Maxwell's equations. Plane-wave propagation and reflection: Plane-wave propagation, Plane waves normally incident on discontinuities, Plane waves obliquely. Two- and three-ways boundary values problems.

Recommended Books:

1. W. Hayt and J. A. Buck, "Engineering Electromagnetics," 8th Edition, McGraw Hill, 2017.
2. M. Sadiku, "Elements of Electromagnetics," 7th Edition, Oxford University Press, 2018.
3. S. Ramo, J. R. Whinnery, T. V. Duzer, "Fields and Waves in Communication Electronics," 3rd Edition, John Wiley & Sons, Inc., 1994.

Course Title: **Communication Systems**

Credit Hours: 4 (3+1)

Course Code: ELEC-312

Prerequisites: Signals and Systems

Course Objectives:

This course is structured as a senior-level course emphasizing fundamental communication principles and application of these principles to contemporary analogue and digital communication systems.

Course Content:

Introduction to communication systems: Fundamental terms and definitions, information, message signal, analog and digital signals, Elements of communication systems (Transmitter, Channel, Receiver), performance measure and design tradeoffs, signal transmission through a linear system and signal distortion over communication channel. Modulation: Amplitude modulation and demodulation, carrier acquisition, angle modulation schemes, concept of

instantaneous frequency, generation of modulated signals, spectral analysis of angle modulation schemes, demodulation of angle modulation. Baseband Modulation: Binary pulse modulation, M-arypulse modulation, probability of error in M-ary pulse Modulation, pulse shaping, ISI, signal space. Band pass Digital Modulation: Amplitude modulation/detection of digital signals, phase modulation/detection of digital signals, probability of error for DPSK. Performance of communication systems in the presence of noise, review of random process and variables, statistical modeling of noise. Introduction to information theory.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," 4th Edition, Oxford University Press, 2009.
2. L. W. Couch, "Digital & Analog Communication Systems," 8th Edition, Prentice Hall, 2014.
3. R. E. Ziemer and W. H. Tranter, "Principles of Communications: System Modulation and Noise," 7th Edition, Wiley, 2007.
4. S. Haykin, "Communication Systems," 3rd Edition, John Wiley and Sons, Inc., 2015.
5. L. W. Couch II, "Analog and Digital Communication Systems," 6th Edition, Prentice Hall, 2001.

Course Name: **Integrated Circuits**

Credit hours: 3 (3+0)
Course Code: ELEC-313
Prerequisites: Electronic Circuit Design

Course Objectives:

This course covers pulse waveforms, linear circuit responses and switching circuit analysis, pulse-shaping and pulse-generating circuits, flip-flops, one-shots, registers, and counters. Different IC logic family characteristics (TTL, NMOS, ECL, CMOS, LVT) are analyzed and compared. Interfacing the different types of IC logic families. To study the basic principles, configuration, and characteristics of Op-Amp. To study of linear and non-linear applications of Op-Amp. The course also deals in power amplifiers and waveform generators.

Course Content:

Types of Waveforms, Linear Wave shaping: Responses of RC-high pass circuit and low pass circuits to sinusoidal, step, pulse, square, ramp and exponential inputs, Criteria for good differentiation and integration, uncompensated and compensated attenuators. Non-Linear Wave Shaping: Diode as Switch, Clipping circuits with diodes, clipping at two independent levels, transfer characteristics of clippers circuits. multi-diode circuits, transient and steady state response of a diode clamping circuit, clamping circuit theorem, practical clamping, effect of diode characteristics on clamping voltage, transfer characteristics of clampers.

Multivibrators (using BJTs): Bistable Multivibrator: fixed bias transistor binary (only), commutating capacitors, unsymmetrical and symmetrical triggering of binary, Schmitt trigger circuit. collector coupled monostable and astable multivibrators - operation & design. Flip-Flops Emitter monostable astable multivibrators - operation & design. Fundamental concepts of digital circuits, CMOS logic family; NMOS, PMOS logic family, TTL logic family, Emitter Coupled Logic (ECL) family, Bi-COMOS. Interfacing the logic Families, interfacing Analog and Digital circuits and their application.
Differential amplifiers: DC and AC analysis of differential amplifier (low and high frequencies responses). Design of simple differential amplifier, level translators. Current sources; simple current mirror, Widler and Wilson current source. Current sources with improved Prformance. Output stage design; classification of output stages (class A, Class B and Class AB output stages). Use of op-amp as a circuit element. The 741 Op-Amp internal circuit. Open loop and close loop circuits of Op-Amp (inverting and non-inverting amplifier circuits). DC and AC analysis of 741 op-amp ICs (Small Signal and large signal Analysis, gain, frequency response and Slew rate of op-amp). Interpreting IC data sheet (Op-Amp). 555 Timer, description of functional diagram – Astable, monostable operation.

Recommended Books:

1. A. S. Sedra, K. C. Smith, T. C. Carusone and V. Gaudet, “Microelectronic Circuits,” 8th Edition, Oxford University Press, 2020.
2. R. A. Gayakwad, “OP-AMP and Linear ICs,” 4th Edition, Pearson Education, 2021.
3. J. Milliman and H. Taub, “Pulse, Digital and Switching Waveforms”, McGraw Hill, 1965.
4. A. Kumar, “Pulse and Digital Circuits,” 2nd Edition, PHI, 2008.
5. D. A. Bell, “Solid State Pulse Circuits,” 2nd Edition, Prentice Hall Company, 1991.
6. D. R. Choudhury and S. B. Jain, “Linear Integrated Circuits,” 5th Edition, New Age International Pvt. Ltd., 2018.
7. J. E. Ayers, “Digital Integrated Circuits: Analysis and Design,” 2nd Edition, CRC Press, 2009.

Course Name: **Embedded System Design**

Credit hours: 4 (3+1)
Course Code: ELEC-314
Prerequisites: Microprocessor System Design

Course Objectives:

To introduce different microcontroller series, the hardware architecture and programming of the 8051 family of microcontrollers, the Arduino Microcontrollers programming and interfacing with different sensors and devices.

Course Content:

Introduction to Microcontrollers, Comparison of PIC, 8051, 68HC11 Microcontrollers, 8051 Microcontroller, Study of internal Architecture of 8051

Family of Microcontrollers and functions of different pins, 8051 Microcontroller Programming basics in Assembly and C Language uVision Keil IDE, Programming in assembly and C51 for Timers/Counters, Serial Port and serial communication, Interrupts, Advanced programming techniques, Interfacing and coding of keypad, LCD module, real-time clock DS12887, DS1307, Dot matrix display, stepper motor, temperature sensor, ADC, DAC.
Arduino Microcontroller Introduction and different features, Arduino IDE and Programming in C Language for Timers/Counters, Serial Port and serial communication, Interrupts, Advanced programming techniques, Interfacing of different sensors and displays with Arduino.

Lab outline:
Lab contents will be in accordance with the course outline.

Recommended Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Prentice Hall, 2008.
2. I. S. MacKenzie and R. C.-W. Phan, "The 8051 Microcontroller," 4th Edition, Pearson, 2006.
3. M. Torvalds, "Arduino Programming: Step-by-step guide to master Arduino hardware and software," 2nd Edition, CreateSpace Independent Publishing Platform, 2017.

Course Name: **Power Electronics**

Credit hours: 4 (3+1)
Course Code: ELEC-315
Prerequisites: Basic Electronics

Course Objectives:
To introduce the fundamentals of Power Electronics and its role in solar energy systems and electric vehicles, Power Electronic Devices, DC to DC Converters, DC to AC Inverters, Thyristors, Renewable Energy Systems.

Course Content:
Introduction to power electronics, Role of power electronics in Electric Vehicles and Solar energy systems, Basics of signals used in Power Electronics, Solid-state devices used in power electronics, power diode, power BJT, power MOSFET, Thyristors, SCR, GTO, IGBT, TRIAC, DIAC; semi-controlled, fully-controlled and uncontrolled, Applications of Thyristors, Single-phase and three-phase inverters, DC to DC converters, Buck, Boost, Buck-boost, SEPIC converters, Closed loop DC to DC converters, Isolated Converters, Applications of DC to DC converters in Solar systems, Applications of Converters and Inverters in Wind Energy Systems.

Lab outline:
Lab contents will be in accordance with the course outline.

Recommended Books:

1. A. Emadi, A. Khaligh, Z. Nie and Y. J. Lee, “Integrated Power Electronic Converters and Digital Control,” 1st Edition, CRC Press, 2017.
2. M. H. Rashid, “Power Electronics: Devices, Circuits and Applications,” 4th Edition, Pearson, 2017.
3. U. R. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converters, Applications and Design,” 3rd Edition, Wiley, 2009.

Course Name: **Linear Algebra**

Credit hours: 3 (3+0)
Course Code: MATH-224
Prerequisites: Calculus and Analytical Geometry

Course Objectives:

This course is designed to introduce the fundamentals of Matrices, Vectors, Determinants, and Differential Equations and their applications in solving Engineering Problems.

Course Content:

Algebra of Matrices; Inverse of a Matrix; Gauss-Jordan Method for the Solution of a System of Linear Algebraic Equations; Vectors in the Plane and in Three Dimensions; Vector Functions; Vector Spaces; Subspaces; Span and Linear Independence; Basis and Dimension; Homogeneous Systems; Coordinates and Isomorphism; Rank of a Matrix; Determinant; Inverse of a Matrix; Applications of Determinants; Determinants from a Computational Point of View; Properties of Determinants; Eigenvalues and Eigenvectors; Systems of Linear Differential Equations; Diagonalization; Hermitian Matrices; Singular value Decomposition; Quadratic Forms; Positive Definite Matrices; Non-Negative Matrices; Floating-Point Numbers; Gaussian Elimination; Pivoting Strategies; Matrix Norms and Condition Numbers; Orthogonal Transformations; Eigenvalue Problem; Least Square Problems.

Recommended Books:

1. E. Kreyszig, “Advance Engineering Mathematics,” 10th Edition, John Wiley & Sons, 2011.
2. B. Kolman and D. Hill, “Elementary Linear Algebra,” 8th Edition, Prentice Hall, 2004.
3. K. Hardy, “Linear Algebra for Engineers and Scientists Using MATLAB,” 1st Edition, Prentice Hall, 2005.
4. S. Goode, “Differential Equations and Linear Algebra,” 2nd Edition, Prentice Hall, 2000.
5. M. J. Strauss, G. L. Bradley and K. J. Smith, “Calculus,” 3rd Edition, Pearson Education, 2002.

Seventh Semester

Course Name: **Data Communication and Networks**
Credit Hours: 4 (3+1)
Course Code: ELEC-401
Prerequisites: Communication Systems

Course Objectives:

This course provides students with a comprehensive understanding of the principles, protocols, and technologies underlying data communication and computer networks. It covers both theoretical concepts and practical aspects, enabling students to design, implement, and troubleshoot network systems.

Course Content:

Introduction to Data Communication: Overview of Data Communication, Basic Terminologies, Components of Data Communication Systems, Communication Channels and Media, Modulation and Multiplexing Techniques; Networking Fundamentals: Network Types and Topologies, OSI and TCP/IP Models, Network Layers and Protocols, Addressing and Routing; Local Area Networks (LANs): Ethernet and IEEE 802 Standards, LAN Technologies: Ethernet, Wi-Fi, Token Ring, etc., LAN Switching and VLANs, LAN Troubleshooting and Management; Wide Area Networks (WANs): WAN Technologies: Leased Lines, DSL, Cable Modems, etc., Circuit Switching vs. Packet Switching, WAN Protocols: PPP, HDLC, Frame Relay, ATM, etc., Virtual Private Networks (VPNs); Internet Protocol (IP) Networks: IPv4 and IPv6 Addressing, IP Subnetting and Supernetting, Routing Protocols: RIP, OSPF, BGP, etc., Internet Control Message Protocol (ICMP); Transport Layer Protocols: Transmission Control Protocol (TCP), User Datagram Protocol (UDP), TCP/IP Socket Programming; Network Security: Threats and Vulnerabilities, Cryptography Basics, Firewalls and Intrusion Detection Systems (IDS), Secure Network Design and Management; Wireless and Mobile Networks: Wireless Technologies: Wi-Fi, Bluetooth, Zigbee, etc., Mobile Communication Standards: GSM, CDMA, LTE, 5G, etc., Mobile IP and Handover Techniques, Ad-hoc and Sensor Networks.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. J. F. Kurose and K. W. Ross, “Computer Networking: A Top-Down Approach,” 6th Edition, Pearson, 2012.
2. W. Stallings, “Data and Computer Communications,” 8th Edition, Prentice Hall, 2007.
3. T. Lammle, “CCNA Routing and Switching Complete Study Guide,” 2nd Edition, Sybex Inc., 2016.
4. W. R. Stevens, “TCP/IP Illustrated, Volume 1, The Protocols,” 2nd Edition, Addison-Wesley Professional,1994.

5. D. E. Comer, “Computer Networks and Internets,” 6th Edition, Addison-Wesley, 2014.
6. S. Tananbaum and D. J. Wetherall, “Computer Networks,” 5th Edition, Prentice Hall, 2010.
7. B. A. Forouzan, “Data Communications and Networking,” 4th Edition, McGraw-Hill Higher Education, 2007.

Course Name: **Digital Signal Processing**

Credit Hours: 4 (3+1)

Course Code: ELEC-402

Prerequisites: Signals and Systems

Course Objectives:

This course aims to develop mathematical and analytical skills necessary to analyze digital signals and systems both in time and frequency domains.

Course Content:

Discrete-Time Systems, The z-transform and its application to the analysis of Linear Time Invariant Systems, Discrete Fourier Transform, Circular Convolution, Fast Fourier Transform, Design of Digital filters, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, Butterworth and Chebyshev approximation of analog filters.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. J. G. Proakis and D. K. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications,” 4th Edition, Pearson Education Inc., 2007.
2. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing,” 3rd Edition, Pearson Education Inc., 2009.
3. R. Lyons, “Understanding Digital Signal Processing,” 3rd Edition, Pearson Education Inc., 2010.
4. J. H. McClellan, R. W. Schafer and M. A. Yoder, “DSP First,” 2nd Edition, Pearson Education, Inc., 2016.

Eighth Semester

Course Name: **Microwave Electronics**

Credit hours: 4 (3+1)
Course Code: ELEC-411
Prerequisites: Electromagnetic Field Theory

Course Objectives:

To introduce the analysis and design of microwave passive and active components, devices, and circuits.

Course Content:

RF and microwave frequencies and technology; Passive microwave components: resistors, capacitors and inductors at RF and microwave frequencies; Transmission lines: coaxial lines, strip line, slot line, coplanar line, and suspended-substrate strip line; Analysis and optimization of transmission lines: impedance matching, Standing Wave Ratio (SWR), reflection loss, impedance matching on Smith chart; Waveguides and its types (rectangular and circular etc.); Passive microwave devices and circuits: directional couplers, isolators, circulators, resonant circuits, passive filter design; Active microwave devices and circuits: diodes, transistors at RF frequencies, quantum electronic devices, small signal RF amplifier design, RF power amplifier; microwave mixers and detectors; Radar systems.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. D. M. Pozar, "Microwave Engineering," 4th Edition, John Wiley & Sons, Inc., 2012.
2. G. Kennedy, B. Davis and S. R. M. Prasanna, "Kennedy's Electronics Communication Systems," 5th Edition, New Delhi: McGraw-Hill Education Pvt. Ltd., 2011.
3. S . Y. Liao, "Microwave Devices and Circuits," 3rd Edition, Prentice-Hall Internation, Inc., 1980.
4. R. E. Collin, "Foundations for Microwave Engineering," 2nd Edition, McGraw-Hill, Inc., 1966.
5. K. W. Yeom, "Microwave Circuit Design: A Practical Approach Using ADS," 1st Edition, Prentice Hall, Inc., 2015.
6. G. D. Vendelin, A. M. Pavio and U. L. Rohde, "Microwave Circuit Design Using Linear and Nonlinear Techniques," John Wiley & Sons, Inc., 2005.

BS Electronics Elective Courses

Course Name: **VLSI Design**

Credit hours: 4 (3+1)
Course Code: ELEC-404
Prerequisites: Digital Logic Design

Course Objectives:

To study the fundamentals of MOSFET circuits and their characteristics. To learn the design and realization of combinational & sequential digital circuits using MOSFET. Fabrication processes of MOS circuits, design rules for layouts and the limitations in scaling. Realization of MOS circuits for various combinational logic blocks and analyze the performance tradeoffs with respect to the area, power, and delay. To have idea of Verilog HDL and implementing various modules on FPGA.

Course Content:

Evolution of VLSI technology trends in VLSI, MOS transistor theory, MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances, transconductance, figure of merit. MOSFE Transistors SPICE MODEL, Level 1, 2 and 3. Fabrication of MOSFET, CMOS fabrication process steps, isolation, latchup, twin well process, triple well process.

MOS inverter, resistive and active load, CMOS inverter design, DC characteristics, switching characteristics, rise time, fall time delays, noise margin, CMOS Inverter design with delay constraints, Interconnect parasitic and Delay, static & dynamic power dissipation in CMOS inverters. Combinational MOS/CMOS logic implementation, pass transistor and transmission gate designs, tristate buffers, cascaded inverters and super buffers.

Sequential MOS/CMOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop, dynamic logic circuits; basic principle, synchronous dynamic circuit techniques, shift register, domino CMOS logic, high performance dynamic CMOS circuits, clocking issues, clock distribution. Introduction to Semiconductor memories.

Introduction to BiCMOS Logic circuits, Static Behavior, Switching in BiCMOS Logic Circuits, BiCMOS Applications. CMOS chip design, design strategies, design flow, design Hierarchy, concept of regularity, modularity & locality, Chip design using programmable logic, testing. Introduction to Layout and design rules. CMOS and SOI Technology.

Overview of digital design with Verilog HDL -Hierarchical modeling concepts- Modules and port definitions -Gate level modeling- Data flow modeling - Behavioral modelling - HDL programs for simple combinational and sequential circuits.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. S. M. Kang and Y. Lebiebici, "CMOS digital integrated circuits analysis & design," 4th Edition, Tata McGraw Hill, 2019.
2. J. M. Rabaey, "Digital Integrated Circuits," 2nd Edition, PHI Learning Pvt. Limited, India, 2016.
3. N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective," 4th Edition, Pearson Education, India, 2011.
4. J. E. Ayers, "Digital Circuit Analysis and Design," 2nd Edition, CRC Press, 2010.
5. Z. Navabi, "Verilog Digital System Design: Register Transfer Level Synthesis, Testbench, and Verification," 2nd Edition, McGraw Hill Education, 2005.

Course Name: **Industrial Electronics**

Credit hours: 4 (3+1)
Course Code: ELEC-405
Prerequisites: Linear Control Systems

Course Objectives:

This course covers essential skills for industrial applications, including motor control circuits, sensors, PLC programming, and advanced control techniques like pulse modulation. Students will learn to optimize processes using distributed control systems and data acquisition methods.

Course Content:

Mechanical Devices, Sensors Switches, Operational Amplifiers, and other ICs, for industrial Applications, time Delay Circuits, phase and power control circuits. DC and AC Motors, Stepper Motors, Motor Control Circuits, Transducers, Industrial Process Control, Digital Sequences Control, Speed control of DC, AC, and servo motors. Process control. Measurement of non-electrical quantities: Temperature, displacement, pressure, time, frequency; digital industrial measuring systems. Ultra-sonic generation and application. X-ray applications in industry. Photo-electric devices. Industrial control using PLC's. Data acquisition. Distributed control system in process industries.
Pulse Modulation in Industrial Telemetry and Data Communication, Segmental Power Control, Programmable Logic Controllers (PLC) and its programming, Automation and Robotics.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. F. D. Petruzella, "Industrial Electronics," 1st Edition, McGraw Hill, 1995.
2. J. T. Humphries and L. P. Sheets, "Industrial Electronics," 4th Edition, Cengage Learning, 1993.
3. F. D. Petruzella, "Programmable Logic Controllers," 5th Edition, McGraw Hill, 2016.

Course Name: **Introduction to Robotics**

Credit hours: 4 (3+1)
Course Code: ELEC-406
Prerequisites: Linear Algebra, Probability and Probability Distributions – I

Course Objectives:

The objective of this course is to introduce students to the basic concepts in robotics that provide essential knowledge of the field that would be required by a practicing engineer who must deal with automation and provide professional development by introducing best practices for engineering design.

Course Content:

Historical development of robots, basic terminology and structure; robots in automated manufacturing, robot configuration space and its topology, degrees of freedom, Rigid Motions and Homogeneous Transformation: Rotations and their composition; Exponential coordinates; Screw theory; Twists; Euler angles; Forward Kinematics: Common robot configurations; Product of Exponentials formula; Denavit-Hartenberg convention; Velocity kinematics: Angular velocity and acceleration; The Jacobian Statics of open chains: The use of the Jacobian; singular configurations; manipulability, Inverse kinematics: Planar mechanisms; geometric approaches; pseudoinverse; spherical wrist; numerical approaches and Newton-Raphson method, Kinematics of closed-chains, Robot dynamics: Lagrangian dynamics; Euler-Newton equations for open kinematic chains. Forward and inverse dynamics. Trajectory generation: trajectories in space of homogeneous transformations; minimum time trajectories Feedback control: Actuators and sensors; velocity and torque control; PID control; linearization; feedback linearization.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. K. M. Lynch and F. C. Park, “Modern Robotics: Mechanics, Planning, and Control,” Cambridge University Press, 2017.
2. J. Craig, “Introduction to Robotics: Mechanics and Control,” 4th Edition, Pearson, 2017.
3. M. Spong, M. Vidyasagar and S. Hutchinson, “Robot Modeling and Control,” 2nd Edition, Wiley & Sons, Inc., 2020.

Course Name: **Industrial Automation**

Credit hours: 4 (3+1)
Course Code: ELEC-407
Prerequisites: Instrumentation and Measurements, Linear Control Systems

Course Objectives:

The course will enable students to understand the Industrial control fundamentals, analog and digital sensors, automation in industries, design of control systems focusing on process control, manufacturing systems, the programmable logic controller (PLC), supervisory control and data acquisition (SCADA).

Course Content:

Mechanical Devices, sensor switches, Operational Amplifiers and other ICs, for industrial Applications, time Delay Circuits, phase and power control circuits, DC and AC Motors, Stepper Motors, Motor Control Circuits, Transducers, Open loop and closed loop systems, Industrial Process Control, Digital Sequences Control, Speed control of DC, AC, and servo motors, Measurement of non-electrical quantities: Temperature, displacement, pressure, time, frequency; digital industrial measuring systems. Ultrasonic generation and application, Photoelectric devices, Data acquisition, Distributed control systems in process industries, Programmable Logic Controller (PLC) and its programming basics, Ladder logic diagrams, Industrial control using PLCs, Process Automation, Supervisory control and data acquisition (SCADA).

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. T. L. M. Bartelt, “Industrial Automated Systems: Instrumentation and Motion Control,” 1st Edition, Cengage Learning, 2010.
2. T. O. Boucher, “Computer Automation in Manufacturing: An Introduction,” Springer, 2012.
3. M. P. Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing,” 5th Edition, Pearson, 2018.

Course Name: **Optoelectronics**

Credit hours: 3 (3+0)
Course Code: ELEC-408
Prerequisites: Basic Electronics

Course Objectives:

The objective of the course is to introduce basics of laser physics and technology, overview of various advanced laser devices, and to provide broad introduction to applications of the lasers in optical communications.

Course Content:

Nature of light, Semiconductor physics, Semiconductor laser structures, Elements of Semiconductor Laser, Elements of Laser Radiation, basic laws, Various Laser Systems, Laser and Non-Laser Light, optical fiber, Basic Characteristics of Light Waves, Unique Properties of laser Light; Monochromaticity, Directionality, Coherence, types of optical fiber material, fabrication, and components. Laser threshold condition, laser losses, Competition Between Stimulated and

Spontaneous Emission, Main Problem with light amplification, Creation of Population Inversion, Mechanisms to Create Population Inversion, Inversely Populated Systems; Two Level, Three-Level and Four-Level Systems. Population inversion and threshold conditions, laser mode, Stimulated Emission in a Resonant Cavity, how does the Resonant Cavity Work, Classes of lasers, semiconductor light sources, light emitting diodes. Active Medium, Photons and Electrons, Light Excitation Mechanism, Basics of Quantum Physics of Atoms, Atomic Transitions and Photons Interaction of Light with Atoms, Optical Gain and Optical Loss, Feedback Mechanism, Optical Cavity, Optical Confinement in Lasers, Wave-Guiding in Lasers, Laser as a Quantum-Mechanical Device. Static and dynamic properties of semiconductor lasers Semiconductor optical amplifiers (SOAs), Gain, Radiative and non-radiative transitions , Quantum well Optical transitions and gain, Quantum wells, Gain in bulk versus QW, Semiconductor laser materials, n-type and p-type semiconductors, Current transport by holes, p-n junction: band diagram, Heterostructures principles, The first heterostructures, GaAs/AlGaAs heterostructure lasers, InGaAsP/InP heterostructure lasers, Total internal reflection, mode propagation, Buried heterostructure: current confinement, Lateral optical and electrical confinement, Material losses, Scattering. Semiconductor laser cavities, Multimode and single mode lasers, Bragg gratings, Tunable DBR lasers, Distributed feedback (DFB) lasers, DFB lasing threshold, Vertical cavity surface emitting lasers (VCSELs), Waveguide and Micro bend losses, Intermodal dispersion, Intramodal dispersion. Static properties of lasers – Densities of electrons and photons, L-I curves, spectra; Dynamic properties of lasers – Rate equations for photons and electrons Voltage and light versus current, Laser power output, Dynamic properties of semiconductor lasers.

Recommended Books:

1. H. Kolimbiris, “Fiber Optics Communications,” Pearson Education, Inc., 2004.
2. E. Rosencher and B. Vinter, “Optoelectronics,” Cambridge University Press, 2002.
3. A. Yariv, “Optical Electronics in Modern Communications,” 5th Edition, Oxford University Press, 1997.
4. S. L. Chuang, “Physics of Optoelectronic Devices,” 1st Edition, Wiley-Interscience, 1995.
5. J.-M. Liu, “Photonic Devices,” Cambridge University Press, 2009.
6. L. A. Coldren, S. W. Corzine and M. L. Mashanovitch, “Diode Lasers and Photonic Integrated Circuits,” 2nd Edition, Wiley, 2012.
7. J. T. Verdeyen, “Laser Electronics,” 3rd Edition, Prentice Hall, 1995.

Course Name: **Laser and Fiber Optics**

Credit hours: 3 (3+0)

Course Code: ELEC-409

Prerequisites: Basic Electronics, Signals and Systems

Course Objectives:

This course is designed to introduce and develop the fundamental mathematical and analytical skills necessary to analyze the concept of Lasing and

Fiber optics transmission. It introduces fundamental laws and principles necessary to understand the laser and Fiber Optics technology.

Course Content:

Nature of light; Physics of light; Laws of Optics; Properties of Laser; Light Measurements; Safe use of Laser Light: Classes of Lasers, Laser Losses; Essential Laser Components; The Lasing Process: Population Inversion, Amplifier Gain; Laser Modes; Optical Accessories; Types of Lasers; Laser Applications: Measurements, Industrial, Medical, Military, and Communication; Introduction to Fiber Optics; Principles of Fiber Optics Light Propagation; Mode Propagation; Skew Waves; The Ray Theory; Types of Optical Fiber; Advantages of Optical Fiber; Fiber Material; Optical Fiber Fabrication; Components of Optical Fiber; Fiber Losses; Dispersion; Principles of Fiber Optic Communication; Modulation; Multiplexing; Optical Transmitters: Light Emitting Diodes, Lasers; Optical Receivers: Photodetectors, Principles of Photodetection, Characteristics of Photodetectors; Optical Networks: Long-Haul Communication, Local Area Networks, Other Communication Systems.

Recommended Books:

1. H. Kolimbiris, “Fiber Optics Communications,” Pearson Education, Inc., 2004.
2. J. Johnson, “Laser Technology,” Heath Company, 1985.
3. H. Zanger and C. Zanger, “Fiber Optics: Communication and Other Applications,” Merrill Pub Co., 1991.
4. J. C. Palais, “Fiber Optic Communication” 5th Edition, Pearson Education, 2011.
5. E. Rosencher and B. Vinter, “Optoelectronics,” Cambridge University Press, 2002.

Course Name: **Advance Computer Programming**

Credit hours: 4 (3+1)
Course Code: ELEC-410
Prerequisites: Computer Programming

Course Objectives:

This course aims to equip students with advanced programming skills in C++, MATLAB, and Python, tailored specifically for applications in electronics engineering. Through hands-on exercises and projects, students will learn to solve complex problems, manipulate data, and implement algorithms commonly encountered in electronics-related tasks.

Course Content:

Overview of C++ language, Control structures, Functions and parameter passing, Arrays and strings, Pointers and memory management, Object-oriented programming (OOP) concepts: classes, objects, inheritance, polymorphism, Advanced OOP concepts: templates, namespaces, operator overloading, Exception handling, File handling and streams, Advanced topics: smart pointers, lambda expressions, move semantics, Introduction to MATLAB environment and

syntax, Working with matrices and arrays, Plotting and visualization, Scripting and programming constructs: loops, conditionals, Functions and function handles, File I/O operations, Introduction to Simulink for simulation and modeling, Advanced data manipulation and processing techniques, Signal processing and filter design, Image processing and computer vision applications, Optimization techniques, Introduction to machine learning with MATLAB, Introduction to Python, Control structures, Functions and modules, Working with lists, tuples, dictionaries, and sets, File I/O operations, Introduction to NumPy for numerical computing, Object-oriented programming in Python, Exception handling and debugging techniques, Introduction to Pandas for data manipulation and analysis, Plotting and data visualization with Matplotlib, Introduction to machine learning libraries such as scikit-learn.

Recommended Books:

1. S. Lippman, J. Lajoie and B. Moo, "C++ Primer," 5th Edition, Addison-Wesley Professional, 2012.
2. H. Moore, "MATLAB for Engineers," 5th Edition, Pearson, 2017.
3. E. Matthes, "Python Crash Course: A Hands-On, Project-Based Introduction to Programming," 3rd Edition, No Starch Press, 2023.

Course Name: **Optical Communication Systems**

Credit hours: 3 (3+0)
Course Code: ELEC-413
Prerequisites: Basic Electronics

Course Objectives:

The aim of this course is to develop in students a comprehensive understanding of optical data transmission, from the underlying semiconductor materials and active devices, through transmission media, to multiplexing techniques and overall systems design.

Course Content:

Principles of Fiber optics light propagation. Heterostructures principles, the first heterostructures, GaAs/AlGaAs heterostructure lasers, Quantum well lasers, What wavelengths are needed for telecommunications? Materials for 1300 and 1550 nm lasers, In GaAsP/InP heterostructure lasers, Total internal reflection, mode propagation, skew waves. How are heterostructures grown? Optical Waveguides, Total internal reflection (TIR), Quantum wells revisited: analogy between waveguides and QWs, Optical confinement factor "Γ", Variation of optical confinement with v, Acceptance angle and numerical aperture Fiber Characteristics. Lateral optical and electrical confinement, Early lateral confinement structures, Laser structures. How do these lateral waveguides work? Buried heterostructure: current confinement, Lateral optical and electrical confinement, Fiber losses, Material losses, Scattering. Semiconductor laser cavities, Multimode and single mode lasers, Bragg gratings, Tunable DBR lasers, Distributed feedback (DFB) lasers, DFB lasing threshold, Vertical cavity surface emitting lasers (VCSELs), Waveguide and Micro bend losses, Intermodal

dispersion, Intramodal dispersion. Static properties of lasers – Densities of electrons and photons, L-I curves, spectra; Dynamic properties of lasers – Rate equations for photons and electrons, how to modulate the laser output – Small-signal, large-signal, Frequency modulation and "chirp" – Spectra under modulation, Step index fiber multi-mode fiber, graded index fiber.
Voltage and light versus current, Laser power output, Dynamic properties of semiconductor lasers, Small-signal direct modulation (rate equations), Resonance frequency and damping, Large-signal modulation, Turn-on delay, Relaxation oscillations, Frequency chirping and frequency modulation step index fiber single mode, other fibers, Principles of Fiber Optic Communication. Limitations of direct intensity modulation, High-speed modulation, Integrated EA-DFB high-speed sources, Direct Modulation of Semiconductor Lasers: Frequency Modulation, Frequency modulation of laser diodes, static and dynamic properties of lasers, Modulation and Multiplexing, fiber Optics Components. Optical transmitter, Optical receivers, Wavelength division multiplexing (WDM), FDM versus WDM, WDM multiplexer, Benefits of WDM, dense wavelength division multiplexing, optical networks.

Recommended Books:

1. H. Kolimbiris, "Fiber Optics Communications," Pearson Education, Inc., 2004.
2. E. Rosencher and B. Vinter, "Optoelectronics," Cambridge University Press, 2002.
3. A. Yariv, "Optical Electronics in Modern Communications," 5th Edition, Oxford University Press, 1997.
4. S. L. Chuang, "Physics of Optoelectronic Devices," 1st Edition, Wiley-Interscience, 1995.
5. J.-M. Liu, "Photonic Devices," Cambridge University Press, 2009.
6. L. A. Coldren, S. W. Corzine and M. L. Mashanovitch, "Diode Lasers and Photonic Integrated Circuits," 2nd Edition, Wiley, 2012.
7. J. T. Verdeyen, "Laser Electronics," 3rd Edition, Prentice Hall, 1995.

Course Name: **Biomedical Instrumentation**

Credit hours: 4 (3+1)
Course Code: ELEC-414
Prerequisites: Instrumentation and Measurements

Course Objectives:

To introduce the fundamentals of measurement systems and errors, biomedical sensor and transducer characteristics, medical devices based on application to physiological systems, working principles of commonly used biomedical instruments and sensors.

Course Content:

Introduction to measurements, Precision, Resolution, Sensitivity, Accuracy, Uncertainty, Bio-potentials, biosensors and transducers, Biomedical signals of the human body, Sensors and transducers for bio-potential measurements, Problems encountered in measuring biopotentials of the human body, Invasive and

noninvasive measurement techniques and related equipment. Functional Building Blocks of a Biomedical Instrumentation System, Cardiovascular System Devices, Diagnostic: Electrocardiography, Measurement of Blood pressure, Blood flow, Therapeutic: Cardiac output. Defibrillator, pacemaker, Pulmonary System Devices, Diagnostic: Pulmonary Function Analyzer, Spirometry, Ventilation Monitors, Respiration: Pulse oximetry, Capnography, Therapeutic: Ventilators, Heart-lung machine, nebulizer, Musculoskeletal & Nervous System Devices, EMG, EEG, Critical Care Devices, Patient Monitoring: Patient Monitors, central monitoring system, telemetry system, Surgical/Operation Theatre Devices Equipment: Electrosurgical unit, Genito-urinary System Devices, Hemodialysis Machine, Quality Assurance and Quality Control Common defects in medical equipment, Performance measurement Calibration, Maintenance and repair.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. L. Cromwell, F. J. Weibell and E. A. Pfeiffer, “Biomedical Instrumentation and Measurements,” 2nd Edition, Prentice Hall, 1990.
2. J. G. Webster, “Bioinstrumentation,” 1st Edition, Wiley, 2003.
3. J. G. Webster and A. J. Nimunkar, “Medical Instrumentation: Application and Design,” 5th Edition, Wiley, 2020.

Course Name: **Nanotechnology**

Credit hours: 3 (3+0)
Course Code: ELEC-415
Prerequisites: Calculus and Analytical Geometry, Linear Algebra

Course Objectives:

This course will cover the introduction to nanoscience and nanotechnology, physical chemistry of solid surfaces, zero-dimensional nanostructures: nanoparticles, quantum dots, one dimensional nanostructures: nanowires and nanorods, template–based synthesis, two-dimensional nanostructures. Thin films by physical and chemical methods, three-dimensional nanostructures: nano-carbons, fullerenes, CNTs and graphene, core-shell nanostructures, nanomaterials hazards and safety procedures. This course will also cover characterization and applications of technologically advanced nanomaterials and nanotechnology, its societal implications and prospects for business and industry.

Course Content:

Introduction to nanotechnology, nanomaterials, nanofabrication methods: photolithography, electron beam lithography, ion-beam lithography, hydrothermal, chemical vapor deposition, and physical vapor deposition, zero dimensional nanostructures, one dimensional nanostructure, two-dimensional nanostructures, their structures, properties, three-dimensional nanostructures: metal-organic frameworks, microporous materials, etc., core-shell nanostructures, different

properties of various nanomaterials, characterization of nanomaterials, applications of nanotechnology in electronics, optics and environmental, nanotechnology hazards and safety issues, inherent risks of various nanotechnology fields, laboratory safety guidelines for handling engineered nanoparticles, waste disposal procedures, industrial problems related to nanotechnology, nanotechnology and prospects for business and industry, societal implications of nanotechnology.

Recommended Books:

1. H. H. Gatzen, Volker Saile and Jürg Leuthold, "Micro and Nano Fabrication: Tools and Processes," Springer, 2015.
2. D. Vollat, "Nanoparticles-Nanocomposites-Nanomaterials," Wiley-VCH, 2013.
3. M. Köhler and W. Fritzsche, "Nanotechnology: An Introduction to Nanostructuring Techniques," Wiley-VCH, 2007.
4. G. Cao and Y. Wang, "Nanostructures and Nanomaterials; Synthesis Properties and Applications," 2nd Edition, World Scientific, 2011.
5. A. Chambers, R. K. Fitch and B. S. Halliday, "Basic Vacuum Technology," 2nd Edition, Tailor and Francis, 1998.

Course Name: **Linear Integrated Circuits**

Credit hours: 4 (3+1)
Course Code: ELEC-416
Prerequisites: Integrated Circuits

Course Objectives:

To study the basic principles, configuration, and characteristics of Op-Amp. To understand various mathematical applications of Op-Amp. To design and understand filters, waveform generators etc. which are used in electronic systems.

Course Content:

Integrated Circuit classification, Fundamentals of Monolithic IC Technology, Basic Fabrication process Fabrication of a typical circuit – Active and passive components of ICs - Operational amplifier – Basic information of Op-Amps – Ideal Op Amp –operational amplifier Internal circuit– Examples of IC Op-Amps - DC, AC Characteristics of Op-Amp –virtual ground, frequency compensation techniques - slew rate. Basic Op-Amp applications (sign changer, scale changer, voltage follower, adder and subtractor) – Instrumentation amplifier – Voltage-to-Current and Current-to-Voltage converter – Logarithmic amplifier - Anti-logarithmic amplifiers Differentiator - Integrator - Comparator – Schmitt trigger – Active filters – Design of Low pass, high pass and band pass filters – Precision rectifiers.

Analog multiplier IC – applications – Analysis of four quadrant and variable Transconductance multipliers – PLL: Basic principles – Phase Detector/Comparator- Voltage controlled Oscillator – Monolithic PLL – PLL applications – Frequency multiplier – AM, FM and FSK demodulators – Frequency synthesizers – Frequency translation. Introduction - basic DAC techniques: Binary weighted resistor type – R-2R ladder type – sample and hold circuits – Analog to-

Digital converters: Flash type ADC – Counter type ADC –Successive approximation register type ADC- Dual slope ADC – DAC / ADC Specifications. Waveform generators – Basic principles of sine wave oscillators – Astable and monostable multivibrators using Op-Amp ICL8038 Function Generator – 555 timer: description of functional diagram – Astable, monostable operation –ICs voltage regulator – switching regulator – Switched capacitor filter – LM380 audio amplifier – Opto couplers and fiber optic ICs.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. A. S. Sedra, K. C. Smith, T. C. Carusone and V. Gaudet, "Microelectronic Circuits," 8th Edition, Oxford University Press, 2020.
2. D. R. Choudhury and S. B. Jain, "Linear Integrated Circuits," 5th Edition, New Age International Pvt. Ltd., 2018.
3. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits," 4th Edition, Prentice Hall, 2002.
4. B. Razavi, "Fundamentals of Microelectronics," 2nd Edition, Wiley, 2014.
5. D. A Bell, "Operational Amplifiers and Linear ICs," 3rd Edition, Oxford University Press, 2011.

Course Name: **Antennas and Wave Propagation**

Credit hours: 3 (3+0)
Course Code: ELEC-417
Prerequisites: Electromagnetic Field Theory

Course Objectives:

To develop understanding of various types of antenna radiation mechanism, to provide the knowledge of basic understanding of antenna operation through the application of Maxwell's equations, to provide the basic knowledge to calculate array factor of array antennas, to introduce various types of antennas and their performance characteristics, to develop the students' ability to apply modern mathematical techniques to the solutions of antenna problems.

Course Content:

Fundamentals of radiation theory, Antenna parameters, Radiation from elementary dipoles and loops, Radiation integrals for current (wire) antennas, Antenna arrays, Radiation from apertures and equivalence theorem, Receiving antennas and noise, Radar range equation and Friis transmission equation, Fundamentals of electromagnetic wave propagation, and introduction of constraints in terms of frequency, polarization, environmental conditions, geometry such as ground reflection, refraction, ducting, multipath, diffraction, interference, atmospheric attenuation in various frequency bands used in communication and radar systems.

Recommended Books:

1. R. E. Collin, “Antennas and Radiowave Propagation,” McGraw Hill, 1985.
2. C. A. Balanis, “Antenna Theory: Analysis and Design,” 4th Edition, John Wiley and Sons, Inc., 2016.
3. J. D. Kraus, “Antennas,” McGraw Hill, 1950.
4. E. C. Jordan and K. G. Balmain, “Electromagnetic Waves and Radiating Systems,” 2nd Edition, Pearson India, 2015.

Course Name: **Transmission Lines and Antennas**

Credit hours: 3 (3+0)
Course Code: ELEC-418
Prerequisites: Electromagnetic Field Theory

Course Objectives:

To lead the foundation for advanced topics in electromagnetics, to provide a foundation to the students in applied electromagnetics and to enable the students understand and grasp the concepts of high-frequency electromagnetics.

Course Content:

Introduction of transmission line, types, transmission line parameters, line equations, equivalent circuit, line impedance, input impedance, measurement of secondary constants, line sections, reflection coefficient, VSWR and power, Smith chart and its applications, impedance matching , some applications of transmission lines.
Introduction to antennas, key antenna parameters, radiation from elemental electric dipoles, radiation from elemental magnetic dipoles, far field of an antenna, half-wavelength dipole, two element antenna arrays, uniform antenna arrays, uniform antenna arrays.

Recommended Books:

1. W. Hayt and J. A. Buck, “Engineering Electromagnetics,” 8th Edition, McGraw Hill, 2017.
2. M. Sadiku, “Elements of Electromagnetics,” 7th Edition, Oxford University Press, 2018.
3. J. A. Edminister, “Theory and Problems of Electromagnetics,” 2nd Edition, McGraw Hill, 1993.
4. N. N. Rao, “Elements of Engineering Electromagnetics,” 6th Edition, Prentice Hall, 2004.
5. F. T. Ulaby, “Electromagnetics for Engineers,” 1st Edition, Pearson Education, 2005.

Course Name: **Artificial Intelligence**

Credit hours: 3 (3+0)
Course Code: ELEC-419
Prerequisites: Linear Algebra, Computer Programming

Course Objectives:

To prepare the students for knowing the principles of artificial intelligence, its

structure, function, algorithms, and applying them to real-world problems and applications.

Course Content:

What is Artificial Intelligence? tasks and agent types, constraint satisfaction, path search, heuristic path search, games, logical agents, uncertainty, machine learning and its algorithms with applications, reinforcement learning, deep learning with applications, neural networks and deep learning, deep learning algorithms.

Recommended Books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach," 4th Edition, Pearson, 2020.
2. M. Mitchell, "Artificial Intelligence: A Guide for Thinking Humans," Macmillan Audio, 2019.
3. I. Goodfellow, Y. Bengio and A. Courville, "Deep Learning," The MIT Press, 2016.
4. C. M. Bishop and H. Bishop, "Deep Learning: Foundations and Concepts," Springer, 2023.
5. F. Chollet, "Deep Learning with Python," 2nd Edition, Manning, 2021.

Course Name: **Pattern Recognition**

Credit hours: 4 (3+1)
Course Code: ELEC-420
Prerequisites: Linear Algebra, Probability and Probability Distributions – I

Course Objectives:

To understand the principles and methodologies of pattern recognition. To develop proficiency in applying pattern recognition algorithms to real-world data. To gain hands-on experience with supervised and unsupervised learning techniques.

Course Content:

Introduction to Pattern Recognition: What is Pattern Recognition? Types of Pattern Recognition: Supervised vs. Unsupervised, Applications of Pattern Recognition: Speech, Image, Text, Bioinformatics, Overview of the Pattern Recognition Pipeline: Data Acquisition, Preprocessing, Feature Extraction, Classification. Data Representation and Preprocessing: Types of Data: Structured vs. Unstructured, Data Preprocessing: Normalization, Scaling, Missing Data Handling, Feature Extraction: Selecting Relevant Features, Dimensionality Reduction: Introduction to Principal Component Analysis (PCA). Supervised Learning - Classification Algorithms: Overview of Supervised Learning, Nearest Neighbor Classifiers (k-NN), Decision Trees and Random Forests, Support Vector Machines (SVM): Theory, Hyperplanes, and Kernels. Linear Classifiers and Logistic Regression: Linear Discriminant Analysis (LDA), Logistic Regression and Maximum Likelihood Estimation, Loss Functions and Optimization, Model Evaluation: Accuracy, Precision, Recall, and F1-Score. Evaluation of

Classification Models: Confusion Matrix and Performance Metrics, Cross-Validation: k-Fold and Leave-One-Out, ROC Curve and AUC (Area Under the Curve), Overfitting and Underfitting. Unsupervised Learning – Clustering: Introduction to Clustering, k-Means Clustering: Algorithm and Distance Measures, Hierarchical Clustering, Clustering Evaluation Metrics: Inertia, Silhouette Score. Probabilistic Methods in Pattern Recognition: Probabilistic Models: Gaussian Mixture Models (GMM), Expectation-Maximization (EM) Algorithm, Naive Bayes Classifier, Maximum Likelihood Estimation (MLE). Feature Selection and Dimensionality Reduction: Feature Selection: Wrapper, Filter, and Embedded Methods, Principal Component Analysis (PCA) for Dimensionality Reduction, t-SNE for Visualizing High-Dimensional Data, LDA for Supervised Dimensionality Reduction. Neural Networks: Introduction to Artificial Neural Networks (ANNs), Structure of a Neural Network: Neurons, Activation Functions, Backpropagation Algorithm. Deep Learning: Introduction to Deep Learning Architectures, Convolutional Neural Networks, Recurrent Neural Networks. Ensemble Methods: Introduction to Ensemble Learning, Bagging and Boosting, Random Forests and AdaBoost, Gradient Boosting Machines (GBM) and XGBoost. Support Vector Machines (SVM): Overview of SVM (Recap), Nonlinear SVM and the Kernel Trick, Support Vector Regression (SVR), Practical Considerations for SVM. Advanced Topics in Pattern Recognition: Reinforcement Learning Overview, Hidden Markov Models (HMM), Anomaly Detection Techniques, Transfer Learning and Domain Adaptation. Applications of Pattern Recognition: Applications in Computer Vision (Image Classification), Speech Recognition, Text Mining and Natural Language Processing (NLP), Bioinformatics (Gene Expression Data). Final Project: Students apply pattern recognition techniques to a dataset of their choice (classification, clustering, etc.), and submit a report detailing the methodology, results, and challenges faced.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. C. M. Bishop, “Pattern Recognition and Machine Learning,” Springer, 2007.
2. S. Raschka and V. Mirjalili, “Python Machine Learning,” 2nd Edition, Packt Publishing, 2017.
3. A. Géron, “Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow,” 2nd Edition, O’Reilly Media, Inc., 2019.
4. T. Hastie, R. Tibshirani and J. Friedman, “The Elements of Statistical Learning,” Springer, 2001.
5. P. Fieguth, “An Introduction to Pattern Recognition and Machine Learning,” Springer, 2022.
6. R. O. Duda, P. E. Hart and D. G. Stork, “Pattern Classification,” 2nd Edition, John Wiley & Sons, Inc., 2006.
7. F. Chollet, “Deep Learning with Python,” 2nd Edition, Manning, 2021.

Course Name: **Digital Image Processing**

Credit hours: 4 (3+1)
Course Code: ELEC-421
Prerequisites: Signals and Systems

Course Objectives:

To introduce the fundamentals of digital image processing, image filtering techniques in spatial and frequency domains, image restoration, compression, color and morphological image processing, and segmentation.

Course Content:

Concept of Digital Image, Types of Images, Fundamental Steps in Digital Image Processing; Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Mathematical Tools used in Digital Image Processing; Filtering in the Spatial Domain: Basic Intensity Transformations, Histogram Processing, Smoothing and Sharpening Spatial Filters; Filtering in the Frequency Domain: Discrete Fourier Transform, Image Smoothing and Sharpening Using Frequency Domain Filters; Image Restoration: Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering; Color Image Processing: Color Models, Pseudo Color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening; Fundamentals of Image Compression, Some Basic Compression Methods; Morphological Image Processing; Image Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation; Object Recognition.

Lab outline:

Lab contents will be in accordance with the course outline.

Recommended Books:

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing,” 3rd Edition, Pearson Education, Inc., 2008.
2. R. C. Gonzalez, R. E. Woods and S. L. Eddins, “Digital Image Processing Using MATLAB,” 3rd Edition, Gatesmark, 2020.
3. C. Solomon and T. Breckon, “Fundamentals of Digital Image Processing: A Practical Approach with Examples in MATLAB,” John Wiley & Sons, Inc., 2011.
4. W. K. Pratt, “Digital Image Processing: PIKS Scientific Inside,” John Wiley & Sons, Inc., 2007.

Course Name: **Information and Coding Theory**

Credit hours: 3 (3+0)
Course Code: ELEC-422
Prerequisites: Communication Systems

Course Objectives:

To provide an insight into the concept of information in the context of communication theory and its significance in the design of communication receivers. To explore in detail, the calculations of channel capacity to support error-free transmission and, the most used source coding and channel coding algorithms. To encourage and train to design coding schemes for data compression and error correction, and they will also get an overall perspective of how this impacts the design of an optimum communication receiver.

Course Content:

Introduction to Probability – Random Variables, sample space, Conditional probability, joint probability, Modeling of Information Sources – Self Information, Entropy, Mutual Information ,Source Coding Theory and algorithms – Kraft inequality, Huffman algorithm, Arithmetic coding, Lempel Ziv coding, Modeling of Communication channels – Binary symmetric channel, Binary Erasure channel, Channel coding theorem, Error Correction Codes – Introduction to Galois fields, polynomial arithmetic, linear block codes for error correction – Generator matrix, Encoding, Parity Check matrix, Decoding – Standard array decoding and Syndrome decoding, Cyclic Codes – Generation of codes, encoding and syndrome decoding, BCH Codes – Minimal polynomial encoding and decoding, Convolutional encoder – Introduction to Convolutional codes, distance properties – Trellis codes, Viterbi decoder.

Recommended Books:

1. K. S. Shanmugam, “Digital and Analog Communication Systems,” Wiley India Pvt. Limited, 2006.
2. H. Simon, “Digital Communication Systems,” United Kingdom: Wiley, 2014.
3. R. Bose, “ITC and Cryptography,” Tata McGraw-Hill, 2nd Edition, 2008
4. I. Glover and M. P. Grant, “Digital Communications,” Germany: Prentice Hall, 2010.

Course Name: **Wireless Communication**

Credit hours: 3 (3+0)

Course Code: ELEC-423

Prerequisites: Communication Systems, Signals and Systems

Course Objectives:

This course provides an in-depth understanding of wireless communication systems, covering fundamental principles, technologies, protocols, and practical applications. Students will explore various wireless systems, modulation techniques, multiple access schemes, channel coding, network architectures, and emerging trends in wireless communications.

Course Content:

Overview of wireless communication systems, Evolution of wireless technologies, Wireless channel characteristics and challenges, Regulatory aspects and spectrum management; Wireless Channel Modeling and Propagation: Path loss

models: free space, long-distance, and empirical models; Shadowing and multipath fading: Rayleigh and Rician fading; Small-scale and large-scale fading effects; MIMO systems and diversity techniques; Modulation Techniques for Wireless Communications: Analog modulation: AM, FM, PM; Digital modulation: ASK, PSK, QAM; Orthogonal Frequency Division Multiplexing (OFDM); Spread spectrum techniques: Direct Sequence (DS) and Frequency Hopping (FH); Multiple Access Techniques: Frequency Division Multiple Access (FDMA); Time Division Multiple Access (TDMA); Code Division Multiple Access (CDMA); Orthogonal Frequency Division Multiple Access (OFDMA); Wireless Network Protocols and Architectures: Wireless LANs: IEEE 802.11 standards (Wi-Fi); Cellular networks: GSM, CDMA2000, LTE, 5G; Ad hoc networks and mesh networks; Cognitive radio and dynamic spectrum access; Channel Coding and Error Control Techniques: Forward Error Correction (FEC) codes: Convolutional codes, Reed-Solomon codes; Automatic Repeat Request (ARQ) protocols; Hybrid ARQ techniques; Interleaving and diversity combining techniques; Wireless Security and Privacy: Security challenges in wireless networks; Encryption and authentication protocols; Key management and secure communication protocols; Privacy issues in wireless communications; Emerging Trends and Future Directions: Internet of Things (IoT) and wireless sensor networks; 6G and beyond Terahertz communication, massive MIMO, AI-driven wireless networks; Ethical considerations and societal impacts of wireless technologies; Review and Project Presentations: Review of key concepts and topics covered in the course; Final project presentations by students demonstrating understanding and application of wireless communication principles.

Recommended Books:

1. T. S. Rappaport, “Wireless Communications: Principles and Practice,” 2nd Edition, Prentice Hall, 2001.
2. J. Schiller, “Mobile Communications,” 2nd Edition, Addison-Wesley, 2003.

Course Name: **Satellite Communication**

Credit hours: 3 (3+0)
Course Code: ELEC-424
Prerequisites: Communication Systems, Signals and Systems

Course Objectives:

This course provides students with a thorough understanding of satellite communication systems, including satellite orbits, link budgets, modulation techniques, multiple access methods, and satellite applications. Students will learn the principles and technologies behind satellite communications and gain practical skills for designing, implementing, and analyzing satellite systems.

Course Content:

Introduction to Satellite Communications: Basics of Satellite Communication Systems, Evolution and History of Satellite Communications, Satellite Orbits and Launch Vehicles, Satellite Subsystems: Payload, Telemetry, Tracking, and Command (TT&C); Satellite Link Design and Analysis: Satellite Link Budget

Calculation, Free-Space Path Loss and Propagation Effects, Antenna Gain and System Noise Temperature, Rain Attenuation and Atmospheric Effects, Link Margin and Signal-to-Noise Ratio (SNR) Analysis; Modulation Techniques: Analog and Digital Modulation Techniques, Frequency Shift Keying (FSK) and Phase Shift Keying (PSK); Multiple Access Techniques: Multiple Access Methods: FDMA, TDMA, CDMA; Spread Spectrum Techniques: Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS); Satellite System Design: Satellite Transponder Design, On-Board Signal Processing and Switching, Earth Station Equipment and Antenna Systems, Satellite Network Architecture and Protocols; Satellite System Implementation: Satellite System Integration and Testing; Error Control Techniques: Error Detection and Correction Codes, Forward Error Correction (FEC) Techniques; Signal Processing: Interleaving and Error Burst Correction, Automatic Repeat reQuest (ARQ) Protocols; Satellite Applications: Telecommunications Satellites: Geostationary and Low Earth Orbit (LEO), Broadcasting and Direct-to-Home (DTH) Services; Remote Sensing and Earth Observation Satellites, Navigation and Global Positioning System (GPS); Satellite Internet and Mobile Communication Services; Emerging Technologies and Regulations: High-Throughput Satellites (HTS) and Ka-band Systems, Software-Defined Satellites and Reconfigurable Payloads, Inter-Satellite Link (ISL) Systems, CubeSats and Small Satellite Constellations, Satellite Communication for Internet of Things (IoT) and 5G Networks, Satellite Communication Standards and Regulations.

Recommended Books:

1. T. Pratt, C. W. Bostian and J. E. Allnutt “Satellite Communications,” 2nd Edition, Wiley, 2002.
2. B. R. Elbert, “Introduction to Satellite Communication,” 3rd Edition, Artech House, 2008.
3. L. J. Ippolito Jr., “Satellite Communications Systems Engineering,” 2nd Edition, Wiley, 2017.

Course Name: **Renewable Energy**

Credit hours: 3 (3+0)
Course Code: ELEC-425
Prerequisites: Basic Electronics

Course Objectives:

This course is designed to provide an engineering assessment of the most important renewable energy resources and the related technologies for harnessing them, from simple methods to state-of the-art advanced energy systems. It gives a brief overview of fundamental concepts of energy conversion and perspectives on energy supply and demand.

Course Content:

Introduction, importance of energy, comparison of different forms of energy, world primary energy resources, renewable energy and its sustainability, solar energy, sun path and solar irradiance, daily and seasonal variations, solar thermal

applications, solar thermal electric systems, photovoltaic effect, photovoltaic cells, photovoltaic materials, different types of solar cells and their characteristics, performance and application, wind energy, wind resources and characteristics, wind mills and their types, environmental impact, wind turbine types and their performance, hydro-power: global resources and classification, basic energy conversion principle, conversion equipment and engineering operations, turbines and their types, biomass resources, residue, farms, forest, solid wastes, agricultural, industrial wastes, biofuels production, biochemical conversion, use of biomass derived fuels, geothermal power, energy from tides, and waves, and economic prospects, environmental and sustainability considerations, types of equipment for extracting wave and tidal energy, nuclear fission, nuclear fusion, nuclear reactor, radiation safety and hazards issues, introduction to fuel cells, typical fuel cell configurations, fuel cell applications, performance of real fuel cells.

Recommended Books:

1. A. V. D. Rosa, “Fundamentals of Renewable Energy Processes,” 3rd Edition, Elsevier, 2012.
2. J. Twidell and T. Weir, “Renewable Energy Resources,” 2nd Edition, Taylor and Francis, 2006.
3. G. Boyle, “Renewable Energy: Power for a Sustainable Future,” 3rd Edition, Oxford University Press, 2012.
4. M. Grathwohl, “World Energy Supply: Resources, Technologies, Perspectives,” Gruyter, 1982.

General Education Courses from Arts and Humanities

Course Name: **An Introduction to Philosophy**
Credit hours: 2 (2+0)
Course Code: Phil-311
Prerequisites: None

Course Objectives:
To help students progress toward the learning goals of logic, reasoning, and fallacies in an argument with a particular focus on ethics and metaphysics and what role philosophy has in the contemporary world.

Course Content:
Definition of Philosophy

Scope of Philosophy
- Ontology.
- Epistemology.
- Axiology, Logic, Aesthetics, Ethics.

Value and importance of Philosophy
Philosophy and Religion
Philosophy and Science
Theories of knowledge
- Rationalism, Empiricism, Authoritarianism or Testimony, Mysticism, Idealism and kinds of idealism—Subjective idealism, Objectivism, Personal idealism. Critical evaluation of idealism.
- Materialism and Naturalism.
- Mechanical Materialism and Dialectical Materialism.

Metaphysical problems of Philosophy
- Existence of God, Pantheism, Deism.
- Proofs for the existence of God (Cosmological, Ontological, Teleological Arguments)
- Human immortality.
- Freedom of will.

Evolution
- Kinds of evolution: (Mechanical Evolution, Teleological Evolution, Creative Evolution).
- Theories of Evolution.
    - Darwinian Theory of Evolution
      (Struggle for existence, survival of the fittest, Natural selection)
    - Lamarckian theory of Evolution.
    - Maulana Rumi's concept of Evolution.
    - Miskawaih concept of Evolution.
    - Allama Iqbal concept of Evolution.

Recommended Books:

1. A. Khaliq, “Elements of Philosophy”.
2. D. Stewart, H. G. Blocker and J. Petrik, “Fundamentals of Philosophy,” 8th Edition, Pearson, 2012.
3. G. T. W. Patrick, “Introduction to Philosophy,” 2012.
4. A. M. Iqbal, “The Reconstruction of Religious Thought in Islam,” Lahore, 1989.
5. R. A. Nicholson, “The Mathnawi of Jalaluddin Rumi,” 2015.

Course Name: **Logic – I**

Credit hours: 2 (2+0)
Course Code: Phil-321
Prerequisites: None

Course Objectives:

To help students progress toward the learning goals of logic, reasoning, and fallacies in an argument. To understand the role of philosophy in the contemporary world.

Course Content:

Introduction

- What is logic?
- Argument.
- Premises and Conclusion.
- Truth and Validity.

Uses of Language

- Three basic functions of language.
- Discourse serving Multiple function.
- Kinds of agreements and disagreements.
- Emotively neutral Language.

Fallacies

- Fallacies of Relevance.
- Fallacies of Ambiguity.
- Avoiding Fallacies.

Definition

- Disputes, Verbal disputes and Definitions.

Deduction

- Categorical syllogism.
- Categorical Proposition and Classes.
- Quality, Quantity and Distribution.
- Symbolism and Diagram for Categorical Syllogism.
- Rules and Fallacies.

Recommended Books:

1. I. M. Copi, C. Cohen and K. McMahon, “Introduction to Logic,” 14th Edition,

Pearson Education Limited, 2014.
2. E. J. Lemmon, “Beginning Logic,” Hackett Publishing Company, Inc., 1978.
3. L. S. Stebbing, “A Modern Elementary Logic,” Routledge, 2017.
4. S. F. Barker, “The Elements of Logic,” 5th Edition, McGraw Hill, 1989.
5. P. Hurley and L. Watson, “A Concise Introduction to Logic,” 13th Edition, Cengage Learning, 2017.

Course Name: **Fables, Wisdom Literature, and Epic**

Credit hours: 2 (2+0)
Course Code: AH-101
Prerequisites: None

Course Objectives:

Understanding human experience, cultivating an appreciation of the past, enriches our capacity to participate in the life of our times, and enables engagement with other cultures and civilizations, both ancient and modern. Thus providing insight into the experiences of others and as well enabling critical examination of one’s own, promoting mutual respect and tolerance, instilling cultural pride and self-confidence, and supporting the development of creative expression.

Course Content:

This course has three components containing both readings and related activities: The first component is about fables—that is, stories with animal characters having human attributes. The second component concerns wisdom literature and looks specifically at some of the stories, both in prose and poetry, of the famous Persian literary figure Sa‘dī. We shall introduce this author to you.
The third component is on the world’s largest epic—the Shāhnāma (Book of Kings) of another literary giant, Firdausi.

Recommended Books:

1. Wyndham Knatchbull, “Kalila and Dimna or The Fables of Bidpai,” Oxford, 1819.
2. Iqbal, “Kulliat-i-Iqbal,” Alhamra Publishing, Islamabad, Pakistan, 2004.
3. John T. Platts, “The Gulistan; or, Rose Garden of Shaikh Muslihu’d- Dīn Sa’dī of Shīrāz,” London: Wm. II. Allen & Co, 1876.
4. Ferdowsi, A. & Davis, D., “Shahnameh: The Persian Book of Kings,” Penguin Classics, 2016.

Course Name: **Introduction to History**

Credit hours: 2 (2+0)
Course Code: HIST-106
Prerequisites: None

Course Objectives:

To provide students the knowledge and basic concepts of history. Familiarize

students with historical evolution of human knowledge. Develop among the students an ability to understand the common themes of historical knowledge. Inculcate among the students of history a sense of critical thinking.

Course Content:

- What is History?
- Nature and scope of History
- Benefits of History: History as a corrective force; History as a repetitive force
- Branches of History: Political, Cultural, Social, Economic
- Relationship of History with other social sciences
- Causation
- Objectivity and subjectivity
- Classification of History: Narrative History, Analytical History, Scientific History, Futuristic History.

Recommended Books:

1. J. H. Arnold, “History: A Very Short Introduction,” Oxford University Press, 2000.
2. P. Burke, “Varieties of Cultural History,” Cornell University Press, 1977.
3. E. H. Carr, “What is History?,” Cambridge University Press, 1961.
4. B. Cohn, “An Anthropologist among Historians and Other Essay,” Oxford University Press, 1988.
5. R. G. Collingwood, “The Idea of History,” Oxford University Press, 1978.
6. C. Ginzburg, “Clues, Myths, and the Historical Method,” John Hopkins University Press, 1992.
7. D. V. Govranski, “History: Meaning and Methods,” Scott, Foresman and Company, 1969.
8. R. Guha, “The Small Voice of History: Collected Essays,” Permanent Black, 2010.
9. M. A. Qureshi, “A Study of Historiography,” Pakistan Book Centre, Latest Edition.
10. C. K. Steedman, “Dust: The Archive and Cultural History (Encounters: Cultural Histories,” Rutgers University Press, 2002.
11. F. R. Stern, “Varieties of History: from Voltaire to the Present,” Vintage Press, 1973.

General Education Courses from Natural Sciences

Course Name: **Applied Physics**
Credit hours: 3 (2+1)
Course Code: PHYS-109
Prerequisites: None

Course Objectives:

To understand the fundamental principles of physics through practical applications and real-world examples. It is designed for students not majoring in physics but wishing to gain a functional understanding of physics concepts that impact everyday life and various professional fields.

Course Content:

Newtonian Mechanics: Kinematics (velocity, acceleration, displacement, equations of motion), Dynamics (Newton's laws of motion, force, mass, weight, tension, friction), Work, Energy, and Power (kinetic energy, potential energy, conservation of energy, work-energy theorem, power), Momentum (linear momentum, impulse, conservation of momentum, elastic and inelastic collisions), Rotational Motion (angular velocity, angular acceleration, torque, rotational inertia, angular momentum, and rotational kinetic energy), Gravitation (Newton's law of universal gravitation, gravitational potential energy, the motion of planets (Kepler's laws)), Fluid Mechanics (buoyancy, Bernoulli's principle, fluid flow, pressure, Archimedes' principle), Harmonic Motion (simple harmonic motion (SHM), pendulums, springs, damped oscillations), Systems of Particles (center of mass, motion of the center of mass, collisions of systems of particles), Statics (equilibrium of forces, tension, torque, and balance).

Thermodynamics: Definition and scope of thermodynamics, Laws of Thermodynamics (Zeroth, First, second and third law), Properties of pure substances (Phases of the matter: Solid, liquid, and gas, Phase diagrams (Pressure-Volume-Temperature, P-V-T diagrams), Ideal gas law and real gases (Van der Waals equation)), Energy Transfer (Heat transfer methods: Conduction, convection, and radiation, Work interactions: Mechanical work, electrical work, Internal energy, heat capacity, and specific heats), Thermodynamic cycles (Power Cycles: Carnot, Rankine, Otto, Diesel cycles, Refrigeration Cycles: Vapor-compression cycle, absorption refrigeration cycle), Entropy (Definition and significance of entropy, Entropy changes in closed and open systems, Entropy balance for ideal gases and other systems), Applications of thermodynamics (Heat engines and refrigerators, Equilibrium, Gibbs free energy).

Electrodynamics: electric and magnetic fields, magnetic flux, Faraday's law of electromagnetic induction, Ampere's law, generator, electric motor, electromagnetic radiations, particle and wave theory of electromagnetic radiation, photoelectric effect, photovoltaic devices (solar cell, light emitting diode), laser, microwaves and radio waves, antenna, radar, fiber optics.

Nuclear Physics: Nuclear structure, Radioactivity and decay, nuclear reactions, Applications of atomic physics.

Recommended Books:

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics," 12th Edition, Wiley, 2021.
2. D. C. Giancoli, "Physics: Principles with Applications," 7th Edition, Prentice Hall, 2015.
3. H. C. Verma, "Concepts of Physics," S. Chand & Company Ltd., 2017.
4. H. D. Young and R. A. Freedman, "University Physics with Modern Physics," 14th Edition, Pearson, 2015.
5. Online: Khan Academy, MIT Open Courseware

General Education Courses from Social Sciences

Course Name: **Introduction to Psychology – I**
Credit hours: 2 (2+0)
Course Code: PSY-114
Prerequisites: None

Course Objectives:
To understand the basics of psychology concepts, methods and approaches.

Course Content:
Introduction to Psychology
- Definition of Psychology; Different branches of psychology
- A brief overview of different theoretical perspectives: Psychoanalytic, Behavioristic, Humanistic, Cognitive, Sociocultural

Methods of Psychology
- Observation
- Case History Method
- Experimental Method
- Survey Method
- Interview

Sensation, Attention and Perception
- Sensation: Characteristics of sensation, Sensory thresholds; Habituation and sensory adaptation
- Attention: Subjective and Objective factors of attention; Span of Attention; Fluctuation of Attention
- Perception: Definition and nature of perception; Types of perception: Depth perception, Time Perception, Form Perception; Perceptual constancies; Illusions

Learning
Definition and Theories of learning:
- Pavlov - Classical conditioning
- B.F.Skinner-operant conditioning
- Observational learning
- Cognitive learning theories: Latent and Insight learning

Memory
- Kinds, Processes and Stages of Memory
- Mnemonic Devices
- Theories of Forgetting
- Physiology of memory

Recommended Books:

1. S. K. Ciccarelli and J. N. White, “Psychology,” 4th Edition, Pearson, 2017.
2. R. S. Feldman, “Understanding Psychology,” 7th Edition, McGraw Hill, 2005.
3. I. Stuart-Hamilton, “Key Ideas in Psychology,” Jessica Kingsley Publishers, 1996.

4. M. G. Matlin, “Psychology,” 2nd Edition, Harcourt Brace College Publishers,1995.
5. S. A. Rathus, “Psychology in the New Millennium,” 7th Edition, Harcourt Brace College Publishers, 1999.

Course Name: **Introduction to Social Psychology**

Credit hours: 2 (2+0)
Course Code: PSY-245
Prerequisites: None

Course Objectives:

To introduce the research and theories within the field of social psychology.

Course Content:

1. **The Field of Social Psychology**
   Introduction to social psychology, Current trends and future scope, Conducting research in social psychology, Theories in Social Psychology
2. **Social Perception**
   Nonverbal behavior, Attribution, Impression Formation and Impression management
3. **Social Cognition**
   Schemas, Heuristics, Affect and Cognition
4. **Attitudes (Evaluating the Social World)**
   Nature of attitudes, Formation, maintenance, and change in attitudes, Relationship between attitude and behavior, Theories of Attitudes
5. **Aspects of Social Identity**
   The self and types of self, Nature of the self, Self-concept, Social diversity, Self-esteem, other aspects of self-functioning, Self-focusing, Self-Monitoring, Self-Efficacy
6. **Social Influence**
   Conformity, Compliance, Obedience
7. **Pro and antisocial behavior**
   Why do we help?, When do we help?, Does true altruism really exist? Whom do we help?, How can we increase helping?
8. **What is Aggression?**
   Influences of Aggression, Reducing Aggression, Prejudice, Ethnicity

Recommended Books:

1. A. Ahmad and M. Bano, “Television Violence, Terrorism and Innocent Children,” Lahore: Institute of Islamic Psychology, 2004.
2. G. W. Allport, “The Nature of Prejudice,” New York: Addison Wesley, 1954.
3. R. J. Fisher, “Social Psychology: An Applied Approach,” New York: St. Martin Press, 1982.
4. D. F. Forsyth, “Social Psychology,” California: Brooks Publishing Company, 1987.
5. T. Gilovich, D. Keltner, S. Chen and R. E. Nisbett, “Social Psychology,” 4th

Edition, New York: W. W. Norton & Company, 2015.
6. D. G. Myers, “Social Psychology,” New York: McGraw-Hill, 1987.
7. J. M. Wayant, “Applied Social Psychology,” New York: Oxford University Press,1986.

Course Name: **Principles of Microeconomics**

Credit hours: 2 (2+0)
Course Code: ECON-311
Prerequisites: None

Course Objectives:

By the end of the course, students will be able to understand introductory microeconomic theory, solve basic microeconomic problems, and use these techniques to think about a number of basic policy questions relevant to the operation of the economy. More specifically, this course aims:

1. To develop an understanding of introductory microeconomic theory and its relevance to the real word.
2. To sharpen the problem- solving tactics required to solve basic microeconomic problems.
3. To give a broader implications of microeconomics principles and their applications.
4. To train the students to work with others as a part of team to solve problems.

Course Content:

1. Introduction

1.1. The Economic Problem
1.2. Economic Decision Makers
1.3. The Circular Flow Model
1.4. Distinction Between Microeconomics and Macroeconomics
1.5. The Market System

2. Demand & Supply

2.1. Demand, Demand Function, Demand Curve, Engel Curve, Changes in Demand, Law of Demand, Shift in Demand, Factors Affecting Demand, Consumer Surplus

2.2. Supply, Supply Function, Supply Curve, Changes in Supply, Factors Affecting Supply, Law of Supply, Producer Surplus

2.3. Equilibrium of Demand and Supply, Market Equilibrium, Price Controls, Taxes and Subsidies

3. Elasticity of Demand & Supply

3.1. Price Elasticity of Demand & Supply
3.2. Point Elasticity of Demand & Supply
3.3. Arc Elasticity of demand & Supply
3.4. Income Elasticity of Demand & Supply
3.5. Cross Elasticity of demand & Supply

4. Consumer Behavior

4.1. Utility Analysis (Cardinal Approach), Marginal Utility
4.2. Law of Diminishing Marginal Utility and Law of Equi-Marginal Utility,

Consumer Equilibrium

4.3. Ordinal Approach of Consumer Behavior, Indifference Curves, Features of Indifference Curves, Budget Line, Consumer Equilibrium, Comparison between two approaches

5. The Theory of production & Theory of Cost

5.1. Cost of Production, Short Period and Long Period Analysis

5.2. Economies of Scale, Elasticity of Cost, Graphical Representation of Long Run Cost

5.3. Production, Factors of Production, Production Function, Short Period Production Relations, Total, Average and Marginal Product, Elasticity of Production

5.4. Laws of Returns to Scale

5.5. Duality Between Production and Cost of Production

6. Market Structure

6.1. Basics of Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly

6.2. Different Possibilities of Short Run firm Equilibrium under Perfect Competition

6.3. Profit Maximization in Short-run and long-run under Perfect Competition

6.4. Supply Curve of Perfectly Competitive Firm under Short and Long Run

6.5. Short run and Long run Equilibrium under Monopoly

Recommended Books:

1. N. G. Mankiw, "Principles of Microeconomics," 9th Edition, 2021.
2. C. R. McConnell and S. L. Brue, "Principles of Economics," 21st Edition, 2022.
3. R. S. Pindyck and D. L. Rubinfeld, "Microeconomics," 9th Edition, Pearson Prentice Hall, 2020.
4. M. J. Swann and W. A. McEachern, "Microeconomics: A Contemporary Introduction," 3rd Edition, 2006.

Course Name: **Principles of Macroeconomics**

Credit hours: 2 (2+0)

Course Code: ECON-321

Prerequisites: None

Course Objectives:

By the end of the course, students will be able to understand introductory macroeconomic theory and understand the concepts of macro aggregates like National Income, inflation, unemployment etc. More specifically, this course aims:

1. To familiarize the student with the generally accepted principles of macroeconomics.
2. To understand the behavior of the economy in the long run.
3. To understand the computation of National Income Accounts.
4. To Interpret and evaluate media reports on the macro-economy.

Course Content:

1. The Science of Macroeconomics

1.1. What do Macroeconomists Study?
1.2. How do Economists Think?
1.3. Theory of Model Building
1.4. Microeconomic Thinking and Macroeconomic Models

2. The Data of Macroeconomics

2.1. Measuring the Value of Economic Activity: Gross Domestic Product
2.2. Income, Expenditure, and the Circular Flow
2.3. Stocks and Flows
2.4. Rules for Computing GDP
2.5. Real GDP Versus Nominal GDP
2.6. The GDP Deflator
2.7. Chain-Weighted Measures of Real GDP
2.8. The Components of Expenditure
2.9. What Is Investment?
2.10. Other Measures of Income
2.11. Measuring the Cost of Living: The Consumer Price Index
2.12. Measuring Joblessness: The Unemployment Rate

3. National Income: Where it comes from and where it goes

3.1. What Determines the Total Production of Goods and Services?
3.2. How Is National Income Distributed to the Factors of Production?
3.3. What Determines the Demand for Goods and Services?
3.4. What Brings the Supply and Demand for Goods and Services into Equilibrium?

4. The Monetary System: What It Is and How It Works

4.1. What Is Money?
4.2. The Role of Banks in the Monetary System
4.3. How Central Banks Influence the Money Supply

5. Inflation: its causes, effects, and social costs

5.1. The Quantity Theory of Money
5.2. Seigniorage: The Revenue from Printing Money
5.3. Inflation and Interest Rates
5.4. The Nominal Interest Rate and the Demand for Money
5.5. The Social Costs of Inflation
5.6. Hyperinflation
5.7. The Classical Dichotomy
5.8. The Cagan Model: How Current and Future Money Affect the Price Level

6. The Open Economy

6.1. The International Flows of Capital and Goods
6.2. Saving and Investment in a Small Open Economy
6.3. Why Doesn’t Capital Flow to Poor Countries?
6.4. Exchange Rates
6.5. The Large Open Economy

7. Unemployment and the Labor Market

7.1. Job Loss, Job Finding, and the Natural Rate of Unemployment
7.2. Job Search and Frictional Unemployment

7.3. Real-Wage Rigidity and Structural Unemployment
7.4. Minimum-Wage Laws
7.5. Labor-Market Experience: The United States
7.6. Unemployment Insurance
7.7. Labor-Market Experience: Europe

8. Economic Growth I: Capital Accumulation and Population Growth

8.1. The Accumulation of Capital
8.2. The Golden Rule Level of Capital
8.3. Population Growth

9. Economic Growth II: Technology, Empirics, and Policy

9.1. Technological Progress in the Solow Model
9.2. From Growth Theory to Growth Empirics
9.3. Convergence
9.4. Factor Accumulation Versus Production Efficiency
9.5. Policies to Promote Growth
9.6. Beyond the Solow Model: Endogenous Growth Theory

Recommended Books:

1. R. Dornbush, S. Fisher and R. Stratz, "Macroeconomics," 13th Edition, McGraw Hill Inc., 2017.
2. R. Froyen, "Macroeconomics: Theory and Policies," 10th Edition, Pearson, 2013.
3. N. G. Mankiw, "Principles of Macroeconomics," 11th Edition, 2022.
4. M. Parkin, "Macroeconomics," 10th Edition, Wesley International Inc., 2011.
5. P. A. Samuelson and W. D. Nordhaus, "Economics," 19th Edition, McGraw Hill, 2009.

Course Name: **Intermediate Microeconomics**

Credit hours: 2 (2+0)
Course Code: ECON-432
Prerequisites: None

Course Objectives:

The objective of the course is to extend the knowledge of the basic microeconomic principles that will provide the foundation for future studies in economics. The course is aimed:

1. To develop the economic way of thinking to tackle the issues like resource allocation of consumers and producers.
2. To provide an insight into how economic models can help us think about important real-world phenomena, like reasons behind the rise and fall of prices and wages, how firms earn profits and why they go out of business.
3. To analyze the role of decision-making agents in the economy and their impact on input and output prices and resource allocation.
4. To analyze critically the role of free markets, the possible reasons behind market failure and the effects of government intervention in the market.
5. To gain basic knowledge of the issues that may arise when market information is asymmetric.

Course Content:

1. Introduction

1.1. Analyzing Economic Problems
1.2. Constructing Economic Models
1.3. Optimization Principle

2. Consumer Theory

2.1. Budget Constraint and its Application
2.2. Utility and Preferences
2.3. Indifference Curve Analysis
2.4. Optimal Choice of Consumer
2.5. Application of Consumer Theory in choosing Taxes
2.6. Income Effect
2.7. Substitution Effect
2.8. Price Effect as a combination of Income and Substitution Effect
2.9. Decomposition of Price Effect into income & substitution effects (all approaches)
2.10. Marshallian and Hicksian Demand Curves (normal, inferior and Giffen Goods)

3. Theory of Demand and Supply

3.1. Income Consumption Curve and Engel Curves
3.2. The Price Consumption Curve and the Demand Curve
3.3. Derivation of Demand Curve
3.4. Demand Function
3.5. Supply Function
3.6. Supply and Demand Equilibria
3.7. Comparative Statics
3.8. The Inverse Demand Function

4. Producer Theory

4.1. Producer's Objective
4.2. Technology Constraints
4.3. Short Run and Long Run Production Function and Cost
4.4. Diminishing Marginal Product
4.5. Diminishing Technical Rate of Substitution
4.6. Returns to Scale and Cost Function
4.7. Isoquant and Iso-cost Analysis
4.8. Cost Minimization in Short and Long run
4.9. Short-Run and Long run Profit Maximization

5. Markets Analysis

5.1. Perfectly Competitive Markets: Analysis and Application
  5.1.1. Short Period Analysis (equilibrium cases, supply curve of firm)
  5.1.2. Long Period Analysis (equilibrium of firm, supply curve of industry)
5.2. Monopoly Markets: Analysis and Application
  5.2.1. Short Period Analysis (equilibrium cases, why no supply curve of firm)
  5.2.2. Long Period Analysis (equilibrium of firm, sub-optimum, optimum and super-optimum cases)

5.2.3. Price Discrimination (concept, need, possibility, forms and degrees of price discrimination)

5.3. Monopolistic Competition: Analysis and Application
- 5.3.1. Short Period Analysis (equilibrium cases)
- 5.3.2. Long Period Analysis (equilibrium of firm)

5.4. Oligopoly: Analysis and Application
- 5.4.1. Cournot Model
- 5.4.2. Bertrand Model
- 5.4.3. Stackelberg Model
- 5.4.4. Sweezy's Kinked Demand Model

Recommended Books:

1. W. Nicholson and C. M. Snyder, "Intermediate Microeconomics and Its Application," 11th Edition, Thomson South-Western, 2009.
2. R. S. Pindyck and D. L. Rubinfeld, "Microeconomics," 5th Edition, Prentice Hall, 2005.
3. H. R. Varian, "Intermediate Microeconomics," 9th Edition, W.W. Norton & Company, 2014.

Course Name: **Intermediate Macroeconomics**

Credit hours: 2 (2+0)
Course Code: ECON-442
Prerequisites: None

Course Objectives:

The course has the following objectives:

1. To learn how to critically analyze the economic fluctuation including short run shocks in the economy.
2. To be able to analyze and relate the facts and figures (numbers) with theory to support and strengthen the research and critical analysis.

Course Content:

1. Introduction to Economic Fluctuations

1.1. The Facts About the Business Cycle
1.2. Time Horizons in Macroeconomics
1.3. How the Short Run and the Long Run Differ
1.4. The Model of Aggregate Supply and Aggregate Demand
1.5. Aggregate Demand
1.6. Aggregate Supply
1.7. Stabilization Policy

2. Aggregate Demand I: Building the IS–LM Model

2.1. The Goods Market and the IS Curve
2.2. The Money Market and the LM Curve
2.3. The Short-Run Equilibrium

3. Aggregate Demand II: Applying the IS–LM Model

3.1. Explaining Fluctuations With the IS–LM Model
3.2. What Is the Fed's Policy Instrument—The Money Supply or the

3.3. Interest Rate?
3.4. IS–LM as a Theory of Aggregate Demand
3.5. The Great Depression

4. The Open Economy Revisited: The Mundell–Fleming Model and the Exchange-Rate Regime

4.1. The Mundell–Fleming Model
4.2. The Small Open Economy Under Floating Exchange Rates
4.3. The Small Open Economy Under Fixed Exchange Rates
4.4. Interest Rate Differentials
4.5. Should Exchange Rates Be Floating or Fixed?
4.6. From the Short Run to the Long Run: The Mundell–Fleming Model with a Changing Price Level
4.7. A Short-Run Model of the Large Open Economy

5. Aggregate Supply and the Short-Run Tradeoff Between Inflation and Unemployment

5.1. The Basic Theory of Aggregate Supply
5.2. Inflation, Unemployment, and the Phillips Curve
5.3. Rational Expectations and the Possibility of Painless Disinflation
5.4. Hysteresis and the Challenge to the Natural-Rate Hypothesis

6. A Dynamic Model of Economic Fluctuations

6.1. Elements of the Model
6.2. Solving the Model
6.3. Using the Model
6.4. Two Applications: Lessons for Monetary Policy
6.5. Toward DSGE Models

7. Understanding Consumer Behavior

7.1. John Maynard Keynes and the Consumption Function
7.2. Irving Fisher and Intertemporal Choice
7.3. Franco Modigliani and the Life-Cycle Hypothesis
7.4. Milton Friedman and the Permanent-Income Hypothesis
7.5. Robert Hall and the Random-Walk Hypothesis
7.6. David Laibson and the Pull of Instant Gratification

8. The Theory of Investment

8.1. Business Fixed Investment
8.2. Residential Investment
8.3. Inventory Investment

Recommended Books:

1. A. B. Abel, B. S. Bernanke and D. Croushore, “Macroeconomics,” 7th Edition, Addison-Wesley, 2010.
2. N. G. Mankiw and W. Scarth, “Macroeconomics,” 2nd Edition, Worth Publishers, New York, 2003.
3. N. G. Mankiw, “Macroeconomics,” 10th Edition, Worth Publishers, 2018.
4. S. D. Williamson, “Macroeconomics,” 4th Edition, Prentice Hall, 2010.

Course Name: **Management**
Credit hours: 2 (2+0)
Course Code: BA-322
Prerequisites: None

Course Objectives:

Demonstrate theoretical knowledge in management course. Gain practical skills and personal attributes and competencies that is required for managerial position. Describe the four management functions of planning, organizing, leading, and controlling. Explain how decisions are made within an organization and how those decisions are communicated to the various stakeholders. Relate the basic concepts of planning: the importance of planning, strategic planning, and the types of objectives and plans developed by organizations. Describe the control process including: the importance of control, tools for measuring organizational performance, and managerial actions.

Course Content:

What do Manager Do, The Roles of Managers, Major Characteristics of the Manager's Job. Overview of Managerial Decision Making, Reflective and Reactive Systems, Programmed and Non-Programed Decisions, Barriers to Effective Decision Making, Improving the Quality of Decision Making, Group Decision Making. The History of Management. External Environment of the organization, External environment and industries, Organizational Design and Structure, The internal Organization and External Environment, Corporate Cultures. Ethics and Business Ethics, Dimensions of Ethics, Corporate Culture and Compliance, Corporate Social Responsibility, Importance of Internal Management, Hofstede Cultural Frame Work, The Globe Frame Work, Cross cultural Assignments, Strategies for Expanding Globally. Entrepreneurship and its Basic Characteristics, Managing a Small Business, The Large impact of a small Business, The small business Management, The small business Administration. Strategic Analysis, Using SWOT for Strategies Analysis, Porter's Five Forces, The internal Environment, Strategies and Competitive Advantage, Strategic Positioning. The Strategic Management Process, The Strategic Management, Vision and Mission, Role of Strategic Analysis in formulating a Strategy. Organizational Structure and Change, Organizational Structure and Design, Organizational Change, Organizational Design. Diversities in Organization, Diversity at the Work Place, Diversity and its impact on companies, Challenges of Diversity, Benefits and Challenges of Work Place Diversity. The Nature of Leadership, The Leadership Process, Types of Leaders and Leader Emergence, The Trait Approach to Leadership, Behavioral Leadership Approach. Situational Approaches to Leadership, Types of Leadership, Leadership and the 21st century. Motivation, Direction, Intensity, Content theories of Motivation, Process theories of Motivation, Recent Research on Motivation Theories. Teamwork in the Workplace, Workplace Diversity, The Process of Managerial Communication, Types of Communication in Organization, Managerial Communication and Reputation. Presentations.

Recommended Books:

5. OpenStax, “The Principles of Management,” XanEdu Publishing Inc., 2019.
6. H. Koontz and C. O’Donnell, “Management,” McGraw-Hill Education, 1984.

Course Name: **Principles of Marketing**

Credit hours: 2 (2+0)
Course Code: BA-324
Prerequisites: None

Course Objectives:

To familiarize the students with the basics of marketing, its definition, marketplace and consumers. To explain the elements in marketing mix and their application in marketing decisions. To learn about functions of marketing communication. To explain and Discuss social responsibility and ethics in marketing. To learn about the importance of customer relationship in marketing and the creation of customer value.

Course Content:

Introduction to Marketing, Nature and scope of Marketing, Evolution of marketing, The Marketing Concept. The Dynamic Marketing Environment, Organization Internal Environment, Macro External Environment. Identifying and selecting Markets, Consumer Markets and buying behaviors, Consumer Decision Making Process. Business Markets and Buying Behaviors, Nature and scope of business Markets, Business Buying Behaviors. Market segmentation, Targeting and Positioning. Marketing Research and Market Information System, Marketing in the information Economy. Product Planning and development, Meaning of Product, Classification of Products, Importance of product innovations and development of new Products. Product Mix Strategies, Product Mix and Product Line, The product Life Cycle, Planned obsolescence and Fashion. Brands, Packaging, and other product features, Branding Strategies and labeling. Price Determination, Meaning of Price, Importance of Price, Pricing Objectives, Factors influencing Price Determination. Pricing Strategies. Market Entry Strategies, Discounts and allowances, Geographic Pricing Strategies. Channels of distributions, Designing distribution channels and selecting the types of channels. Retailing and whole selling, Nature and importance of retailing, Retailers classification, Nature and importance of whole selling. Promotions, Integration Marketing Communication, Role of Promotion in Marketing, the communication process and promotion, determining the promotion mix. Oral presentations.

Recommended Books:

1. P. Kotler and G. Armstrong, “Principles of Marketing,” 18th Edition, Pearson, 2020.
2. S. Zaheer, “Basic Marketing,” 1st Edition, ZAC House, 2021.
3. M. J. Etzel, B. J. Walker and W. J. Stanton, “Marketing,” 13th Edition, McGraw-Hill/Irwin, 2004.

Course Name: **Introduction to Sociology**
Credit hours: 2 (2+0)
Course Code: SOC-111
Prerequisites: None

Course Objectives:
To introduce the students to sociological concepts in the discipline; To make students understand the nature of social Processes, Groups, Society, Community, Culture, Social Stratification, Mobility, Deviance, Social Control, and Collective behavior.

Course Content:
1. Introduction
- 1.1 Definition, Scope, Significance and Subject Matter
- 1.2 Sociology as a Science
- 1.3 Historical background of sociology
- 1.4 Relationship of sociology with other social sciences

2. Basic Concepts
- 2.1 Group: Definition, Characteristics, Functions and Types
- 2.2 Community: Definition, Characteristics, Functions and Types
- 2.3 Society: Definition, Characteristics, Functions and Types
- 2.4 Association: Definition, Characteristics, Functions and Types
- 2.5 Organization: Definition, Characteristics, Functions and Types
- 2.6 Social Interaction and Social Processes: Associative and Dissociative
- 2.7 Social Structure (i) Status (ii) Roles (iii) Power and Authority (iv) Role Allocation

3. Culture
- 3.1 Definition, Characteristics and Types
- 3.2 Elements of Culture / Basis of Order in Society: Norms, values, Traditions, Mores, customs, sanctions and Law
- 3.3 Organizations of Culture: Traits, Complexes, patterns, Ethos and Theme
- 3.4 Cultural Lag
- 3.5 Cultural Variation, Cultural Integration, Cultural Evolution, Cultural Pluralism, cultural relativism, sub-culture
- 3.6 Ethnocentrism and Xenocentrism

4. Socialization and Personality Development
- 4.1 Socialization: Definition, Characteristics, Functions, types and agencies
- 4.2 Personality: Definition, Factors, types and Theories

5. Deviance and Social Control
- 5.1 Deviance: Definition, characteristics, types and theories
- 5.2 Social Control: Definition, Needs, forms, Methods and Agencies of Social Control

6. Social Stratification and Mobility
- 6.1 Definition, Determinants and Nature
- 6.2 Approaches to the Study of Social Stratification
- 6.3 Caste and Class
- 6.4 Social Mobility: Definition, Forms and Factors

7. Collective Behavior

7.1 Definition and Characteristics/Features

7.2 Types: Crowd, Mob and Public and Social Movements

Recommended Books:

1. Béteille, "Sociology: Essays on Approach and Method," New Delhi: Oxford University Press, 2002.
2. R. Cohen and P. Kennedy, "Global Sociology," Hampshire: Palgrave, 2000.
3. J. Ferrante, "Seeing Sociology: An Introduction," Belmont: Wadsworth Cengage Learning, 2011.
4. J. M. Henslin, "Sociology: A Down to Earth Approach," 11th Edition, New York: Pearson Education Ltd., 2012.
5. F. Kelly, and J. Stein, "The Real World: An Introduction to Sociology," New York: W. W. Norton and Company, Inc., 2010.
6. J. J. Macionis, "Sociology," Boston: Pearson Education, Inc., 2012.
7. J. J. Macionis and K. Plummer, "Sociology: A Global Introduction," 2nd Edition, Essex, Harlow: Pearson Education, Inc., 2002.
8. H. L. Tischler, "Introduction to Sociology," 10th Edition, Belmont: Wadsworth, 2011.

Course Name: **Project Planning and Management**

Credit hours: 2 (2+0)

Course Code: SW-682

Prerequisites: None

Course Objectives:

This subject will enhance the students understanding regarding the project planning, proposal development and project management. They will become able to monitor, evaluate and report the projects. They will learn the skills of relating the project concepts to the social welfare practices in Pakistan.

Course Content:

1. Definition, Meaning, Importance and Explanation of a Project

2. Importance of Social Welfare Projects

3. Developing a Project Proposal

- Technical Project Proposal
- Financial Proposal

6. **Logical Framework**

Problem Statement, Goal, Objectives, Outcome, Output, Input, Indicators, Means of Verification, Threats and Opportunities, Budget and Timeframe

5. Project Cycle

- Initiation Phase
- Planning Phase: SWOT, Cost Benefit Analysis, Feasibility Study
- Implementation Phase
- Monitoring Phase
- Completion
- Evaluation

6. Project Management

- Concept & Nature of Project Management
- Role & Functions of Project Manager
- Project Management Skills

7. Project Planning & Management Practices in Pakistan

- Planning Commission of Pakistan: Public Sector Development Program (Federal); Annual Development Program (Provincial)
- PC Forms & Its Use: PC-I (Project Planning); PC-II (Project Feasibility Report); PC-III (Project Monitoring); PC-IV (Project Completion); PC-V(Project Evaluation)

8. Challenges in Project Management

9. Importance of Transferring Project from Development to Current Budget

Recommended Books:

1. S. Barker and R. Cole, “Brilliant Project Management ePub eBook: What the best project managers know, do and say,” Pearson, 2014.
2. E. Bereaux, “The Complete Guide to Project Management for New Managers and Management Assistants: How to Get Things Done in Less Time,” Atlantic Publishing Company, 2008.
3. R. Blackman, “Project Cycle Management,” Tear Fund, 2003.
4. K. Forsberg, H. Mooz and H. Cotterman, “Visualizing Project Management: Models and Frameworks for Mastering Complex Systems,” John Wiley & Sons, Inc., 2005.
5. G. R. Heerkens, “Project Management,” McGraw Hill, 2007.
6. L. K. Johnson, R. Luecke and R. D. Austin, “The Essentials of Project Management,” Harvard Business Press, 2006.
7. S. Kemp, “Budgeting for Managers,” McGraw Hill, 2003.
8. H. R. Kerzner, “Project Management 2.0,” John Wiley & Sons, 2015.
9. J. Lewis, “Project Planning, Scheduling, and Control: The Ultimate Hands-On Guide to Bringing Projects in On Time and On Budget,” McGraw Hill Professional, 2010.
10. A. Mondal and S. Dutta, “Monitoring for Outcomes in Community Driven Projects: Using Learning Based Approach,” Academic Foundation, 2007.
11. G. Spolander and L. Martin, “Successful Project Management in Social Work and Social Care: Managing Resources, Assessing Risks and Measuring Outcomes,” Jessica Kingsley Publishers, 2012.

BS Electronics Non-Credit Courses

Course Name: **Pre-Calculus – I**
Credit hours: 3 (3+0)
Course Code: MATH-101
Prerequisites: None

Course Objectives:
To introduce basics of functions with detailed analysis of elementary functions including exponential, logarithmic and trigonometric functions.

Course Content:
Sets, Real Numbers and Their Properties, Polynomials, Linear and Quadratic Equations, Inequalities, Relations and Functions, Review of Linear Functions, Quadratic Functions, Inverse Functions, Exponential and Logarithmic Functions, Trigonometric Functions, Graphs of Trigonometric Functions, Trigonometric Identities, The Law of Sines, The Law of Cosines, Complex Numbers, De Moivre's Theorem.

Recommended Books:
1. M. Lial, J. Hornsby, D. Schneider and C. Daniels, "Precalculus," 6th Edition, Pearson, 2016.
2. M. Sullivan, "Precalculus," 11th Edition, Pearson, 2019.
3. J. Stewart, L. Redlin and S. Watson, "Precalculus: Mathematics for Calculus," 7th Edition, Cengage Learning, 2015.
4. M. Small and C. Kirkpatrick, "Functions 11," Nelson Canada, 2007.

Course Name: **Pre-Calculus – II**
Credit hours: 3 (3+0)
Course Code: MATH-102
Prerequisites: None

Course Objectives:
To introduce the concept of matrices, conic section, basic probability theory, limits, basics of derivatives and basics of definite integrals.

Course Content:
System of Linear Equations, Matrices and Determinants, Circles, Parabolas, Ellipses, Hyperbolas, Sequences and Series, The Binomial Theorem, Mathematical Induction, Basics of Counting Theory, Basics of Probability, Introduction to Limits and Continuity, Tangent Lines and Derivatives, Area and Definite Integral.

Recommended Books:
1. J. Hornsby, M. Lial and G. Rockswold, "A Graphical Approach to Precalculus

with Limits," 7th Edition, Pearson, 2018.
2. M. Lial, J. Hornsby, D. Schneider and C. Daniels, "Precalculus," 6th Edition, Pearson, 2016.
3. R. Larson, "Precalculus with Limits," 5th Edition, Cengage Learning, 2021.
4. M. Sullivan, "Precalculus," 11th Edition, Pearson, 2019.
5. J. Stewart, L. Redlin and S. Watson, "Precalculus: Mathematics for Calculus," 7th Edition, Cengage Learning, 2015.