PUNJAB BOARD OF TECHNICAL EDUCATION

21-A, Kashmir Block Allama Iqbal Town, Lahore

www.pbte.edu.pk R&D Section Tel # 042-99260273

SAY NO TO CORRUPTION

No PBTE/R&D/2024/624 Dated:- 26-08-25

NOTIFICATION

In pursuance of NAVTTC Notification No. DG(SS&C)/DAE/2024 dated 25-07-2025, it is notified that the following old courses of DAE (3 years) have been repealed and replaced with revised courses in respective fields of technology as detailed below:

i- Diploma of Associate Engineer in Mechanical Technology (Power) with specialization in Auto & Farm Machinery (3 Years).
ii- Diploma of Associate Engineer in Architecture Technology (3 Years).
iii- Diploma of Associate Engineer in Food Processing and Preservation Technology (3 Years).
iv- Diploma of Associate Engineer in Electronics Technology (3 Years).
v- Diploma of Associate Engineer in Telecommunication Technology (3 Years).

The implementation of said revised technologies shall be effective on the students who shall be registered from academic session 2025-26 and onward. Punjab Board of Technical Education, Lahore shall conduct the examinations of the said revised technologies w.e.f. 1st Annual Examination 2026 and onwards accordingly. However, the candidates enrolled in the previous versions of the aforesaid DAE technologies will avail the prescribed chances under the old curricula. Soft copy of the revised curricula of the aforesaid technologies may be downloaded from the website of PBTE i.e. www.pbte.edu.pk/textbooks.html

SECRETARY

CC To

1- PA to Chairperson, PBTE, Lahore.
2- PA to DG Academics, TEVTA, Lahore.
3- PA to DG Operations, TEVTA, Lahore.
4- PA to Secretary, PBTE, Lahore.
5- PA to Controller of Examinations, PBTE, Lahore.
6- The Principals concerned.
7- Deputy Controller of Examinations (Conduct), PBTE, Lahore.
8- Deputy Controller of Examinations (Secrecy), PBTE, Lahore.
9- System Analyst, PBTE Lahore.
10- Assistant Controller of Examinations (Technical), PBTE, Lahore.
11- Assistant Controller of Examinations (Secrecy), PBTE, Lahore.
12- Assistant Controller of Examinations (P&P-I), PBTE, Lahore.
13- Assistant Controller of Examinations (P&P- II), PBTE, Lahore.
14- Web Administrator, PBTE Lahore to upload on Board Website.
15- In-Charge P&S Section, PBTE, Lahore.
16- In-Charge Operation Wing, PBTE Lahore.

CURRICULUM
For
THREE YEARS' DIPLOMA OF ASSOCIATE ENGINEER
IN
TELECOMMUNICATION TECHNOLOGY

Technical Education and Vocational Training Authority

TEVTA

CURRICULUM SECTION

ACADEMICS DEPARTMENT

96-H, GULBERG-II, LAHORE

Ph # 042-99263055-9, 99263064

dg.acad@tevta.gop.pk, director.cur@tevta.gop.pk

CURRICULUM SALIENTS:

Entry Level: -	Matriculation (Science)
Duration of Course: -	3-Years
Credit Hours:	SEVENTY (70)
Methodology:	Theory 40%
	Practical 60 %
Examination & Certification Body:	Punjab Board of Technical Education
Examination System:	Annual System (same as for all the DAEs programs)

REVISED SCHEME OF STUDIES, (Feb. 2025)

DAE TELECOMMUNICATION (3 -YEARS COURSE)

1ST YEAR					
SR	**CODE**	**COURSE TITLE**	**T**	**P**	**C**
1	Gen-111	Islamiat/Pakistan Studies	1	0	1
2	TTQ-111/Civic-111	Tarjama Tul Quran/ Civics	1	0	1
3	Eng-112	English	2	0	2
4	Math-123	Applied Mathematics-I	3	0	3
5	Phy-132	Applied Physics	1	3	2
6	Comp-162	Computer Application	1	3	2
7	Elt-113	Electrical Circuits	2	3	3
8	Tel-112	Telecommunication Drawing	0	6	2
9	Tel-122	Telecommunication Workshop	0	6	2
10	Tel-133	Telecommunication Fundamentals	2	3	3
11	Tel-141	Occupational Health, Safety And Environment	1	0	1
			14	**24**	**22**
2ND YEAR					
SR		**COURSE TITLE**	**T**	**P**	**C**
1.	Gen-201	Islamiat/Pakistan Studies	1	0	1
2.	TTQ-211/Civic-111	Tarjama Tul Quran/ Civics	1	0	1
3.	Math-233	Applied Mathematics-II	3	0	3
4.	Ch-222	Applied Chemistry	1	3	2
5.	Mgm-231	Communication Skills And Report Writing	1	0	1
6.	Elt-213	Electronics Devices And Circuits	2	3	3
7.	Tel-213	Digital Logic Design	2	3	3
8.	Tel-223	Measuring Instruments	2	3	3
9.	Tel-233	Microcontroller Applications	2	3	3
10.	Tel-243	Telecommunication Networks	2	3	3
11.	Tel-253	Power Systems	2	3	3
			19	**21**	**26**
3RD YEAR					
SR.		**COURSE TITLE**	**T**	**P**	**C**
1.	Gen-301	Islamiat/Pakistan Studies	1	0	1
2.	Mgm-371	Entrepreneurship And Management	1	0	1
3.	Tel-313	Switching System	2	3	3
4.	Tel-323	Telecommunication Services And Terminal Equipment	2	3	3
5.	Tel-333	Transmission System	2	3	3
6.	Tel-343	Mobile Communication	2	3	3
7.	Tel-353	Emerging Technology	2	3	3
8.	Tel-363	Quality of Service and Maintenance	2	3	3
9.	Tel-372	Final Year Project	0	6	2
			14	**24**	**22**
		GRAND TOTAL	**47**	**69**	**70**

1st YEAR

سال اول

اسلامیات

	ٹی	پی	سی
گھنٹے	۱	۰۰	۱
نشانات	۵۰	۰۰	۵۰

موضوعات

کتاب وسنت

الف: قرآن مجید

(۱) تعارف قرآن مجید (۲) نزول قرآن (۳) مکی ومدنی سورتوں کی خصوصیات (۴) وحی کی اقسام

(۵) پندرہ منتخب آیات معہ ترجمہ

۱۔ لن تنالوا البر حتی تنفقوا مما تحبون

۲۔ واعتصموا بحبل اللہ جمیعا ولا تفرقو

۳۔ ولا یجرمنکم شنأن قوم علی ان لا تعدلوا

۴۔ ان اللہ یامرکم ان تؤدوا الامٰنٰت الی اھلھا

۵۔ ان اللہ یامرکم بالعدل والاحسان

۶۔ ان الصلوۃ تنھی عن الفحشاء والمنکر

۷۔ لقد کان لکم فی رسول اللہ اسوۃ حسنۃ

۸۔ ان اکرمکم عند اللہ اتقاکم

۹۔ وما اتاکم الرسول فخذ وہ وما نھی فخذوہ

۱۰۔ وَاَوْفُوْا بعھد اللہ

۱۱۔ وعاشروھن بالمعروف

۱۲۔ یحق اللہ الربوٰ ویُرْبِی الصَّدَقَات

۱۳۔ واصبر علی ما اصابک

۱۴۔ وقولوا قولاً سدیدا

۱۵۔ ان الدین عند اللہ السلام

ب۔ سنت

۱۔ سنت کی اہمیت

۲۔ دس منتخب احادیث معہ ترجمہ وتشریح

۱۔ انما الاعمال بالنیات

۲۔ انما بعثت لاتمم مکارم الاخلاق

۳۔ لا یومن احدکم حتی یحب لاخیہ ما یحب لنفسہ

۴۔ المسلم من سلم المسلمون من لسانہ ویدہ

۵۔ قل امنت باللہ ثم استقم

۶۔ خیرلم خیرکم لاھلہ

۷۔ سباب المسلم فیسوق وقتالہ کفر

۸۔ المومن اخوالمومن

۹۔ کل المسلم علی المسلم حرام دمہ ومالہ ومرضہ

۱۰۔ آیۃ المنافق ثلاث اذا احدث کرب واذا اوتمن خان واذا وعد اخلف

۳۔ دین اسلام

۳۔۱ اسلام کے بنیادی عقائد کی وضاحت اور انسان کی انفرادی واجتماعی زندگی پران کے اثرات

۱۔ توحید ۲۔ رسالت ۳۔ آخرت ۴۔ ملائکہ ۵۔ آسمانی کتاب

۳۔۲ عبادات

۱۔ نماز ۲۔ روزہ ۳۔ حج ۴۔ زکوۃ

مندرجہ بالا عبادات کی اہمیت وفضیلت، حکمتیں اور انسان کی انفرادی ومعاشرتی زندگی پران کے اثرات

۴۔ دین اسلام

عمومی مقصد

دین اسلام کے بنیادی عقائد اور عبادات میں جان سکے اور بیان کر سکے

خصوصی مقاصد

- لفظ دین اسلام کے لغوی اور اصطلاحی معنی بیان کر سکے
- دین اسلام کے بنیادی عقائد کی اہمیت بیان کر سکے
- دین اسلام کے بنیادی عقائد کے انسان کی کی انفرادی واجتماعی زندگی پر پڑنے والے اثرات بیان کر سکے
- عبادات کے لفظی واصطلاحی معنی بیان کر سکے
- عقیدے اور عبادات کا فرق بیان کر سکے
- عبادات (نماز، روزہ، حج، زکوۃ) کے فوری احکامات اور انسانی زندگی پران کے اثرات بیان کر سکے
- اسلامی عقائد اور عبادات کے مطابق اپنی زندگی ڈھال کر ایک اچھا مسلمان بن سکے

سال اول

تدریسی مقاصد

اسلامیات

الف۔ قرآن مجید

عمومی مقصد

طالب علم یہ سمجھنے کے قابل ہو کہ اسلام کی تعلیمات کا اصل سرچشمہ قرآن مجید ہے

خصوصی مقاصد : طالب علم اس قابل ہو جائے گا کہ

- قرآن مجید کی تعریف کر سکے گا
- قرآن مجید کے نزول کی صورت بیان کر سکے گا
- قرآن مجید کی مکی و مدنی سورتوں کی پہچان کر سکے گا
- منتخب آیات کا ترجمہ و تشریح کر سکے گا

عمومی مقصد : طالب علم یہ سمجھنے کے قابل ہو جائے گا کہ منتخب قرآنی آیات کے ذریعے اسلام کی تعلیمات کا مفہوم کیا ہے

خصوصی مقاصد : طالب علم اس قابل ہو جائے گا کہ

- قرآنی آیات کا ترجمہ و تشریح کر سکے گا
- قرآنی تعلیمات کی روشنی میں اپنی اور معاشرتی اصلاح کر سکے گا

ب۔ سنت

عمومی مقصد : طالب علم نبوی کی اہمیت و ضرورت کو اچھی طرح سمجھنے کے قابل ہو جائے گا

خصوصی مقاصد

- سنت کی تعریف بیان کر سکے گا
- سنت کی اہمیت و ضرورت کی وضاحت کر سکے گا
- سنت کی روشنی میں اسوۃ حسنہ پر عمل کر سکے گا

ج۔ منتخب احادیث نبوی

عمومی مقصد : طالب علم احادیث کی روشنی میں اخلاقی اقدار سے آگاہی حاصل کر سکے گا

خصوصی مقاصد

- احادیث کا ترجمہ و تشریح کر سکے گا
- رسول اللہ ﷺ کے اسوۃ حسنہ کی پیروی کا جذبہ پیدا ہو گا

سال اول

اخلاقیات

(غیر مسلم طلباء کیلئے)

	ٹی	پی	سی
گھنٹے	۱	۰۰	۱
نشانات	۵۰	۰۰	۵۰

سال اول

موضوعات

اخلاقیات کی تعریف اور اہمیت

اخلاقیات کا معیار (قانون، عقل، علمی کتب)

مندرجہ ذیل اخلاق کی وضاحت

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

سال اول

مطالعہ پاکستان

	ٹی	پی	سی
گھنٹے	۱	۰۰	۱
نشانات	۵۰	۰۰	۵۰

حصہ دوم

موضوعات

- حریت فکر، مسلمان قوم میں آزادی فکر کی تاریخ، مسلمانوں میں سیاسی آزادی کی اہمیت اور ضرورت، ذہنی وجسمانی غلامی کے نقصانات
- نظریہ پاکستان، قیام پاکستان کی اساس (دین اسلام) قیام پاکستان کی غرض وغایت
- نظریہ پاکستان کی وضاحت، نظریہ پاکستان علامہ اقبال اور قائداعظم کے ارشادات کی روشنی میں
- نظریہ پاکستان کا تاریخی پہلو، محمد بن قاسم کی آمد
- مجدد الف ثانی اور شاہ ولی اللہ کی تعلیمی خدمات
- سید احمد شہید کی تحریک مجاہدین
- تعلیمی تحریکیں

علی گڑھ، ندوۃ العلماء، دیوبند، مدرسۃ الاسلام (سندھ)، اسلامیہ کالج (پشاور)، انجمن حمایت اسلام (لاہور)

نظریہ پاکستان کا تاریخی پہلو

عمومی مقصد

نظریہ پاکستان کے تاریخی پس منظر سے واقفیت ہو سکے

خصوصی مقاصد

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

علمی تحریک

عمومی مقصد

برصغیر کی علمی تحریکوں سے آگاہی حاصل ہو سکے

خصوصی مقاصد

- علی گڑھ، دیوبند، ندوۃ العلماء، مدرسۃ اسلام، اسلامیہ کالج، انجمن حمایت اسلام نے تعلیم کے ذریعہ سیاسی شعور مسلمانوں میں پیدا کیا اسے بیان کر سکے
- آزادی ہند کے سلسلہ میں تحریک مجاہدین کی خدمات بیان کر سکے

TTQ 111/ Civics-111 TARJUMA TUL QURAN/ CIVICS

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

Note: Syllabi for these subject would be as per BISEs / General education, developed by Punjab Curriculum TextBook Board (PCTB)

ENG-112: ENGLISH

Total Contact Hours:

		T	P	C
Theory:	64			
Practical:	0	2	0	2

LEARNING OUTCOMES: At the end of the course, the students will be equipped with cognitive skill have the capability of presenting facts in a systematic and logical manner to meet the demands of English language in the dynamic fields commerce and industry. The course is designed to inculcate skills of reading, writing and comprehending the facts from the written material. This will also help the students in developing speaking skill.

COURSE CONTENTS

1. PROSE/TEXT 13 Hours

1.1 First eight essays of Intermediate English Book-II for the province of the Punjab and first eight essays of Intermediate English Book-I for other provinces.

2. GROUP DISCUSSION/SPEAKING (Sessional Evaluation) 13 Hours

3. GRAMMAR 19 Hours

3.1 Sentence structure
3.2 Tenses (correct use of verb/tense)
3.3 Parts of speech
3.4 Change of direct speech into indirect form
3.5 Words often confused.

4. COMPOSITION 13 Hours

4.1 Business letters
4.2 Applications for job, character certificate and grant of scholarship
4.3 Essay writing (topics specified in Instructional objectives).

5. TRANSLATION 6 Hours

5.1 Translation from Urdu into English (for Foreign Students: A paragraph or a dialogue).

ENG-112: ENGLISH

INSTRUCTIONAL OBJECTIVES:

1. Demonstrate Better Reading, Comprehension and Vocabulary.

1.1 Describe and narrate in simple English.
1.2 Identify the author and the essay.
1.3 Write summaries of the textual essays.
1.4 Identify facts and ideas.

2. Listen and Speak English Clearly (Sessional Evaluation).

2.1 Converse fluently.
2.2 Express ideas clearly.

3. Apply the Grammatical Rules to Writing a Speaking.

3.1 Describe sentence structure.
  3.1.1 Identify kinds of sentences.
3.2 Use correct verb/tense in sentences.
  3.2.1 Identify the tense of a sentence.
3.3 Narrate the direct speech in indirect form.
3.4 Distinguish between confusing words.

4. Apply the Concepts of Composition Writing to Practical Situations.

4.1 Write letters to communicate messages in the business world (inquiry, placing orders, complaints etc.).
  4.1.1 Identify parts of a business letter.
  4.1.2 Describe the qualities of a good business letter.
4.2 Write applications for job opportunities, grant of character certificate and grant of scholarship.
  4.2.1 Describe the structure of application.
  4.2.2 Design and compose Curriculum Vitae (C.V.), Bio-data or Resume separately.
4.3 Write essays pertaining to Technical Education, Science and our life, Computer, Environmental Pollution, Duties of a student and Life of a Technician or develop an essay from the given outline of some scientific topics.
  4.3.1 Identify major kinds of essay.

5. Apply Rules of Translation.

5.1 Convert sentences from Urdu to English.
5.2 Translate a passage of Urdu into English making appropriate substitution of words.

MATH-123 APPLIED MATHEMATICS - I

		T	P	C
Total Contact Hrs:	96			
Theory	96	3	0	3
Practical	Nil			

LEARNING OUTCOMES: After completing the course, the students will be able to solve problems of Algebra, Trigonometry, Vectors, Boolean Algebra, Complex numbers and Analytic Geometry, develop skills in the use of mathematical instruments and acquire mathematical clarity and insight in the solution of technical problems.

COURSE CONTENTS

1. QUADRATIC EQUATIONS **6 hours**

- 1.1 Standard Form
- 1.2 Solution
- 1.3 Nature of roots
- 1.4 Sum and product of roots
- 1.5 Formation
- 1.6 Problems

2. BINOMIAL THEOREM **6 hours**

- 2.1 Factorials
- 2.2 Binomial expression
- 2.3 Binomial co-efficient
- 2.4 Statement
- 2.5 The general term
- 2.6 The binomial series
- 2.7 Problems.

3. PARTIAL FRACTIONS **6 hours**

- 3.1 Introduction
- 3.2 Linear distinct factors case I
- 3.3 Linear repeated factors case II
- 3.4 Quadratic distinct factors case III
- 3.5 Quadratic repeated factors case IV
- 3.6 Problems

4. FUNDAMENTALS OF TRIGONOMETRY **6 hours**

- 4.1 Angles
- 4.2 Quadrants
- 4.3 Measurements of angles
- 4.4 Relation between sexagesimal and circular system
- 4.5 Relation between length of a circular arc and the radian measure of its central angle
- 4.6 Problems

5. TRIGONOMETRIC FUNCTIONS AND RATIOS **6 hours**

- 5.1 Trigonometric functions of any angle
- 5.2 Signs of trigonometric functions
- 5.3 Trigonometric ratios of particular angles

5.4 Fundamental identities
5.5 Problems

6. GENERAL IDENTITIES 6 hours

6.1 The Fundamental Law
6.2 Deductions
6.3 Sum and difference formulae
6.4 Double angle identities
6.5 Half angle identities
6.6 Conversion of sum or difference to products
6.7 Problems

7. SOLUTION OF TRIANGLES 6 hours

7.1 The law of Sines
7.2 The law of Cosines
7.3 Measurement of heights and distances
7.4 Problems

8. VECTORS AND PHASORS 12 hours

8.1 Scalars and Vectors
8.2 The unit Vectors i, j, k
8.3 Direction Cosines
8.4 Dot product
8.5 Cross product
8.6 Analytic expressions for dot and cross products
8.7 Phasors
8.8 Significance of j operator
8.9 Different forms
8.10 Algebraic operations
8.11 Problems

9. COMPLEX NUMBERS 9 hours

9.1 Introduction and properties
9.2 Basic operations
9.3 Conjugate
9.4 Modulus
9.5 Different forms
9.6 Problems

10. BOOLEAN ALGEBRA AND GATE NETWORKS 15 hours

10.1 Concept and basic laws
10.2 Sums of product and product of sums
10.3 Binary, decimals and octals, presentation of decimal numbers in BCD
10.4 Interconversion of numbers
10.5 OR Gates and AND Gates
10.6 Logical Expressions and their simplification
10.7 Demorgan's theorems

10.8 NAND Gates and NOR Gates
10.9 Problems

11. PLANE ANALYTIC GEOMETRY AND STRAIGHT LINE 6 hours

11.1 Coordinate system
11.2 Distance formula.
11.3 Ratio formulas.
11.4 Inclination and slope of line.
11.5 Slope formula.
11.6 Problems.

12. EQUATIONS OF THE STRAIGHT LINE 6 hours

12.1 Some important forms
12.2 General form
12.3 Angle formula.
12.4 Parallelism and perpendicularity
12.5 Problems

13. EQUATIONS OF THE CIRCLE. 6 hours

13.1 Standard and Central forms of equation.
13.2 General form of equation.
13.3 Radius and coordinates of center.
13.4 Problems

RECOMMENDED BOOKS

1. Ghulam Yasin Minhas, Technical Mathematics Vol - I, Ilmi Kitab Khana, Lahore.
2. Riaz Ali Khan, Polytechnic Mathematic Series Vol I and II, Majeed Sons, Faisalabad
3. Sana Ullah Bhatti, A Text Book of Algebra and Trigonometry, Punjab Text Book Board, Lahore.
4. Sana Ullah Bhatti, A Text Book of Analytic Geometry and Calculus, Punjab Text Book Board, Lahore.

MATH-123 APPLIED MATHEMATICS-I

INSTRUCTIONAL OBJECTIVES

1.2 USE DIFFERENT METHODS FOR THE SOLUTION OF QUADRATIC EQUATION

1.1 Define a standard quadratic equation.
1.2 Use methods of factorization and method of completing the square for solving the equations.
1.3 Derive quadratic formula.
1.4 Write expression for the discriminant.
1.5 Explain nature of the roots of a quadratic equation.
1.6 Calculate the sum and product of the roots.
1.7 Form a quadratic equation from the given roots.
1.8 Solve problems involving quadratic equations.

2. APPLY BINOMIAL THEOREM FOR THE EXPANSION OF BINOMIAL AND EXTRACTION OF ROOTS.

2.1 State binomial theorem for positive integral index.
2.2 Explain binomial coefficients:
(n,0), (n,1).....(n,r)....., (n,n)
2.3 Derive expression for the general term.
2.4 Calculate the specified terms.
2.5 Expand a binomial of a given index.
2.6 Extract the specified roots.
2.7 Compute the approximate value to a given decimal place.
2.8 Solve problems involving binomials.

3. APPLY DIFFERENT METHODS FOR RESOLVING A SINGLE FRACTION INTO PARTIAL FRACTIONS USING DIFFERENT METHODS

3.1 Define a partial fraction, a proper and an improper fraction.
3.2 Explain all the four types of partial fractions.
3.3 Set up equivalent partial fractions for each type.
3.4 Explain the methods for finding constants involved.
3.5 Resolve a single fraction into partial fractions.
3.6 Solve problems involving all the four types.

4. EXPLAIN THE SYSTEMS OF MEASUREMENT OF ANGLES.

4.1 Define angles and the related terms.
4.2 Illustrate the generation of an angle.
4.3 Explain sexagesimal and circular systems for the measurement of angles.
4.4 Derive the relationship between radian and degree.
4.5 Convert radians to degrees and vice versa.
4.6 Derive a formula for the circular measure of a central angle.
4.7 Use this formula for solving problems.

5. EXPLAIN BASIC CONCEPTS AND PRINCIPLES OF TRIGONOMETRIC FUNCTIONS.

5.1 Define the basic trigonometric functions/ratios of an angle as ratios of the sides of a right triangle.
5.2 Derive fundamental identities.
5.3 Find trigonometric ratios of particular angles.
5.4 Draw the graph of trigonometric functions.
5.5 Solve problems involving trigonometric functions.

6. USE TRIGONOMETRIC IDENTITIES IN SOLVING TECHNOLOGICAL PROBLEMS.

6.1 List fundamental identities.
6.2 Prove the fundamental law.
6.3 Deduce important results.
6.4 Derive sum and difference formulas.
6.5 Establish half angle, double and triple angle formulas.
6.6 Convert sum or difference into product and vice versa.
6.7 Solve problems.

7. USE CONCEPT, PROPERTIES AND LAWS OF TRIGONOMETRIC FUNCTIONS FOR SOLVING TRIANGLES.

7.1 Define angle of elevation and angle of depression.
7.2 Prove the law of sines and the law of cosines.
7.3 Explain elements of a triangle.
7.4 Solve triangles and the problems involving heights and distances.

8. EXPLAIN PRINCIPLES OF VECTORS AND PHASORS

8.1 Define unit vectors i, j, k.
8.2 Express a vector in the component form.
8.3 Explain magnitude, unit vector, direction cosines of a vector.
8.4 Explain dot product and cross product of two vector.
8.5 Deduce important results from dot and cross product.
8.6 Define phasor and operator j.
8.7 Explain different forms of phasors.
8.8 Perform basic Algebraic operation on phasors.
8.9 Solve problems on phasors.

9. USE PRINCIPLES OF COMPLEX NUMBERS IN SOLVING TECHNOLOGICAL PROBLEMS.

9.1 Define a complex number and its conjugate.
9.2 State properties of complex numbers.
9.3 Give different forms of complex numbers.
9.4 Perform basic algebraic operations on complex numbers.
9.5 Solve problem involving complex numbers.

10. SOLVE TECHNICAL PROBLEMS USING PRINCIPLES OF BOOLEAN ALGEBRA

10.1 Explain fundamental concepts of Boolean algebra
10.2 Explain binary numbers, octal numbers, decimal numbers and their interconversion.

10.3 Explain digital addition and multiplication and its applications to OR gates and AND Gates
10.4 Illustrate complimentation and inversion
10.5 Evaluate logical expression
10.6 List basic Laws of Boolean Algebra
10.7 Explain De-Morgan's theorem
10.8 Explain basic duality of Boolean algebra
10.9 Derive Boolean expression
10.10 Explain combination of GATES
10.11 Illustrate sum of products and product of sum
10.12 Derive product of sum expression
10.13 Explain NAND Gates and NOR Gates
10.14 Use the map methods for simplifying expressions
10.15 Explain sub-cubes and covering

11. EXPLAIN THE CONCEPT OF PLANE ANALYTIC GEOMETRY

11.1 Explain the rectangular coordinate system.
11.2 Locate points in different quadrants.
11.3 Derive distance formula.
11.4 Describe the ratio formula
11.5 Derive slope formula
11.6 Solve problems using the above formulae.

12. USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

12.1 Define equation of a straight line.
12.2 Derive slope intercept and intercept forms of equations of a straight line.
12.3 Write general form of equations of a straight line.
12.4 Derive an expression for angle between two straight lines.
12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
12.6 Solve problems using these equations/formulae.

13. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE

13.1 Define a circle.
13.2 Describe standard, central and general forms of the equation of a circle.
13.3 Convert general form to the central form of equation of a circle.
13.4 Deduce formula for radius and coordinates of the center of a circle.
13.5 Derive equation of the circle passing through three points.
13.6 Solve problems involving these equations.

PHY-132 APPLIED PHYSICS

Total Contact Hrs: 128

		T	P	C
Theory	32			
Practicals	96	1	3	2

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

COURSE CONTENTS

1 MEASUREMENTS. 2 Hours.

1.1 Fundamental units and derived units
1.2 Systems of measurement and S.I. units
1.3 Concept of dimensions, dimensional formula
1.4 Conversion from one system to another
1.5 Significant figures

2 SCALARS AND VECTORS. 4 Hours.

2.1 Revision of head to tail rule
2.2 Laws of parallelogram, triangle and polygon of forces
2.3 Resolution of a vector
2.4 Addition of vectors by rectangular components
2.5 Multiplication of two vectors, dot product and cross product

3 MOTION 4 Hours.

3.1 Review of laws and equations of motion
3.2 Law of conservation of momentum
3.3 Angular motion
3.4 Relation between linear and angular motion
3.5 Centripetal acceleration and force
3.6 Equations of angular motion

4 TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA. 4 Hours.

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

5 SOUND. 5 Hrs

5.1 Longitudinal waves
5.2 Intensity, loudness, pitch and quality of sound
5.3 Units of Intensity of level and frequency response of ear

5.4 Interference of sound waves silence zones, beats
5.5 Acoustics
5.6 Doppler effect.

6 LIGHT. 5 Hours

6.1 Review laws of reflection and refraction
6.2 Image formation by mirrors and lenses
6.3 Optical instruments
6.4 Wave theory of light
6.5 Interference, diffraction, polarization of light waves
6.6 Applications of polarization in sunglasses, optical activity and stress analysis

7 OPTICAL FIBER. 2 Hours

7.1 Optical communication and problems
7.2 Review total internal reflection and critical angle
7.3 Structure of optical fiber
7.4 Fiber material and manufacture
7.5 Optical fiber - uses.

8 LASERS. 3 Hours

8.1 Corpuscular theory of light
8.2 Emission and absorption of light
8.3 Stimulated absorption and emission of light
8.4 Laser principle
8.5 Structure and working of lasers
8.6 Types of lasers with brief description.
8.7 Applications (basic concepts)
8.8 Material processing
8.9 Laser welding
8.10 Laser assisted machining
8.11 Micro machining
8.12 Drilling, scribing and marking
8.13 Printing
8.14 Lasers in medicine

9 ELECTROMAGNETIC WAVES. 3 Hours

9.1 Magnetic field around a current carrying conductor
9.2 Electric field induced around a changing magnetic flux
9.3 Moving fields
9.4 Types of electromagnetic waves
9.5 Generation of Radio Waves
9.6 Spectrum of electromagnetic waves.

10 ARTIFICIAL SATELLITES. 2 Hours

10.1 Review law of gravitation
10.2 Escape velocity
10.3 Orbital velocity
10.4 Geosynchronous and geostationary satellites
10.5 Use of satellites in data communication.

RECOMMENDED BOOKS

1 Tahir Hussain, Fundamentals of Physics Vol-I and II
2 Farid Khawaja, Fundamentals of Physics Vol-I and II
3 Wells and Slusher, Schaum's Series Physics .
4 Nelkon and Oyborn, Advanced Level Practical Physics
5 Mehboob Ilahi Malik and Inam-ul-Haq, Practical Physics
6 Wilson, Lasers - Principles and Applications
7 M. Aslam Khan and M. Akram Sandhu, Experimental Physics Note Book

PHY-132 APPLIED PHYSICS

INSTRUCTIONAL OBJECTIVES

1 USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS.

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

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

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

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

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

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

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

5 EXPLAIN CONCEPTS OF SOUND.

5.1 Describe longitudinal wave and its propagation
5.2 Explain the concepts: Intensity, loudness, pitch and quality of sound
5.3 Explain units of Intensity of level and frequency response of ear
5.4 Explain phenomena of silence zones, beats
5.5 Explain Acoustics of buildings
5.6 Explain Doppler effect giving mathematical expressions.

6 USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS and LENSES.

6.1 Explain laws of reflection and refraction
6.2 Use mirror formula to solve problems
6.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscopes, telescopes, camera and sextant.

7 EXPLAIN WAVE THEORY OF LIGHT

7.1 Explain wave theory of light
7.2 Explain phenomena of interference, diffraction, polarization of light waves
7.3 Describe uses of polarization given in the course contents.

8 EXPLAIN THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER.

8.1 Explain the structure of the Optical Fiber
8.2 Explain its principle of working
8.3 Describe use of optical fiber in industry and medicine.

9 EXPLAIN THE STRUCTURE, WORKING AND USES OF LASERS.

9.1 Explain the stimulated emission of radiation
9.2 Explain the laser principle
9.3 Describe the structure and working of lasers
9.4 Distinguish between types of lasers
9.5 Describe the applications of lasers in the fields mentioned in the course contents.

10 EXPLAIN NATURE, TYPES, GENERATION AND SPECTRUM OF ELECTROMAGNETIC WAVES.

10.1 Explain magnetic field due to current and electric field due to changing magnetic flux
10.2 Explain moving fields
10.3 Describe types of electromagnetic waves
10.4 Explain generation of Radio Waves
10.5 Explain spectrum of electromagnetic waves.

11 EXPLAIN TYPES AND USES OF ARTIFICIAL SATELLITES.

11.1 Explain escape velocity
11.2 Explain orbital velocity
11.3 Distinguish between geosynchronous and geostationary satellites
11.4 Describe uses of artificial satellites in data communication.

PHY-132 APPLIED PHYSICS

LIST OF PRACTICALS.

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

COMP-162 COMPUTER APPLICATIONS

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

Pre-requisites: None

AIMS: This subject will enable the student to be familiar with the basic daily life applications of computer. Trainee will also learn computer applications and other information according to profession at elementary level. Trainee will learn the knowledge and skills regarding EDP, Windows OS, MS-Word, C++, Spread Sheets (Excel), Power Point & Internet.

COURSE CONTENTS:

1. ELECTRONIC DATA PROCESSING (E.D.P.)
4 Hours

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

2. MS-WINDOWS 2010 6 Hours

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

3. MS-OFFICE (MS-WORD 2016) 7 Hours

3.1 Introduction to MS-Office
3.2 Introduction to MS-Word & its Screen
3.3 Create a new document
3.4 Editing & formatting the text
3.5 Saving & Opening a document
3.6 Page setup (Set the Margins & Paper)
3.7 Spell Check & Grammar
3.8 Paragraph Alignment

3.9 Inserting Page numbers, Symbols, Text box & Picture in the document
3.10 Use the different Format menu drop down commands(Drop Cap, Change Case, Bullet & Numbering and Border & Shading)
3.11 Insert the 'Table and it's Editing
3.12 Printing the document
3.13 Saving a document file as PDF format

4. MS-OFFICE (MS-EXCEL 2016) 4 Hours

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

5. MS-OFFICE (MS-POWER POINT 2016) 4 Hours

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

6. INTRODUCTION TO PROGRAMMING 4 Hours

6.1 Introduction to computer programming and languages
6.2 Introduction to C++
6.3 Arithmetical operations
6.4 Logical operations
6.5 Looping
6.6 Flow chart

7. INTERNET & E-MAIL 3 Hours

7.1 Introduction to Internet & browser window
7.2 Searching, Saving and Print a page from internet
7.3 Creating, Reading & Sending E-Mail
7.4 File Attachment
7.5 Uploading and downloading file(s) and software(s)
7.6 Explain some advance features over the internet and search engines
7.7 Difference between Internet, Intranet and Extranet

COMP-162 COMPUTER APPLICATIONS

INSTRUCTIONAL OBJECTIVES:

1. UNDERSTAND ELECTRONIC DATA PROCESSING (E.D.P)

1.1. Describe Basic Terms of Computer Science. Data & its Types, Information, Hardware, Software
1.2. Explain Computer & its types
1.3. Generations of Computers
1.4. Explain Block diagram of a computer system
1.5. State the terms such as BIT, Byte, RAM & ROM
1.6. Identify Input & Output devices
1.7. Describe Secondary Storage devices
1.8. Explain Types of Software
1.9. Introduction to Programming Language
1.10. Explain Applications of computer in different fields
1.11. Application in Engineering, Education & Business

2. UNDERSTAND MS-WINDOWS 2010

2.1 Explain Introduction to Windows
2.2 How to install Drivers & Windows
2.3 Describe Loading & Shut down process
2.4 Explain Introduction to Desktop items(Creation of Icons, Shortcut, Folder & modify Taskbar)
2.5 Explain Desktop properties
2.6 Describe Use' of Control Panel (add/remove program, time & date, mouse and create user account)
2.7 Explain the method of searching a document

3. UNDERSTAND MS-OFFICE (MS-WORD 2016)

3.1 Explain Introduction to MS-Office
3.2 Describe -Introduction to MS-Word & its Screen
3.3 Describe create a new document
3.4 Explain Editing & formatting the text
3.5 Describe saving & Opening a document
3.6 Explain Page setup, (Set the Margins & Paper)
3.7 Describe Spell Check & Grammar
3.8 Explain Paragraph Alignment
3.9 Explain Inserting Page numbers, Symbols, Text box & Picture in the document
3.10 Describe Use the different Format menu drop down commands(Drop Cap, Change Case, Bullet &Numbering and Border & Shading)
3.11 Explain Insert the Table and its Editing and modifying
3.12 Describe printing the document
3.13 Describe the method of file saving as a PDF Format

4. UNDERSTAND MS-OFFICE (MS-EXCEL 2016)

4.1 Explain Introduction to MS-Excel & its Screen
4.2 Describe Entering data & apply formulas in worksheet
4.3 Describe Editing &Formatting the, Cells, Row & Column
4.4 Explain Insert Graphs in sheet
4.5 Describe Page setup, Print preview & Printing
4.6 Explain in details formulas for sum, subtract, multiply, divide, average

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

5. UNDERSTAND MS-OFFICE (MS-POWER POINT 2016)

5.1 Describe Introduction to MS-Power point
5.2 Explain creating a presentation
5.3 Describe Editing & formatting a text box
5.4 Explain Adding pictures & colors to a slide
5.5 Describe Making slide shows
5.6 Explain Slide Transitions

6. UNDERSTAND LANGUAGE

6.1 Define program, programming, programmer , and programming languages.
6.2 Classify computer programming languages.
6.3 Describe briefly computer languages.
6.4 Describe C++ programming language and its advantages.
6.5 Explain arithmetic operations (addition, multiplication, subtraction, division etc.)
6.6 Explain logical operations (AND, OR, NOT, Equal to, etc.)
6.7 Explain the basics of loops for repetitive operations.
6.8 Explain the components of Flow-Charts for simple computer program.

7. UNDERSTAND INTERNET & E-MAIL

7.1 Explain Introduction to Internet and browser window
7.2 Explain Introduction to Internet and browser window
7.3 Explain Searching, Saving and Print a page from internet
7.4 Describe Creating, Reading & Sending E-Mail
7.5 File attachment.
7.6 Uploading and downloading file(s) and software(s)
7.7 Explain some advance features over the internet and how to search topics on different search engines
7.8 Difference between Internet, Intranet and Extranet

COMP-162 COMPUTER APPLICATIONS

List of Practical: 96 Hours

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

Speakers, microphone, scanner, digital camera, card reader, DSL

Modem and other magnetic elements.

2. MS WINDOWS 2010 18 Hours

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

3. MS OFFICE (MS-WORD 2016) 27 Hours

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

4. MS OFFICE (MS-EXCEL 2016) 18 Hours

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

5. MS OFFICE (MS-POWER POINT 2016) 09 Hours

- 5.1 Identifying the MS POWER POINT Screen and its menu
- 5.2 Practice of create a new presentation and save
- 5.3 Practice of open saves presentations
- 5.4 Practice of inset picture and videos

6. INTRODUCTION TO PROGRAMMING LANGUAGE 12 Hours

6.1 Practice on C++ for addition, multiplication, subtraction, division etc.
6.2 Practice on C++ using loop statements.
6.3 Practice on C++ using logical operations (AND, OR, NOT, Shift, Equal to etc)
6.4 Practice on C++ using incremental statement.
6.5 Practice of making flow chart(Prepare a flow chart to find the sum of 529 and 256)

7. INTERNET & E-MAIL 09 Hours

7.1 Identifying internet explorer
7.2 Practice of searching data from any search engine
7.3 Practice of create an E-Mail account and how to send and receive mails, download attachments
7.4 File attachment.
7.5 Uploading and downloading file(s) and software(s)

Elt-113 ELECTRICAL CIRCUITS

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

LEARNING OUTCOMES:

The students will be able to:

- Understand Fundamental Electrical Concepts
- Apply Ohm's and Kirchhoff's Laws in Circuit Analysis
- Analyze and Simplify Electrical Networks
- Explore Magnetism and Electromagnetism Principles
- Master AC and DC Circuit Behaviors and Components
- Understand and Utilize Electrical Devices and Applications

COURSE CONTENTS

1 BASIC PRINCIPLES OF ELECTRICITY 04 Hours

1.1 Electron Theory
- 1.1.1 Structure of atom, K, L and M shell, energy levels and valence electrons
- 1.1.2 Energy bands with reference to conductors, insulators and semiconductor

1.2 Electrical Quantities
- 1.2.1 Potential, current and resistance
- 1.2.2 Units of potential, current and resistance
- 1.2.3 Conventional and electron current

2 DC FUNDAMENTALS 06 Hours

2.1 Ohm's Law
- 2.1.1 Definition of Ohm's law
- 2.1.2 Problems on Ohm's Law

2.2. Laws of Resistance
- 2.2.1 Specific Resistance, conductance and conductivity
- 2.2.2 Resistance in series, parallel and series-parallel
- 2.2.3 Calculations on combination of resistance and cells in series, parallel and series parallel combinations
- 2.2.4 Power and Energy their units and calculations
- 2.2.5 Power dissipation in resistors

2.3 Resistors
- 2.3.1 Resistor construction and Basic types
- 2.3.2 Application of resistors
- 2.3.3 Resistors Power rating and Troubles

3 DC SOURCES 06 Hours

3.1 Types of DC sources
- 3.1.1 Introduction of Solar Energy Sources
- 3.1.2 Introduction of Chemical Energy Sources

3.1.3 Introduction of Electromechanical Energy Sources

3.2 Batteries

3.2.1 Introduction to tubular, Lithium-ion Batteries and Lead Acid Batteries.

3.2.2 Internal resistance of a cell

3.2.3 Application of cell as constant voltage and constant current source.

3.3 Photo and Thermo-Electricity

3.3.1 Photoelectric effects, Photo- conductive, and photovoltaic phenomena

3.3.2 Application of photoelectric effects

4 NETWORK THEOREMS 06 Hours

4.1 Kirchhoff's Laws

4.1.1 Introduction of Kirchhoff's Laws

4.1.2 Basic Problems using KVL and KCL.

4.2 Superposition theorem for Resistive circuits

4.3 Calculation based on the superposition theorem

4.4 Star and Delta transformation

4.5 Calculation based on Star and Delta transformation

5 MAGNETISM AND ELECTROMAGNETISM 08 Hours

5.1 Magnetism.

5.1.1 Introduction to magnetism, magnetic line of force, flux, flux-density, permeability, Reluctance and their units

5.1.2 Properties of magnetic lines of force

5.1.3 Types of magnets

5.1.4 Magnetic properties of materials (ferro-, para- and dia-magnetic) magnetic induction

5.2 Electromagnetism

5.2.1 Introduction to Electromagnetism

5.2.2 Electromagnetic induction

5.2.3 Magnetic field around a current carrying conductor.

5.2.4 Force between two magnetic fields and motor action

5.2.5 Faraday’s Law of Electromagnetic induction ($R=Nd\Phi/dt.$)

5.2.6 Lenz's Law

6 ELECTROSTATICS 08 Hours

6.1 Principle of electrostatic, positive and negative charges

6.2 Coulomb’s Laws of electrostatic

6.3 Electrostatic induction and field strength

6.4 Properties of electric lines of force and comparison with magnetic lines

6.5. Dielectric, dielectric strength and break down voltage.

6.6 Capacitance and capacitors.

6.7 Basic Types and uses of capacitors

6.8 Equivalent capacitance for series, parallel and series parallel combination of capacitors

7 AC FUNDAMENTALS 10 Hours

7.1 The simple AC generator

7.1.1 Sine wave, cycle, wavelength, period, frequency and units

7.1.2 AC sine wave form and its characteristics. (Instantaneous, peak, average, rms or effective values and their inter relation)

7.1.3 Audio and Radio frequencies
7.1.4 Types of alternating wave forms (sinusoidal and non-sinusoidal waves).
7.2 Ohm's Law in AC Circuits
7.2.1 Phase angle, in-phase, out of phase waves and phase lag & lead and power factor
7.2.2 AC through pure resistance.
7.2.3 AC through pure capacitor.
7.2.4 AC through pure Inductor
7.2.5 Skin effect

8 RESONANCE 08 Hours

8.1 Condition of resonance and resonant circuit
8.2 Relation between f, L and C at resonance
8.3 Series resonant circuit.
8.4 Parallel resonant circuit
8.5 Series and parallel resonance curve comparison and Bandwidth

9 TRANSFORMER 08 Hours

9.1 Principle of transformer, mutual inductance, coefficient of mutual inductance
9.2 Turn ratio and e.m.f. equation
9.3 Construction, types of transformers, core materials
9.4 Application of transformers in electronics
9.5 Auto-transformers, principle, advantages, disadvantages and applications

RECOMMENDED REFERENCE BOOKS

1. Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N. O. Sadiku
2. Electrical Engineering: Principles and Applications" by Allan R. Hambley
3. Electric Circuits" by James W. Nilsson and Susan A. Riedel
4. Engineering Electromagnetics" by William H. Hayt and John A. Buck

Elt-113 ELECTRICAL CIRCUITS

INSTRUCTIIONAL OBJECTIVES

1 BASIC PRINCIPLES OF ELECTRICITY

1.1 Electron Theory

1.1.1 Explain the structure of an atom, including K, L, and M shells, energy levels, and valence electrons.

1.1.2 Explain energy bands and how they relate to conductors, insulators, and semiconductors.

1.2 Electrical Quantities

1.2.1 Explain the relationship between potential, current, and resistance in electrical circuits.

1.2.2 Learn the units of potential, current, and resistance in electrical circuits.

1.2.3 Distinguish between conventional current and electron flow in circuits.

2 DC FUNDAMENTALS

2.1 Ohm's Law

2.1.1 Explain the definition of Ohm’s law

2.1.2 Solve problems related to Ohm's law, including calculating voltage, current, and resistance.

2.2 Laws of Resistance

2.2.1 Explain the concepts of specific resistance, conductance, and conductivity in materials.

2.2.2 Learn how to find the total resistance in series, parallel combinations.

2.2.3 Solve problems involving the combination of resistances in series, parallel

2.2.4 Explain the concepts of power and energy, including their units

2.2.5 Calculate power dissipation in resistors

2.3 Resistors

2.3.1 Learn about the construction and basic types of resistors used in electrical circuits.

2.3.2 Explain the various applications of resistors in electrical and electronic circuits.

2.3.3 Learn about the power rating of resistors and troubleshoot common issues related to them.

3 DC Sources

3.1 Types of DC sources

3.1.1 Explain the basics of solar energy sources

3.1.2 Learn about chemical energy sources and their role in energy production.

3.1.3 Explore the concept of electromechanical energy sources and their applications.

3.2 Batteries

3.2.1 Explain the types and uses of tubular, lithium-ion, and lead-acid batteries.

3.2.2 Learn the concept of internal resistance in a cell

3.2.3 Explore how cells are used as constant voltage and constant current sources in circuits.

3.3 Photo and Thermo-Electricity

3.3.1 Explain the photoelectric effect, photo-conductive, and photovoltaic phenomena.

3.3.2 Learn the practical applications of the photoelectric effect in various technologies.

4 NETWORK THEOREMS

4.1 Kirchhoff's Laws

4.1.1 Explain the basic concepts of Kirchhoff's current and voltage laws.

4.1.2 Solve basic problems using Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL).

4.2 Learn the superposition theorem and its application in resistive circuits.

4.3 Solve problems using the superposition theorem in electrical circuits.

4.4 Explain the process of transforming between star and delta resistor configurations.

4.5 Solve problems involving star and delta transformations in electrical circuits.

5 MAGNETISM AND ELECTROMAGNETISM

5.1 Magnetism.

5.1.1 Learn the basic concepts of magnetism, magnetic lines of force, flux, flux-density, permeability, and reluctance.

5.1.2 Explain the properties and characteristics of magnetic lines of force.

5.1.3 Learn about the different types of magnets and their properties.

5.1.4 Explore the magnetic properties of materials and the concept of magnetic induction.

5.2 Electromagnetism

5.2.1 Explain the principles of electromagnetism

5.2.2 Explain the process of electromagnetic induction

5.2.3 Explore how a magnetic field is created around a current-carrying conductor.

5.2.4 Describe the force between two magnetic fields and its role in motor action.

5.2.5 Explain Faraday's Law of Electromagnetic Induction and its mathematical expression.

5.2.6 Describe Lenz's Law and its application in electromagnetic induction.

6 ELECTROSTATICS

6.1 Explain the basic principles of electrostatics, including the behavior of positive and negative charges.

6.2 Explain Coulomb’s law of electrostatic.

6.3 Explore the concept of electrostatic induction and the relationship with field strength.

6.4 Explain the properties of electric lines of force and how they compare to magnetic lines.

6.5 Describe dielectrics, their dielectric strength, and breakdown voltage.

6.6 Explain the concept of capacitance and the role of capacitors in circuits.

6.7 Describe the basic types of capacitors (fixed and variable) and their applications in electrical circuits.

6.8 Explain capacitance in series, parallel, and series-parallel combinations of capacitors.

7 AC FUNDAMENTALS

7.1 The simple AC generator

7.1.1 Explain the basic concepts of sine waves, including cycle, wavelength, period, frequency, and their units.

7.1.2 Learn the characteristics of AC sine waves and the inter-relation of instantaneous, peak, average, and RMS values.

7.1.3 Write down the audio and radio frequency ranges.

7.1.4 Learn about different types of alternating waveforms, including sinusoidal and non-sinusoidal waves.

7.2 Ohm's Law in AC Circuits

7.2.1 Explain phase angle, the concepts of in-phase and out-of-phase waves, phase lag, lead, and power factor.

7.2.2 Learn how alternating current behaves when passing through pure resistance.

7.2.3 Explain the behavior of alternating current through a pure capacitor.

7.2.4 Explore the effects of alternating current when passing through a pure inductor.

7.2.5 Explain the phenomenon of the skin effect in alternating current.

8 RESONANCE

8.1 Learn the conditions for resonance in an electrical circuit and Explain the concept of a resonant circuit.

8.2 Explain the relationship between frequency (f), inductance (L), and capacitance (C) at resonance.

8.3 Explore the characteristics and behavior of a series resonant circuit.

8.4 Explain the impedance characteristics of a parallel resonant circuit.

8.5 Compare the resonance curves of series and parallel circuits and Explain bandwidth.

9 TRANSFORMER

9.1 Explain the principle of transformer operation, mutual inductance, and the coefficient of mutual inductance.

9.2 Learn how the turn ratio affects the transformer and drive the electromotive force (EMF) equation.

9.3 Explore the construction, types of transformers, and the materials used for their cores.

9.4 Explain the various applications of transformers in electronic circuits.

9.5 Learn the principle, advantages, disadvantages, and applications of auto-transformers.

Elt-113 ELECTRICAL CIRCUITS

LIST OF PRACTICAL 96 HRs

1. Identification of Basic Electrical/Electronic Components e.g., Resistor, Capacitor, Inductor etc.
2. Demonstration and use of Ammeter, Voltmeter and Multi-meter.
3. Measurement of current, voltage and resistance through Multi-meter.
4. Verification of Ohm's Law by: Keeping the voltage constant &Keeping the resistance
5. Verify series combination of resistances.
6. Verify parallel combination of resistances.
7. Verify the Kirchhoff's' current laws.
8. Verify the Kirchhoff's' voltage laws.
9. Measure power by: Voltmeter/Ammeter method & Wattmeter.
10. Practice of resistor color coding.
11. Combine cells in series and parallel and verify the net voltage.
12. Verify Lenz's Law.
13. Verify Self-Induction
14. Verify Mutual-Induction
15. Study of the effect on a current carrying conductor when placed in a magnetic field.
16. Verify Faraday's Laws of Electromagnetic induction.
17. Verify laws of combination of capacitors.
18. Demonstrate sine wave on an oscilloscope and determine its peak, peak to peak, r.m.s. and average values of current and voltage.
19. Determine of wave length of a given AC signal by oscilloscope. ,
20. Determine time period and frequency of a given AC signal by oscilloscope.

Tel -112 TELECOMMUNICATION DRAWING

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

LEARNING OBJECTIVES:

1. **Demonstrate** manual drawing skills to create circuit schematics, block diagrams, and equipment layouts in telecommunication systems.
2. **Utilize** computer softwares to develop accurate telecommunication diagrams and network architectures.
3. **Interpret** telecommunication system diagrams and symbols used in various communication technologies.

LIST OF PRACTICALS **192 HRs**

(1) MANUAL DRAWING **70 HRs**

1. Use and care of drawing instruments and pencils.
2. Single stroke and inclined Gothic letters.
3. Practice in numbering, lettering, vertical and inclined.
4. Alphabets of line and line values.
5. Tangency exercises.
6. One view drawing and dimensioning techniques.
7. System and kind of dimensioning.
8. Preparation of multi-view drawing from the given model showing conventional placement of dimensions there upon.
9. Simple pictorial drawings:

a) Isometric
b) Oblique
c) One point perspective

10. Schematic drawing of simple circuits (resonant/filter circuits).
11. Practice in single line diagram schematic drawing.
12. Drawing the different telecom symbols used in drawing
13. Drawing telephone outside plant/cables route diagrams.
14. Drawing Inter-rack/Intercom wiring.
15. Draw the layout plans of equipment.
16. Block diagram of PCM Transmission Equipment.
17. Block diagram of Optical Fibre Terminal Equipment.
18. Block diagram of Microwave Terminal Equipment.
19. Flow chart symbols.

(2) COMPUTER BASED DRAWING 122 HRs

20. Introduction to a CAD Software
21. Drawing Techniques
22. Unit Selection, Drawing Limits and Drawing Aids
23. Draw Commands
24. Modifying Drawing
25. Application of Auto CAD.
26. Draw the diagram of a BTS in CAD
27. Draw Block diagram simple radio receiver.
28. Draw wave shapes of AM modulation signals.
    a) Modulating signal.
    b) Career signal.
    c) AM modulated signal.
29. Draw Block diagram of GSM system architecture,
30. Draw the Circuit Diagram of Telephone Set.
31. Draw the Circuit Diagram of Antiside Tone Circuit of Telephone Set.
32. Draw the Block diagram of wireless local loop.
33. Draw the Block diagram of telephone exchange.
34. Draw the PABX system wiring diagram.
35. Draw the Block diagram of GPON Technology.
36. Draw the Block diagram of GPON Point-to-Multipoint (GPON P2MP) Architecture.
37. Draw the Block diagram of different radio paths communication.
    i. Sky Waves.
    ii. Ground Waves.
    iii. Line of Sight communications.
38. Introduction of MS VISIO software
39. Introduction to GUI of MS VISIO software
40. Draw Block diagram of GSM system architecture in MS VISIO software
41. Draw the Block diagram of wireless local loop in MS VISIO software
42. Draw the Block diagram of telephone exchange in MS VISIO software
43. Draw the Block diagram of GPON Technology in MS VISIO software
44. Draw the Block diagram of GPON Point-to-Multipoint (GPON P2MP) Architecture in MS VISIO software
45. Draw the Block diagram of different radio paths communication in MS VISIO software
46. Introduction of CST Software
47. Basic Antenna Design and Testing using CST Software

TEXT /REFERENCE BOOKS:

1. *Auto CAD A Problem-Solving Approach*
2. *Auto CAD Fundamentals*

(Tel-122) TELECOMMUNICATION WORKSHOP

Total contact Hours:	**192**			
Practical:	192 Hours	T	P	C
		0	**6**	**2**

LERARNING OBJECTIVES:

At the end of the course, the students are expected to be able to:

- Explain correct methods and techniques of using appropriate tools and instruments for fabrication and assembly of electrical and electronic devices and circuits.
- Explain how to interact with the CST Studio Suite interface and how to perform basic tasks in terms of modeling, setup of simulation, and analyzing pre and post-processing results.
- Assemble electrical and electronic devices.

LIST OF PRACTICALS **192 Hours**

1. METAL WORKSHOP **60 HRs**

1. Demonstrate the safety precautions for metal workshop and welding shop.
2. Demonstrate how can hand tools and measuring devices be effectively selected, used, and maintained for precision and efficiency in various tasks?
3. Demonstrate Proper Use, Care and Maintenance of Various Workshop Tools.
4. Prepare name plate for the practice of cutting, filling, drilling and sawing.
5. Prepare drawer handle for the practice of bending and drilling,
6. How can various woodwork tools be utilized to create different types of wood joints, and what are the practical applications of these joints in woodworking projects?
7. Demonstrate the processes of electroplating, galvanizing, and painting, and explain how each technique protects and enhances the surface of metals.
8. Perform different types of joints used in fastening and bonding.
9. Demonstrate the proper use and selection of screws, nuts, bolts, washers, and rivets, and explain their roles in creating secure and reliable fastened joints in various applications.
10. Perform and compare the techniques of welding, brazing, and bonding, demonstrating their applications and effectiveness in joining different materials.
11. Demonstrate the correct procedure for flame making, and explain its applications in various metalworking processes.
12. Prepare and demonstrate the creation of a butt joint, explaining the steps involved and their applications in metal fabrication.
13. Prepare and demonstrate the creation of a lap joint, explaining the steps involved and their applications in metal fabrication.
14. Prepare and demonstrate the formation of a corner joint using a filler rod, explaining the technique and its practical applications in welding.
15. Prepare and demonstrate the formation of a T joint using a filler rod, explaining the technique and its practical applications in welding.
16. Practice of TIG welding
17. Practice of MIG welding

18. Perform grinding of different joints

2. ELECTRONIC WORKSHOP 87 HRs

Basic Wiring

19. Identify and describe wiring accessories
20. Study various protective devices (fuse, circuit breaker).
21. Identify sizes and types of wiring cables
22. Perform correct wiring of single lamp circuit
23. Perform correct wiring of staircase wiring circuit
24. Prepare an extension board.
25. Control a bell through push button.
26. Perform correct telephone wiring
27. Identify color codes in telephone wiring
28. Describe the purpose of Earthing
29. Perform Earth resistance testing.
30. Study the different fire extinguisher

Soldering

31. Demonstrate the selection and use of soldering materials, including solder and flux, and explain their roles in creating strong and reliable soldered connections.
32. Demonstrate the proper use of soldering and desoldering tools, explaining their functions and techniques for creating and removing soldered connections effectively.
33. Perform and demonstrate various soldering techniques.
34. Practice soldering and desoldering on a Vero board.
35. Assemble electronic components and circuits, ensuring all connections are properly made for efficient and functional circuit operation.
36. Make Series Parallel Resistance Combination using veroboard

PCB Fabrication

37. Identify the different types of PCBs (Printed Circuit Boards) and explain their specific Applications in electronics and electrical systems.
38. Explain and demonstrate the various methods of PCB fabrication.
39. Marking and Assembly Techniques
    i. Perform chemical etching process
    ii. Mount and solder components correctly in PCB
40. Test PCB

3. COMPUTER WORKSHOP 45 HRs

41. Introduction to Workbench software
42. Design, simulate, and analyze electronic circuits using Electronic Workbench for practical explaining
43. Draw series circuit using electronic Workbench.
44. Draw parallel circuit using electronic Workbench.
45. Draw KCL circuit using electronic Workbench.
46. Draw KVL circuit using electronic Workbench.
47. Introduction to proteus.
48. Design, simulate, and analyze electronic circuits using proteus for practical

explaining

49. Draw series circuit using proteus
50. Draw parallel circuit using proteus
51. Draw KCL circuit using proteus
52. Draw KVL circuit using proteus
53. Draw half wave rectifier circuit using proteus

RECOMMENDED /REFERENCE BOOKS:

1. Workshop Technology by W. A. J. Chapman (Vol. Latest)
2. Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky. Latest Edition, Publisher: Pearson Education
3. Electronic Circuit Simulation with LT Spice and Proteus" by Gilles Brocard, Latest Edition, Publisher: Edison

Tel-133 TELECOMMUNICATION FUNDAMENTALS

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

LEARNING OUTCOMES:

1. **Describe** the evolution, basic concepts, and key technologies of telecommunication, along with national and international standards and regulatory frameworks.
2. **Explain** the principles of telecommunication systems, covering analog and digital communication, modulation techniques, transmission mediums, and network components.
3. **Explain** various telecommunication services, including interactive, multimedia, banking, e-commerce, social media, and IoT applications, highlighting their roles and impact on modern communication and daily life.

COURSE CONTENTS:

1 EVOLUTION OF TELECOM (8 Hours)

1.1 Introduction to Telecommunications.
1.2 Evolution of:
- 1.2.1 Telegraphy
- 1.2.2 Telephony
- 1.2.3 Wireless Communication
- 1.2.4 Internet
- 1.2.5 Email and Facsimile.

1.3 Pictorial Evolution of Fixed and Wireless Communication
1.4 GSM
1.5 Telecommunication Industry and Services in Pakistan
- 1.5.1 Wireless Communication.
- 1.5.2 Progress of Telecommunication Services

1.6 Describe E SIM
1.7 Mobile Number Portability
1.8 Telecommunication as a Facilitating Infrastructure for Economic Development

2 INTERNATIONAL CO-ORDINATION, REGULATION AND STANDARDS (4 Hours)

2.1 Define Standard and Regulation
2.2 Importance of Standards
2.3 Enlist the Types of Standards & Define these
- 2.3.1 De Jure Standards.
- 2.3.2 De Facto Standards.
- 2.3.3 User or House Standard

2.4 Describe the Advantages of Standards
2.5 Describe the History and Growth of following Telephone Companies.
2.5.1 Bell Operating Companies.
2.5.2 American Telephone and Telegraph Company. (AT & T).
2.5.3 Telephone Industries of Pakistan (TIP).
2.6 Global Telecom Networks
2.7 Introduce the following standards Making bodies. (National & International.)
2.7.1 International organizations. (Global Organization.)
2.7.1.1 ITU
2.7.1.2 ISO
2.7.1.3 ETSI
2.7.1.4 IEEE
2.7.2 National organizations. (Local Organizations)
2.7.2.1 ANSI
2.7.2.2 EIA
2.7.2.3 TIA

3 NATIONAL REGULATORY AUTHORITIES AND SERVICE PROVIDERS (4 hours)

3.1 Pakistan Telecom Authority
3.2 Frequency Allocation Board.
3.3 Public Sector Operating Entities in Pakistan
3.3.1 PTCL
3.3.2 NTC
3.3.3 SCO
3.4 Private Sector Operating Entities in Pakistan
3.4.1 Jazz
3.4.2 Telenor Pakistan
3.4.3 Zong
3.4.4 Ufone
3.4.5 Nayatel
3.5 License Procedure for Telecom Operator in Pakistan

4 PRINCIPLES OF TELECOMMUNICATION TECHNOLOGY (16 Hours)

4.1 Telecommunication Link-Basic
4.2 Define Signal (Analog & Digital)
4.2.1 Generation of sound waves.
4.3 Terminology
4.3.1 Frequency.
4.3.2 Time period.
4.3.3 Amplitude.
4.3.4 Bandwidth
4.3.5 Wave length
4.4 Analog Modulation
4.4.1 Need of Modulation
4.4.2 Types of Analog Modulation
4.4.2.1 AM

- 4.4.2.2 FM
- 4.4.2.3 PM
- 4.4.3 Application area of each Modulation Type
- 4.4.4 Advantages and Disadvantages

4.5 Basic Components of Communication System
- 4.5.1 Transmitter
- 4.5.2 Receiver
- 4.5.3 Channel

4.6 Transmission Medium Types
- 4.6.1 Guided Medium
  - 4.6.1.1 Coaxial Cable
  - 4.6.1.2 Twisted Wire
  - 4.6.1.3 Optic Fiber
- 4.6.2 Unguided Medium
- 4.6.3 Merits and Demerits of each Medium

4.7 Multiplexing
- 4.7.1 Requirement
- 4.7.2 Types of Multiplexing
  - 4.7.2.1 TDM
  - 4.7.2.2 FDM
  - 4.7.2.3 CDM

4.8 Amplifiers and Repeater
- 4.8.1 Difference and Applications
- 4.8.2 Importance of Amplifiers and Repeaters

4.9 Switching System
- 4.9.1 Requirement of Exchanges
- 4.9.2 Type of Exchanges

4.10 Types of Telecom Networks
- 4.10.1 PSTN
- 4.10.2 Mobile Networks
- 4.10.3 LANs and WANs
- 4.10.4 IP based Networks

4.11 Telecommunication Devices
- 4.11.1 Routers
- 4.11.2 Switches
- 4.11.3 HUB
- 4.11.4 Bridges
- 4.11.5 Gateway

4.12 Cyber Security in Telecom

5 COMMUNICATION SYSTEMS (18 hours)

5.1 Analog Communication System
- 5.1.1 AM
- 5.1.2 FM

5.2 Analog Signals

5.3 Noise in Analog Communication

5.4 Applications of Analog Communication

5.5 Digital Communication Fundamental

5.6 Comparison of analog and Digital Communication System

5.7 Digital Signals

5.8 Analog to Digital Conversion

- 5.8.1 Sampling
- 5.8.2 Quantization
- 5.8.3 Coding

5.9 Digital Modulation Techniques
- 5.9.1 ASK
- 5.9.2 FSK
- 5.9.3 PSK
- 5.9.4 QAM

5.10 Error Detection and Correction
- 5.10.1 FEC
- 5.10.2 ARQ

5.11 Digital Communication Standards
- 5.11.1 Ethernet
- 5.11.2 WiFi
- 5.11.3 Mobile Communication
- 5.11.4 Bluetooth

5.12 Noise in Communication System
- 5.12.1 Types of Noise
- 5.12.2 Signal to Noise Ratio

5.13 Optical Communication System

5.14 Satellite Communication System

5.15 Machine Type Communication System

5.16 Radar Communication System

6 TELECOMMUNICATION SERVICES (06 hours)

6.1 Interactive
- 6.1.1 Conversational.
- 6.1.2 Voice, Data,(Voip Intro)
- 6.1.3 Video Surveillance
- 6.1.4 Video Conference,
- 6.1.5 Video Phone
- 6.1.6 Messaging
- 6.1.7 Voice Mail,
- 6.1.8 Electronic Mail

6.2 Multimedia
- 6.2.1 MMS
- 6.2.2 Media Streaming
- 6.2.3 Telemedicine
- 6.2.4 Cloud Storage
- 6.2.5 Online Gaming
- 6.2.6 Digital Marketing

6.3 Banking and e-Commerce

6.4 Social Media

6.5 Internet of Things (IoT) Services

7 SHORT DISTANCE WIRELESS COMMUNICATION SYSTEMS (08 hours)

7.1 Introduction of Bluetooth Technology

7.2 Characteristics of Bluetooth Technology

7.3 Introduction of Wi-Fi Technology
7.4 Characteristics of Wi-Fi Technology
7.5 Introduction of Zigbee Technology
7.6 Characteristics of Zigbee Technology
7.7 RFID based System
    7.7.1 M-tag
7.8 Introduction of Low range communication (Lora) Technology
7.9 Characteristics of Low range communication Technology.
7.10 Introduction of Lifi Technology
7.11 Characteristics of Lifi Technology
7.12 Introduction of Wimax Technology

RECOMMENDED REFERENCE BOOKS

1. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport
2. "Digital Communication" by John G. Proakis
3. "Data and Computer Communications" by William Stallings
4. "Fundamentals of Wireless Communication" by David Tse and Pramod Viswanath
5. “Wireless communications” by Andrea Goldsmith

Tel-133 TELECOMMUNICATION FUNDAMENTALS

INSTRUCTIONAL OBJECTIVES:

EVOLUTION OF TELECOM

1.1 Define Telecommunications.
1.2 Explain the evolution of telecommunication
1.3 Show the Pictorial Evolution of Fixed and Wireless Communication
1.4 Define the GSM
1.5 Describe the Telecommunication Industry and Services in Pakistan
1.6 Define E SIM
1.7 Explain the Mobile Number Portability, its importance and procedure
1.8 Explain the Telecommunication Infrastructure in the context of Economic Development

2 **INTERNATIONAL CO-ORDINATION, REGULATION AND STANDARDS**

2.1 Define Standard and Regulation
2.2 Explain the Importance of Standards
2.3 Enlist the Types of Standards (GSM, 3GPP, 5G-Advanced).
2.4 Describe the Advantages of Standards
2.5 Describe the History and Growth of local and global Telephone Companies.
2.6 Define Global Telecom Networks
2.7 Introduce the following standards developing bodies. (National & International.)

3 **NATIONAL REGULATORY AUTHORITIES AND SERVICE PROVIDERS**

3.1 Explain Pakistan Telecom Authority, its role and duties
3.2 Describe importance of Frequency Allocation and duties of FAB
3.3 Explain the Public Sector Operating Telecom Entities in Pakistan
3.4 Explain Private Sector Operating Entities in Pakistan
3.5 Describe the License Procedure for Telecom Operator in Pakistan

4 **PRINCIPLES OF TELECOMMUNICATION TECHNOLOGY**

4.1 Explain the basics of Telecommunication Link
4.2 Define Signal (Analog & Digital) and procedure to generate the waves
4.3 Explain Various Terminology used in Telecommunication
4.4 Explain Analog Modulation, its need, types, applications, merits and demerits
4.5 Explain Basic Components of Communication System by using a block diagram
4.6 Describe the guided and unguided Transmission Mediums along with their comparison
4.7 Explain Multiplexing, its need and various types and applications
4.8 Compare Amplifiers and Repeater in the context of application.
4.9 Explain Switching System, requirement of exchanges, enlist types.
4.10 Discuss Various Types of Telecom Networks and Compare them
4.11 Explain various Telecommunication Devices and their role within the network
4.12 Explain the importance of Cyber Security in Telecom.

5 COMMUNICATION SYSTEMS

5.1 Draw the block diagrams of Analog Communication Systems (AM/FM) and explain each block
5.2 Define various Analog Signals
5.3 Explain Noise in Analog Communication, its importance.
5.4 Explain various Applications of Analog Communication in daily life
5.5 Define the Digital Communication Fundamental
5.6 Compare the analog and Digital Communication System in the context of advantages and applications in daily life.
5.7 Define various Digital Signals
5.8 Explain the complete procedure for Analog to Digital Conversion
5.9 Compare various Digital Modulation Techniques
5.10 Explain Error Detection and Correction, their techniques and working
5.11 Define various Digital Communication Standards
5.12 Define Noise in analog and digital communication system, why SNR is not used in digital communication. Also discuss various noise sources.
5.13 Explain the block diagram of Optical Communication System and its applications
5.14 Explain the block diagram of Satellite Communication System and its applications
5.15 Explain Machine Type Communication System and its applications in future
5.16 Explain Radar Communication System, principle and applications

6 TELECOMMUNICATION SERVICES

6.1 Define various Interactive services of Telecommunication
6.2 Define various Multimedia services of Telecommunication
6.3 Define Banking and e-Commerce
6.4 Define the Social Media services of Telecommunication
6.5 Define the IoT Services and applications

7. SHORT DISTANCE WIRELESS COMMUNICATION SYSTEMS

7.1 Define the Bluetooth Technology along with channel allocation in ISM band and frequency hopping
7.2 Explain the Characteristics of Bluetooth Technology, its range and applications
7.3 Introduce Wi-Fi Technology
7.4 Explain Characteristics of Wi-Fi Technology, enlist its protocol and applications
7.5 Introduce the Zigbee Technology
7.6 Explain Characteristics of Zigbee Technology and its applications
7.7 Define RFID based System, its components and few applications
7.8 Explain Low range Technology
7.9 Describe Characteristics of Low range Technology and its applications
7.10 Introduce the Lifi Technology
7.11 Explain the Characteristics of Lifi Technology and its applications.
7.12 Introduce the Wimax Technology

Tel-133 TELECOMMUNICATION FUNDAMENTALS

LIST OF PRACTICAL **96 HRs**

1. Study of selected latest telecommunication standards
2. Study the process of frequency allocation through FAB.
3. Demonstrate the Telephone Set parts.
4. Perform and analyze the frequency, Time period, Amplitude and wavelength of the signal
5. Demonstrate the Telephone Exchange.
6. Perform the Frequency Modulation and find modulation index.
7. Perform Amplitude Modulation and find modulation index.
8. Perform Phase Shift Keying.
9. Perform the TDM Multiplexing.
10. Perform the FDM Multiplexing
11. Perform the analog to digital conversion
12. Demonstrate and Construct the Telephone Cable and Drop Wire for Out Door Use
13. Practice Use of Walkie-Talkie Set Noting the Conditions for Satisfactory Operation and Range.
14. Demonstrate the Transmission and Reception Operation of Cellular Mobile Set.
15. Study and demonstrate conduct of a video surveillance and video conferencing system
16. Demonstrate the working of various telecommunication devices and their installation procedure
17. Demonstrate complete procedure for installing Wi-Fi system at home
18. Study and demonstration of RFID system installation and maintenance (M-tag as test)
19. Study and Demonstrate the Various Parts of Satellite Dish Antenna System and Operation of Receiver.
20. Demonstrate the Networking of Computer.

TEL-141 OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENT

Total Contact Hrs: 32		T	P	C
Theory:	32Hours	1	0	1
Practical:	00 Hours			

LEARNING OBJECTIVES:
This course emphasizes the importance of safe working practices, risk management, regulatory compliance, and environmental protection in telecom technology. By the end of the course, students will be able to apply OHSE principles to ensure a safer working environment, reduce workplace accidents, and promote a culture of safety in telecom operations.

1	**Introduction to OHSE in Telecom Technology**	**(2 Hours)**
1.1	Overview of OHSE in telecom industry	
1.2	Importance of OHSE in telecom technology	
1.3	Roles and responsibilities of telecom professionals in OHSE	
2	**Hazards in Telecom Technology**	**(4 Hours)**
2.1	Physical hazards (falls, electrical shock)	
2.2	Health hazards (RF radiation, noise)	
2.3	Environmental hazards (climate, weather)	
2.4	Ergonomic hazards (manual handling, repetitive strain)	
3	**Risk Assessment and Management**	**(3 Hours)**
3.1	Identifying hazards and risks in telecom technology	
3.2	Assessing risks using methods (HIRA, JSA)	
3.3	Implementing risk control measures (PPE, safety protocols)	
3.4	Monitoring and reviewing risk management plans	
4	**Safety Protocols and Procedures**	**(6 Hours)**
4.1	Emergency response planning (fire, evacuation)	
4.2	First aid and medical emergency response	
4.3	Lockout/tagout procedures	
4.4	Confined space entry procedures	
5	**RF Radiation Safety**	**(5 Hours)**
5.1	Understanding RF radiation and its effects	
5.2	RF radiation exposure limits and guidelines	
5.3	RF radiation safety measures (PPE, shielding)	
5.4	RF radiation monitoring and measurement	
6	**Tower Climbing and Rigging Safety**	**(4 Hours)**
6.1	Tower climbing safety procedures	
6.2	Rigging safety procedures	
6.3	Fall protection systems and equipment	

6.4 Rescue planning and procedures

7 Electrical Safety (4 Hours)

7.1 Electrical safety principles and procedures

7.2 Electrical hazard identification and control

7.3 Lockout/tagout procedures for electrical systems

7.4 Electrical safety equipment and PPE

8 OHSE Management Systems and Compliance (4 Hours)

8.1 Overview of OHSE management systems (e.g., OHSAS 18001)

8.2 Compliance with OHSE regulations and standards

8.3 OHSE auditing and inspection

8.4 Continuous improvement and review of OHSE management systems

8.5 Introduction to OSHA and NEBOSH

RECOMMENDED BOOKS:

1. Safety Practices and Procedures by National Institute of Science and Technical Education (NISTE), Islamabad.

2. "Health and Safety in a Changing World" by Robert Dingwall, Sidney Stark, and Kirstie Ball, 2021, Routledge, ISBN: 9780367350152

TEL-141 OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENT

INSTRUCTIONAL OBJECTIVES:

1. Introduction to OHSE in Telecom Technology

1.1 Explain OHSE (Occupational Safety, Health, and Environment) means in telecom.
1.2 Understand why safety is important in telecom work.
1.3 Explain the responsibilities of telecom workers to keep the workplace safe.

2. Hazards in Telecom Technology

2.1 Explain physical hazards like falls and electric shocks.
2.2 Explain health risks such as RF radiation and loud noise.
2.3 Explain environmental hazards like extreme weather conditions.
2.4 Explain ergonomic hazards (lifting heavy objects, working for long hours).

3. Risk Assessment and Management

3.1 Explain how to find hazards and risks in telecom work.
3.2 Describe risk assessment methods (HIRA, JSA) to check workplace safety.
3.3 Explain how to control risks using PPE and safety rules.
3.4 Explain how to monitor and improve safety plans.

4. Safety Protocols and Procedures

4.1. Understand emergency plans for fire, evacuation, and accidents.
4.2. Explain first aid basics for handling injuries at work.
4.3. Explain lockout/tagout procedures to prevent electrical accidents.
4.4. Describe safety steps for working in small/confined spaces.

5. RF Radiation Safety

5.1 Describe what RF radiation is and how it can affect health.
5.2 Explain the safe limits for RF exposure.
5.3 Describe ways to reduce RF exposure (using PPE and shields).
5.4 Explain how to measure RF radiation at a worksite.

6. Tower Climbing and Rigging Safety

6.1 Explain how to climb telecom towers safely.
6.2 Explain safe rigging techniques to install equipment.
6.3 Describe Use fall protection systems like harnesses and ropes.
6.4 Explain how to rescue someone in case of an accident.

7. Electrical Safety

7.1 Explain basic electrical safety rules for telecom work.
7.2 Identify electrical hazards and ways to stay safe.
7.3 Explain lockout/tagout procedures to prevent shocks.
7.4 Describe how to use electrical safety equipment like gloves and tools.

8. OHSE Management Systems and Compliance

8.1 Explain OHSE safety systems like OHSAS 18001 and ISO 45001.
8.2 Describe rules and laws for safety in telecom.
8.4 Explain how to inspect and audit a workplace for safety.
8.4 Explain how to improve workplace safety over time.
8.5 Introduce students with international safety certifications, OSHA and NEBOSH

2nd YEAR

اسلامیات/مطالعہ پاکستان

نصاب سال دوئم

حصہ اول اسلامیات

حصہ دوئم مطالعہ پاکستان

ٹی	پی	سی
1	0	1

کل وقت 20 گھنٹے:

موضوعات:

1۔ سورۃ المومنون ایک تا گیارہ آیات کا ترجمہ مع تشریح

2۔ دس منتخب احادیث مع ترجمہ وتشریح

() خیر کم من تعلم القرآن و علمه

() لا ایمان لمن لا امانته له ولا دین لا من لا اعهد له

() و یاکم والظن ان الظن اکرب الحدیث

() من احدث فی امرنا هذا ما لیس منه فهورد

() من حمل علینا السلاح فلیس منا

() انا و کافل الیتیم فی الجنه

() لا ضرور ولا ضرار فی السلام

() کلکم راع و کلکم راع و کلکم مسول عن رعیته

3۔ سیرۃ طیبہ

() مکی زندگی۔ولادت۔بعثت۔ہجرت

() مدنی زندگی۔مواخات۔میثاق مدینہ۔فتح مکہ(آسباب ونتائج)

4۔ حضورﷺ بحیثیت

() خطبہ حجۃ الوداع۔انسانی حقوق کا اعلامیہ/حقوق انسانی پالیسی 2018

() معلم کامل۔سربراہ خاندان

5۔ اسلامی معاشرہ

نظام تعلیم اوراس کے مقاصد۔عدل وانصاف۔امر بالمعروف۔نہی عن المنکر۔انسانی حقوق کا معاشرتی اور معاشی ترقی میں کردار

جہاد۔کسب حلال۔مسجد(اہمیت وفضیلت)

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

حقوق آگاہی رمعلومات تک رسائی

۔ ملازم پیشہ خواتین کا تحفظ

`

اسلامیات

تدریس مقاصد:

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

() قرآن مجید () منتخب آیات قرآنی

خصوصی مقاصد:

() قرآنی آیات کا ترجمہ

() قرآنی آیات کی تشریح

() قرآنی آیات کی روشنی میں ایک مومن کے اوصاف بیان کر سکے

() قرآنی آیات میں بیان کردہ مومن کے اوصاف اپنے اندر پیدا کر سکے

احادیث نبوی:

عمومی مقاصد:

() احادیث کی روشنی میں اسلامی اخلاقی اقدار (انفرادی واجتماعی) سے آگاہ ہو سکے

خصوصی مقاصد:

() احادیث کا ترجمہ بیان کر سکے

() احادیث کی تشریح کر سکے

() احادیث کی روشنی میں اسلام کی اخلاقی اقدار کی وضاحت کر سکے

() احادیث کی دی گئی تعلیمات کے مطابق اپنی زندگی گزار سکے

سیرت طیبہ:

() عمومی مقاصد: حضورﷺ کی سیرت طیبہ کے بارے میں جان سکے

خصوصی مقاصد:

() حضورﷺ کی ابتدائی زندگی اختصار کے ساتھ بیان کر سکے

() حضورﷺ کی ہجرت کا واقع بیان کر سکے

() حضورﷺ کی مدنی زندگی اختصار سے بیان کر سکے

() حضورﷺ کی بطور معلم خصوصیات بیان کر سکے

() حضورﷺ کی بطور سربراہ بیان کر سکے

حضورﷺ بحیثیت

() خطبہ حجۃ الوداع۔ انسانی حقوق کا اعلامیہ، حقوق انسانی پالیسی 2018 کے بارے جان سکے

اسلامی معاشرہ:

عمومی مقاصد: اسلامی معاشرہ کی خصوصیات سے آگاہی حاصل کر سکے

خصوصی مقاصد:

() اسلامی معاشرہ کا معنی و مفہوم کر سکے

() اسلامی معاشرہ کی امتیازی خصوصیات بیان کر سکے

() اسلامی معاشرہ میں عدل و احسان کی اہمیت بیان کر سکے

() تبلیغ کے لغوی معنی بیان کر سکے

() تبلیغ کی اہمیت اور ضرورت بیان کر سکے

() جہاد کے لفظی و اصطلاحی معنی بیان کر سکے

() جہاد کی اہمیت بیان کر سکے

() جہاد اور قتل میں فرق بیان کر سکے

() جہاد کی مختلف اقسام بیان کر سکے

() لفظ مسجد کی تعریف بیان کر سکے

() مسجد کی سابقہ حیثیت کو بحال کرنے کے بارے میں اقدامات کو مان سکے

() انسانی حقوق کی معاشی اور معاشرتی ترقی میں اہمیت اور کردار بیان کر سکے

اسلامی ریاست:

عمومی مقاصد:

() اسلامی ریاست کی خصوصیات بیان کر سکے

خصوصی مقاصد:

() ریاست کی تعریف بیان کر سکے

() اسلامی ریاست میں طرز حکومت سے آگاہی حاصل کر سکے

() اسلامی ریاست کی خصوصیات بیان کر سکے

() اسلامی ریاست کے اغراض ومقاصد بیان کر سکے
() اسلامی ریاست کے قیام کی لیے جدوجہد کر سکے
() حقوق آگاہی رمعلومات تک رسائی کا قانون جان سکے
() ملازمت پیشہ خواتین کے حقوق کا تحفظ جان سکے اور
() معاشرے میں خواتین کے حقوق کا تحفظ یقینی بنائے

نصاب مطالعہ پاکستان

	ٹی	پی	سی
سال دوئم	1	0	1
حصہ دوم	کل وقت 12 گھنٹے		

موضوعات:

() دوقومی نظریہ
() تحریک پاکستان
() انڈین کانگریس
() مسلم لیگ
() تقسیم بنگال
() میثاق لکھنو
() تحریک خلافت
() سندھو تحریک
() تجاویز دہلی
() نہرو رپورٹ
() قائداعظم کے چودہ نکات
() خطبہ آلہ آباد
() انتخابات 1938 اور انتقال اقتدار
() قرارداد پاکستان

حصہ دوم

مطالعہ پاکستان

تدریس مقاصد:

تحریک پاکستان:

عمومی مقاصد:

() قیام پاکستان کے اسباب وتحریک کو بیان کر سکے

خصوصی مقاصد:

() قومیت کے مفہوم کو بیان کر سکے

() دو قومی نظریہ کی تعریف وتوضیح کر سکے

() دوقومی نظریہ کی اہمیت بیان کر سکے

() ہندوستانی مسلمانوں کی محرومیوں کو بیان کر سکے

() قومی تشخص کو بحال رکھنے کے لیے مسلمانان ہند کی مساعی بیان کر سکے

() آزادی ہند اور قیام پاکستان علامہ اقبال اور قائداعظم کی مساعی بیان کریں

() قیام پاکستان سے مستقبل اسلامی مملکت کے قیام کے لیے مسلم عوام کی کوششوں کو بیان کر سکے

() مسلم لیگ کے قیام پاکستان کے لیے جدو جہد بیان کر سکے

(غیر مسلم طلباء کے لیے)

نصاب اخلاقیات

ٹی	پی	سی
1	0	1

سال دوم

کل وقت 20 گھنٹے

موضوعات:

معاشرتی اقدار بلحاظ ہمسایہ۔قوم۔قومی سطح۔شہری سطح۔صنعتی اداروں کی سطح۔ضروریات۔ورثہ

() حقوق وفرائض

() قوت برداشت

() قوت ارادی

() لگن وجذبہ

() وسیع النظری

() بے غرضی

() انسانی دوستی

() حفاظتی شعور

() پاس آزادی

() کامل آگاہی

() تغیرات کو قبول کرنا

() خودشناسی

() انسانی حقوق کا اعلامیہ/حقوق انسانی پالیسی 2018

() انسانی حقوق کا معاشرتی اور معاشی ترقی میں کردار

() حقوق آگاہی/معلومات تک رسائی۔ملازم پیشہ خواتین کا تحفظ

نصاب اخلاقیات

سال دوم

تدریس مقاصد:

طالب علم اخلاقیات کی اہمیت وضرورت سے آگاہ ہوسکے اور بیان کر سکے

خصوصی مقاصد: طالب علم اس قابل ہو کہ

() موضوعات کا مطلب بیان کر سکے

() عملی زندگی سے مثالوں کی نشاندہی کر سکے

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

() اعلیٰ اخلاقی اقدار میں سے قوت برداشت۔قوت ارادی۔لگن وجذبہ۔وسیع النظری۔بے غرض۔انسانی دوستی شعور۔پاس آزادی۔کامل آگاہی اور خود شناسی کی اہمیت

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

() انسانی حقوق کا اعلامیہ/حقوق انسانی کی پالیسی 2018 کے بارے میں جان سکے

() انسانی حقوق کا معاشرتی اور معاشی ترقی میں اہمیت اور کردار بیان کر سکے

() حقوق اگاہی/معلومات تک رسائی کے قانون کو جان سکے

() ملازم پیشہ خواتین کا تحفظ کو اخلاقیات کا حصہ تصور کرے

TTQ 211/ Civics-211 TARJUMA TUL QURAN / CIVICS

Note: Syllabi for these subject would be as per BISEs / General education, developed by Punjab Curriculum TextBook Board (PCTB)

T	P	C
1	0	1

Total Contact Hours:

Theory: **32**

Practical: **0**

MATH-233 APPLIED MATHEMATICS - II

Total Contact Hours:	**96**			
Theory	96	T	P	C
Practical	0	3	0	3

LEARNING OUTCOMES: At the end of the course, the students will be able to:

Solve problems of Calculus, Laplace Transformation and Fourier Series, and develop mathematical skills and logical perceptions in the use of mathematical instruments.

COURSE CONTENTS

1. FUNCTIONS & LIMITS. 6 hours

- 1.1 Constant & Variable Quantities
- 1.2 Functions & their classification
- 1.3 The concept of Limit
- 1.4 Limit of a Function
- 1.5 Fundamental Theorems on Limit
- 1.6 Some important Limits
- 1.7 Problems

2. DIFFERENTIATION 6 hours

- 2.1 Increments
- 2.2 Differential Coefficient or Derivative
- 2.3 Differentiation ab-initio or by first Principle
- 2.4 Geometrical Interpretation of Differential Coefficient
- 2.5 Differential Coefficient of X^n and $(ax + b)^n$
- 2.6 Three important rules
- 2.7 Problems

3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS 9 hours

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

4. DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS 6 hours

- 4.1 Differential Coefficient of Sin x, Cos x, Tan x from first principle.
- 4.2 Differential Coefficient of Cosec x, Sec x, Cot x
- 4.3 Differential Coefficient of Inverse trigonometric functions.
- 4.4 Problems.

5. DIFFERENTIATION OF LOGARITHMIC & EXPONENTIAL FUNCTIONS 6 hours

- 5.1 Differentiation of ln x
- 5.2 Differentiation of Log a^x
- 5.3 Differentiation of a^x
- 5.4 Differentiation of e^x
- 5.5 Problems

6. RATE OF CHANGE OF VARIABLES 6 hours

6.1 Increasing and decreasing functions
6.2 Maxima and Minima
6.3 Criteria for maximum & minimum values
6.4 Methods of finding maximum & minimum
6.5 Rate measure
6.6 Slope of a line
6.7 Velocity and acceleration
6.8 Problems

7. INTEGRATION (SIMPLE BASIC RULES) 9 hours

7.1 Concept
7.2 Fundamental Formulas
7.3 Important Rules
7.4 Problems

8. METHODS OF INTEGRATION 9 hours

8.1 Integration by substitution
8.2 Integration by parts
8.3 Problems

9. DEFINITE INTEGRALS 6 hours

9.1 Properties
9.2 Application to area
9.3 Problems

10. DIFFERENTIAL EQUATIONS 6 hours

10.1 Introduction
10.2 Order and Degree
10.3 First order Differential Equation of Ist degree.
10.4 Solution of problems
10.5 Problems

11. LAPLACE TRANSFORMATIONS 9 hours

11.1 Laplace Transformations
11.2 Inverse Laplace Transformations
11.3 Problems.

12. FOURIER SERIES. 9 hours

12.1 Introduction
12.2 Periodic Functions
12.3 Even and Odd Functions
12.4 Problems

13. STATISTICS 9 hours

13.1 Concept of mean, median and mode
13.2 Standard Deviation
13.3 Laws of probability
13.4 Problems

RECOMMENDED BOOKS

1. Thomas Finny, Calculus and Analytic Geometry
2. Ghulam Yasin Minhas, Technical Mathematics Vol - I & II, Ilmi Kitab Khana, Lahore.
3. Riaz Ali Khan, Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad
4. Sana Ullah Bhatti, Calculus and Analytic Geometry, Punjab Text Book Board, Lahore.

MATH-233 APPLIED MATHEMATICS-II

INSTRUCTIONAL OBJECTIVES

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

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

2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT.

2.1 Define differential coefficient.
2.2 Derive mathematical expression of a derivative.
2.3 Explain geometrically the meaning of differential coefficient.
2.4 Differentiate ab-initio x^n and $(ax+b)^n$.
2.5 Solve problems of these formulas.

3. USE RULES OF DIFFERENTIATION FOR SOLVING PROBLEMS OF ALGEBRAIC FUNCTIONS.

3.1 Derive product rule, quotient rule and chain rule.
3.2 Interpret the chain rule.
3.3 Differentiate explicit and implicit functions.
3.4 Find derivatives of parametric forms of a function w.r.t another function, by rationalization.
3.5 Use these important rules to find derivatives of relevant functions.

4. USE RULES OF DIFFERENTIATION TO SOLVE TRIGONOMETRIC FUNCTIONS.

4.1 Differentiate from first principle sin x, Cos x, tan x.
4.2 Derive formulas for derivatives of Sec x, Cosec x, Cot x.
4.3 Find derivatives of inverse trignometric functions.
4.4 Solve problems based on these formulas.

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

5.1 Derive formulas for differential coefficients of Logarithmic and exponential functions.
5.2 Solve problems using these formulae.

6. UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH ANOTHER

6.1 Derive formulas for velocity, acceleration and slope of a line
6.2 Use derivative as a measure of rate of change.
6.3 Explain an increasing and a decreasing function.
6.4 Show graphically maxima and minima values and point of inflexion.
6.5 Explain criteria for finding maxima and minima.
6.6 Solve problems based upon these topics.

7. USE PRINCIPLES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.

7.1 Explain concept of integration.

7.2 Write basic theorems of integration.
7.3 Define fundamental formulas of integration.
7.4 List some important rules of integration.
7.5 Solve problems based on these rules.

8. UNDERSTAND VARIOUS METHODS OF INTEGRATION

8.1 List standard formulas of integration.
8.2 Integrate a function by substitution method.
8.3 Use method of integration by parts for finding integrals.
8.4 Employ these methods to solve problems.

9. UNDERSTAND THE METHODS OF SOLVING DEFINITE INTEGRALS.

9.1 Define definite integral.
9.2 List properties of definite integrals.
9.3 Use definite integral in the computation of areas.
9.4 Solve problems involving definite integrals.

10. USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS.

10.1 Define a differential equation, its degree and order.
10.2 Explain method of separation of variables for solving differential equations of first order and first degree.
10.3 Solve differential equations of first order and first degree.

11. USE LAPLACE AND INVERSE LAPLACE TRANSFORMATION FOR SOLVING PROBLEMS.

11.1 Define Laplace and Inverse Laplace Transformation
11.2 List properties of Laplace Transformation
11.3 Solve problems using Laplace Transformations

12. EXPAND FUNCTIONS USING FOURIER SERIES

12.1 Define a Fourier series.
12.2 Write extended rule of integration by parts.
12.3 Illustrate periodic functions, even and odd functions.
12.4 Explain Fourier expansion and Fourier constants.
12.5 Expand the given functions of Fourier series.

13. UNDERSTAND THE BASIC CONCEPTS OF STATISTICS

13.1 Define mean, median and mode
13.2 Explain standard deviation
13.3 State laws of probability
13.4 Calculate the above mentioned quantities using the proper formula

CH-222 APPLIED CHEMISTRY.

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

LEARNING OUTCOMES: After studying this course a student will be able to:

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

COURSE CONTENTS

1. INTRODUCTION AND FUNDAMENTAL CONCEPTS **2 Hours**

- 1.1 Scope and significance of the subject.
- 1.2 Orientation with reference to this technology.
- 1.3 Terms used & units of measurements in the study of chemistry.
- 1.4 Symbols, valency, radicals, formulae.
- 1.5 Chemical reactions and their types

2. ATOMIC STRUCTURE. **2 Hours**

- 2.1 Sub-atomic particles.
- 2.2 Atomic number and atomic mass.
- 2.3 The periodic classification of elements, periodic law.
- 2.3 General characteristics of a period and group.

3. CHEMICAL BOND. **3 Hours**

- 3.1 Nature of Chemical Bond.
- 3.2 Electrovalent bond with examples.
- 3.3 Covalent bond (polar and non-polar, sigma & Pi bonds with examples).
- 3.4 Co-ordinate bond with examples.

4. WATER. **3 Hours**

- 4.1 Chemical nature and properties.
- 4.2 Impurities.
- 4.3 Hardness of water (types, causes & removal)
- 4.4 Scales of measuring hardness (Degrees Clark, French, PPM, Mg-per liter).
- 4.5 Boiler feed water, scales and treatment.
- 4.6 Sea-water desalination Sewage treatment

5. ACIDS, BASES AND SALTS. **2 Hours**

- 5.1 Definitions with examples.
- 5.2 Properties, their strength, basicity & acidity.
- 5.3 Salts and their classification with examples.
- 5.4 pH-value and scale.

6. OXIDATION & REDUCTION. **2 Hours**

- 6.1 The process with examples.
- 6.2 Oxidizing and reducing agents.
- 6.3 Oxides and their classification.

7. CORROSION. **2 Hours**

- 7.1 Introduction with causes.

7.2 Types of corrosion.
7.3 Rusting of Iron.
7.4 Protective measures against corrosion

8. ELECTRO-CHMISTRY. 3 Hours

8.1 Ionization and Archenious theory of ionization
8.2 Electrolytes and Electrolysis
8.3 Faraday's laws and numericals related to them
8.4 Application of Electrolysis (Electroplating)
8.5 Electro chemical cells

9. ELECTRICAL INSULATING MATERIALS. 2 Hours

9.1 Introduction
9.2 Solid insulators with chemical nature
9.3 Liquid insulators with chemical nature
9.4 Gaseous insulators with chemical nature
9.5 Uses and their classification.

10. ELECTRICAL MATERIALS OF SPECIAL INTEREST. 2 Hours

10.1 Material for fuses
10.2 Contract materials
10.3 Materials used for making heating elements
10.4 Materials for high conductivity and resistivity

11. SEMI CONDUCTORS. 2 Hours

11. 1 Introduction
11.2 Atomic structure of silicon and germanium
11.3 Bonding and conductivity
11.4 Energy bands in a semiconductor

12. ETCHING PROCESS. 2 Hours

12.1 The process and its aims
12.2 Etching reagents
12.3 Applications of processor

13. FUELS AND COMBUSTION. 2 Hours

13.1 Introduction of fuels
13.2 Classification of fuels
13.3 Combustion
13.4 Numerical problems of combustion

14. LUBRICANTS. 2 Hours

14.1 Introduction.
14.2 Classification.
14.3 Properties of lubricants.
14.4 Selection of lubricants.

15. POLLUTION. **2 Hours**

15.1 The problem and its dangers
15.2 Causes of environmental pollution.
15.3 Common pollutants.
15.4 Remedies to combat the hazards of pollution.

REFERENCE

1. Intermediate Text Book of Chemistry (I&II)
2. Intermediate Chemistry I-II
3. Applied Science, Sh. Atta Muhammad
4. Polytechnic Chemistry, J.N. Reedy Tata McGraw Hill
5. Chemistry for Engineers, P.C. Jain

CH-222 APPLIED CHEMISTRY.

LEARNING OBJECTIVES

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

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

2. UNDERSTAND THE STRUCTURE OF ATOMS.

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

3. UNDERSTAND THE NATURE OF CHEMICAL BONDS.

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

4. UNDERSTAND THE CHEMICAL NATURE OF WATER.

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

5. UNDERSTAND THE NATURE OF ACIDS, BASES AND SALTS.

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

6. UNDERSTAND THE PROCESS OF OXIDATION AND REDUCTION.

6.1 Define oxidation.
6.2 Explain the oxidation process with examples.
6.3 Define reduction.
6.4 Explain reduction process with examples.
6.5 Define oxidizing and reducing agents with examples.
6.6 Define oxides.
6.7 Classify the oxides with examples.

7. UNDERSTAND THE PROCESS OF CORROSION.

7.1 Define corrosion.
7.2 Describe different types of corrosion.
7.3 State the causes of corrosion.
7.4 Explain the process of rusting of iron.
7.5 Describe methods to prevent/control corrosion.

8. UNDERSTAND THE APPLICATION OF ELECTROCHEMISTYR IN DIFFEREND FIELEDS OF INDUSTRIES.

8.1 Define ionization, electrolyte and electrolysis
8.2 Describe Arrehnius theory of ionization
8.3 State Faraday's Laws of different fields of industry
8.4 Apply Faraday's laws of different fields of industry
8.5 Solves numerical problem on Faraday's laws
8.6 Explain the construction and working of primary cell, lead accumulator and alkaline batteries

9. KNOW THE USE OF INSULATING MATERIALS

9.1 Define insulator, conductor
9.2 Classify solid, liquid and gaseous insulators with their chemical nature
9.3 Describe their uses

10. UNDERSTAND THE COMPOSITION AND PROPERTIES OF SOME SPECIAL MATERIALS USED FOR ELECTRICAL PURPOSES

10.1 Explain compositions and properties with examples of materials and as "Tuses"
10.2 Describe the composition and properties of contact materials in electrical installations
10.3 Explain properties of materials used as "heating elements"
10.4 List materials of high conductivity and high resistively used in electrical engineering

11. UNDERSTAND THE NATURE AND CHEMISTRY OF CEMI CONDUCTORS

11.1 Define semi conductors
11.2 Draw the atomic structure of silicon and germanium
11.3 Describe the process of bonding and conductivity in conductors and semi conductors
11.4 Explain energy bands in semi conductors

12. USE ETCHING PROCESS IN DIFFERENT FIELDS OF TECHNOLOGY

12.1 Define etching process and its aims
12.2 Enlist the chemicals/reagents used in the process
12.3 Explain the use of the process in the technology

13. UNDERSTAND THE NATURE OF FUELS AND THEIR COMBUSTION

13.1 Define fuels
13.2 Classify fuels and make distinction of solid, liquid and gaseous fuels
13.3 Describe important fuels
13.4 Explain combustion
13.5 Calculate air quantities in combustion gases

14. UNDERSTAND THE NATURE OF LUBRICANTS.

14.1 Define a lubricant
14.2 Explain the uses of lubricants.
14.3 Classify lubricants and give examples
14.3 State the properties of oils, greases and solid lubricants
14.4 State the criteria for the selecting lubricant for particular purpose/job

15. UNDERSTAND THE NATURE OF POLLUTION.

15.1 Define pollution (air, water, soil).
15.2 Describe the causes of environmental pollution.
15.3 Enlist some common pollutant
15.4 Explain methods to prevent pollution

CH-222 APPLIED CHEMISTRY

LIST OF PRACTICALS

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

MGM- 231 COMMUNICATION SKILLS & REPORT WRITING

T	P	C
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Total Contact Hours :32

Theory: 32 Hours
Practical: 00 Hour

LEARNING OUTCOMES:
This course has been designed to enable students to be familiar with:

1. Effective verbal and non-verbal communication techniques.
2. Writing professional reports and emails.
3. Public speaking and presentation skills.
4. Listening and critical thinking abilities.

COURSE CONTENTS

1. INTRODUCTION TO COMMUNICATION (4 Hours)

- 1.1 Definition, Nature and Scope of Communication
- 1.2 Importance and Purpose of Communication
- 1.3 Process of Communication
- 1.4 Types of Communication

2. NON-VERBAL COMMUNICATION (01 Hour)

- 2.1 Personal Appearance
  - 2.1.1 Gestures
  - 2.1.2 Postures
  - 2.1.3 Facial Expression
  - 2.1.4 Eye Contacts
  - 2.1.5 Body Language (Kinesics)
  - 2.1.6 Time language
  - 2.1.7 Silence
- 2.2 Tips for Improving Non-Verbal Communication

3. EFFECTIVE COMMUNICATION (06 Hours)

- 3.1 Essentials of Effective Communication
- 3.2 Communication Techniques
- 3.3 Barriers to Communication
- 3.4 7 C’s of communication

4. COMMUNICATION NETWORK IN AN ORGANIZATION (06 Hours)

- 4.1 Personal Communication
- 4.2 Internal Operational Communication
- 4.3 External Operational Communication
- 4.4 Horizontal (Lateral) Communication
- 4.5 Vertical (Downward) Communication
- 4.6 Vertical (Upward) Communication

5. LISTENING SKILLS (06 Hours)

- 5.1 Purpose of Listening
- 5.2 Listening to Conversation (Formal and Informal)
- 5.3 Active Listening- an Effective Listening Skill
- 5.4 Benefits of Effective Listening

5.5 Barriers to Listening
5.6 Listening to Announcements- (Public places)
5.7 Academic Listening (Listening to Lectures)
5.8 Listening to Talks and Presentations
5.9 Note Taking Tips

6. ORAL COMMUNICATION SKILLS (SPEAKING SKILLS) (03 Hours)

6.1 Importance of Spoken English
6.2 International Phonetic Alphabet (IPA) Symbols
6.3 Spelling and Pronunciation

7. EFFECTIVE WRITING SKILLS (06 Hours)

7.1 Elements of Effective Writing (What is writing?)
7.2 The Sentence, Phrases and Clauses
7.3 Types of Sentences
7.4 Main Forms of Written Communication
7.5 Paragraph Writing (Linkage and Cohesion)
7.6 Letter Writing (formal and informal)
7.7 Industrial visit report writing
7.8 Notices
7.9 Summarizing
7.10 Project report writing

Recommended Books

1. The Art of Communicating by Thich Nhat Hanh
2. Report Writing Skills Training Course by Margaret Greenhall
3. How to Win Friends and Influence People by Dale Carnegie

MGM- 231 COMMUNICATION SKILLS & REPORT WRITING

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO COMMUNICATION

1.1 Nature, and Scope of Communication

1.1.1. Define communication and discuss its nature and scope in detail.

1.1.2. Why is understanding the scope of communication crucial in professional life?

1.2 Importance and Purpose of Communication

1.2.1. Explain the importance of communication in building relationships.

1.2.2. Discuss the purpose of communication in organizational growth.

1.3 Process of Communication

1.3.1. Describe the stages of the communication process with examples.

1.3.2. What role does feedback play in the communication process?

1.4 Types of Communication

1.4.1. Differentiate between verbal and non-verbal communication with examples.

1.4.2. Explain the role of written communication in formal settings.

2. NON-VERBAL COMMUNICATION

2.1 Personal Appearance

1. How does personal appearance affect first impressions in communication?
2. Discuss ways to maintain a professional appearance in communication.

2.1.1 Gestures

1. What is the role of gestures in non-verbal communication?
2. How can inappropriate gestures lead to miscommunication?

2.1.2 Postures

1. Discuss the significance of posture in professional communication.
2. How can posture convey confidence or nervousness?

2.1.3 Facial Expression

1. Why facial expressions are considered a universal language in communication?

2. Provide examples of facial expressions that convey positive and negative emotions.

2.1.4 Eye Contacts

1. How does maintaining eye contact improve communication?
2. Discuss cultural differences in the interpretation of eye contact.

2.1.5 Body Language (Kinesics)

1. Define kinesics and explain its importance in non-verbal communication.
2. Provide examples of positive and negative body language in meetings.

2.1.6 Time Language

1. What is time language, and how does it impact communication?
2. Discuss how punctuality reflects professionalism in communication.

2.1.7 Silence

1. How can silence be used effectively in communication?
2. Discuss the difference between meaningful silence and awkward silence.

2.2 Tips for Improving Non-Verbal Communication

2.2.1. List and explain five tips for improving non-verbal communication.

2.2.2. How can self-awareness enhance non-verbal communication skills?

3. EFFECTIVE COMMUNICATION

3.1 Essentials of Effective Communication

3.1.1. What are the key essentials of effective communication? Explain.

3.1.2. How does clarity improve the effectiveness of communication?

3.2 Communication Techniques

3.2.1. Describe three techniques to improve communication in a team.

3.2.2. How can storytelling be used as a communication technique?

3.3 Barriers to Communication

3.3.1. Identify common barriers to communication and suggest ways to overcome them.

3.3.2. How do emotional barriers affect communication? Provide examples.

3.4 Describe the 7 Cs of communication

4. COMMUNICATION NETWORK IN AN ORGANIZATION

4.1 Personal Communication

4.1.1. Discuss the importance of personal communication in team building.

4.1.2. How can personal communication be improved in the workplace?

4.2 Internal Operational Communication

4.2.1. Define internal operational communication and provide examples.

4.2.2. How does effective internal communication improve organizational efficiency?

4.3 External Operational Communication

4.3.1. Discuss the role of external operational communication in building client relationships.

4.3.2. Provide examples of tools used in external operational communication.

4.4 Horizontal (Lateral) Communication

4.4.1. What are the advantages of horizontal communication in an organization?

4.4.2. How can conflicts in lateral communication be resolved?

4.5 Vertical (Downward) Communication

4.5.1. Explain the purpose of downward communication with examples.

4.5.2. How can downward communication be made more effective?

4.6 Vertical (Upward) Communication

4.6.1. Why is upward communication important for employee feedback?

4.6.2. Discuss challenges faced in upward communication and their solutions.

5. LISTENING SKILLS

5.1 Purpose of Listening

5.1.1. What are the primary purposes of listening in professional settings?

5.1.2. How does listening enhance learning and understanding?

5.2 Listening to Conversation (Formal and Informal)

5.2.1. Discuss the difference between listening to formal and informal conversations.

5.2.2. How can one improve listening skills during casual conversations?

5.3 Active Listening – An Effective Listening Skill

5.3.1. What is active listening, and why is it essential for communication?

5.3.2. Provide examples of behaviors that demonstrate active listening.

5.4 Benefits of Effective Listening

5.4.1. Explain how effective listening leads to better decision-making.

5.4.2. Discuss the role of listening in conflict resolution.

5.5 Barriers to Listening

5.5.1. Identify and explain common barriers to effective listening.

5.5.2. How can physical distractions hinder listening, and how can they be managed?

5.6 Listening to Announcements

5.6.1. What are the challenges of listening to announcements in public places?

5.6.2. How can one enhance their focus while listening to announcements?

5.7 Academic Listening

5.7.1. Why is academic listening critical for students?

5.7.2. Provide tips to improve listening during lectures.

5.8 Listening to Talks and Presentations

5.8.1. How does listening to talks differ from listening to conversations?

5.8.2. Discuss strategies for taking notes effectively during presentations.

5.9 Note-Taking Tips

5.9.1. Why is note-taking important for effective listening?

5.9.2. Describe methods for organizing notes during academic or professional events.

6. ORAL COMMUNICATION SKILLS (SPEAKING SKILLS)

6.1 Importance of Spoken English

6.1.1. Why is spoken English important in global communication?

6.1.2. How does fluency in spoken English impact career opportunities?

6.2 International Phonetic Alphabet (IPA) Symbols

6.2.1. What are IPA symbols, and how do they aid in pronunciation?

6.2.2. Provide examples of common IPA symbols and their corresponding sounds.

6.3 Spelling and Pronunciation

6.3.1. How does accurate pronunciation influence effective speaking?

6.3.2. Why is spelling important in oral communication?

7. EFFECTIVE WRITING SKILLS

7.1 Elements of Effective Writing

7.1.1. What are the key elements of effective writing? Explain each.

7.1.2. How can structure improve the quality of written communication?

7.2 Sentences, Phrases, and Clauses

7.2.1. Explain the difference between a phrase, clause, and sentence with examples.

7.2.2. How do clauses contribute to sentence complexity?

7.3 Types of Sentences

7.3.1. What are the different types of sentences? Provide examples.

7.3.2. How does sentence variety improve written communication?

7.4 Main Forms of Written Communication

7.4.1. What are the main forms of written communication? Provide examples.

7.4.2. Discuss the role of reports and emails in professional communication.

7.5 Paragraph Writing (Linkage and Cohesion)

7.5.1. Explain the importance of linkage and cohesion in paragraph writing.

7.5.2. How can transition words improve paragraph structure?

7.6 Letter Writing (Formal and Informal)

7.6.1. How do formal letters differ from informal letters? Provide examples.

7.6.2. Write a formal letter to your college principal requesting leave.

7.7 Industrial visit report writing

7.7.1. What are the key components of a well-written Industrial visit report writing?

7.7.2. How does brainstorming help in Industrial visit report writing?

7.8 Notices

7.8.1. What are the key features of an effective notice?

7.8.2. Draft a notice for a school event.

7.9 Summarizing

7.9.1. What are the essential steps for summarizing a text effectively?

7.9.2. How does summarizing help in academic writing?

7.10 Project report writing

7.10.1. Provide tips for report writing.

7.10.2. How to write an effective report writing.

Elt-213 ELECTRONIC DEVICES

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

LEARNING OUTCOMES:

- To provide a comprehensive understanding of both basic and specialized electronic components and their applications in circuits and systems.

COURSE CONTENTS

1 INTRODUCTION TO ELECTRONIC DEVICES (02 Hours)

1.1 Vacuum tubes
1.2 Diodes
1.3 Transistors
1.4 Integrated Circuits
1.5 Surface mounted devices
1.6 Microelectronics

2 DIODES AND APPLICATIONS (10 Hours)

2.1 Introduction to Diode, P-type and N-type materials
2.2 Biasing the PN junction
    2.1.1 Depletion region, Junction barrier potential
    2.1.2 Forward and Reverse bias
2.2 Rectifier Diode
2.3 Half wave and full wave (Bridge) rectifier
2.4 Ripple factor, surge current
2.5 Diode Multiplier
    2.5.1 Voltage multiplier circuits (Doubler, Tripler, Quadrupler)
2.6 Diode as a switch
2.7 Diode as Clipper
2.8 Diode as clamper

3 BIPOLAR JUNCTION TRANSISTORS (10 Hours)

3.1 Introduction and construction of BJT
3.2 Types of BJT
3.3 Basic Transistor operation, Forward, Reverse Bias. Transistor currents, Transistor gains (α,β)
3.4 Transistor Parameters
3.5 Transistor as a voltage amplifier
3.6 Transistor amplifier configurations and uses
3.7 Transistor modes of operation
3.8 Transistor types
    3.8.1 General purpose transistors
    3.8.2 Power Transistor
    3.8.3 RF Transistor
3.9 BJT Biasing Techniques

3.9.1 The fixed base bias
3.9.2 The collector bias
3.10 Introduction to IGBT
3.11 Working principle and construction of IGBT

4 FIELD EFFECT TRANSISTOR (09 Hours)

4.1 Field Effect Transistor
4.2 Junction Field Effect Transistor (JFET) and its types
4.3 JFET Characteristics and parameter
4.4 Metal oxide Semiconductor FET (MOSFET)
4.5 Types of MOSFET

5 SPECIAL DIODES (12 Hours)

5.1 Zener Diode
5.1.1 Zener Diode as voltage Regulator, percentage of regulation
5.2 Varactor Diode
5.3 Optical Diodes
5.3.1 Light Emitting Diode (LED)
5.3.2 Liquid crystal Diode (LCD)
5.3.3 Photo diode
5.3.4 Opto-coupler

5.4 Other Diodes
5.4.1 Schottky diode, construction, characteristics, uses
5.4.2 Tunnel Diode
5.4.3 PIN Diode
5.4.4 Gunn Diode
5.4.5 LASER Diode
5.4.6 IMPATT Diode
5.4.7 Introduction of SMD Components (DIODE, TRANSISTOR, CAPACITORS)

6 THYRISTORS (08 Hours)

6.1 Silicon Controlled Rectifier (SCR)
6.2 Light Activated SCR (LASCR)
6.3 SCR Applications
6.4 Silicon Controlled Switch (SCS)
6.5 Diac and Triac
6.6 Unijunction Transistor (UJT)

7 AMPLIFIERS (05 Hours)

7.1 Classification of amplifiers according to operations
7.2 Classification of amplifiers according to feedback
7.3 Positive and negative feedback
7.4 High Power amplifier

8 OPERATIONAL AMPLIFIER (08 Hours)

8.1 Introduction to operational Amplifier
8.2 Inverting and non-inverting amplifiers
8.3 Voltage follower
8.4 The differential Amplifier
8.5 Summing Amplifier
8.6 Comparator
8.7 Introduction to 741 OP AMP

RECOMMENDED REFERENCE BOOKS

1. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
2. Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith
3. Electronic Devices: Conventional Current Version" by Thomas L. Floyd

Elt-213 ELECTRONIC DEVICES

INSTRUCTIIONAL OBJECTIVES

1 INTRODUCTION TO ELECTRONIC DEVICES

1.1 Define Vacuum tubes. Enlist its types
1.2 Define Diodes
1.3 Define Transistors
1.4 Define Integrated Circuits
1.5 Define Surface mounted devices
1.6 Define Microelectronics

2 DIODES AND APPLICATIONS

2.1 Describe P-type and N-type materials
2.2 Define Depletion region and Junction barrier potential
2.3 Define Biasing the PN junction
2.4 Explain Forward and Reverse bias
2.5 Define Rectifier
2.6 Explain Half wave and full wave (Bridge) rectifier
2.7 Define Ripple factor and surge current
2.8 Define voltage Multiplier
2.9 Explain types of Voltage multiplier circuits (Doubler, Tripler, Quadrupler)
2.10 Explain Diode as a switch
2.11 Define Diode as Clipper. Explain types of clipper circuits
2.12 Explain Diode as clamper. Explain types of clamper circuits

3 BIPOLAR JUNCTION TRANSISTORS

3.1 Define and enlist the types of transistor
3.2 Explain the construction of BJT
3.3 Explain the types of BJT
3.4 Explain basic Transistor operation.
3.5 Define transistor current
3.6 Define transistor Parameters
3.7 Explain Transistor as a voltage amplifier
3.8 Explain Transistor amplifier configurations and uses
3.9 Explain Transistor modes of operation
3.10 Enlist the transistor types (General purpose transistors, Power Transistor, RF Transistor)
3.11 Explain BJT Biasing Techniques (The fixed base bias, the collector bias)
3.12 Explain IGBT
3.13 Explain Working principle and construction of IGBT

4 FIELD EFFECT TRANSISTOR

4.1 Explain Field Effect Transistor
4.2 Explain Junction Field Effect Transistor (JFET)
4.3 Explain types of JFET
4.4 Explain Characteristics of JFET
4.5 Describe the parameters of JFET
4.6 Explain Metal oxide Semiconductor FET (MOSFET)
4.7 Explain Types of MOSFET

5 SPECIAL DIODES

5.1 Define Zener Diode
5.2 Explain Zener Diode as voltage Regulator
5.3 Define percentage regulation and line regulation
5.4 Describe Varactor Diode
5.5 Define Optical Diodes
5.6 Describe Light Emitting Diode (LED)
5.7 Describe Liquid crystal Diode (LCD)
5.8 Describe Photo diode
5.9 Describe Opto-coupler
5.10 Explain construction, working, characteristics and uses of Schottky diode
5.11 Explain construction, working, characteristics and uses of Tunnel Diode
5.13 Explain construction, working, characteristics and uses of PIN Diode
5.14 Explain construction, working, characteristics and uses of Gunn Diode
5.15 Explain construction, working, characteristics and uses of LASER Diode
5.16 Explain construction, working, characteristics and uses of IMPATT Diode
5.17 Explain construction, working, characteristics and uses of SMD Components (DIODE, TRANSISTOR, CAPACITORS)

6 THYRISTORS

6.1 Describe Silicon Controlled Rectifier (SCR)
6.2 Describe Light Activated SCR (LASCR)
6.3 Describe applications of SCR
6.4 Describe Silicon Controlled Switch (SCS)
6.5 Explain construction and working of Diac
6.6 Explain construction and working of Triac
6.7 Explain Unijunction Transistor (UJT)

7 AMPLIFIERS

7.1 Describe the Classification of amplifiers according to operations
7.2 Describe the Classification of amplifiers according to feedback
7.3 Define feedback. Explain Positive and negative feedback
7.4 Explain High Power amplifier

8 OPERATIONAL AMPLIFIER

8.1 Define operational Amplifier
8.2 Explain Inverting and non-inverting amplifiers
8.3 Explain Voltage follower
8.4 Explain The differential Amplifier
8.5 Explain Summing Amplifier
8.6 Explain Comparator
8.7 Describe 741 OP AMP

Elt-213 ELECTRONIC DEVICES

LIST OF PRACTICAL **96 HRs**

1. Identify the various diodes, transistors & IC package, number system and terminals.
2. Draw the forward & reverse characteristics of a P.N. junction diode.
3. Assemble a half wave diode rectifier circuit and observe its input and output waveforms
4. Assemble a full wave bridge rectifier circuit, observe its input and output waveforms.
5. Assemble a diode limiter circuit.
6. Construction of a voltage doubler circuit.
7. Demonstrate diode as a switch.
8. Plot the input & output characteristics of a transistor in common base configuration.
9. Plot the input & output characteristics of a transistor in common emitter configuration.
10. Plot the input and output characteristic of transistor in common collector configuration.
11. Assemble a transistor voltage amplifier and find its voltage gain.
12. Plot the characteristics curves for a common source FET amplifier.
13. Plot the characteristics curves for a MOSFET amplifier
14. Demonstrate MOSFET as a switch.
15. Use a Zener diode as voltage regulator.
16. Plot the characteristics curves for SCR
17. Assemble a light dimmer using a Diac
18. Assemble a differential amplifier using transistor.
19. Use of op-amp as an inverting amplifier.
20. Use of op-amp as non-inverting amplifier.
21. Use of op-amp as a voltage follower.
22. Use of op-amp as a comparator.
23. Construct a summer using OP-AMP.

Tel-213 DIGITAL LOGIC DESIGN

T	P	C
2	3	3

Total Contact Hours : 160

Theory : 64 Hours
Practical : 96 Hours

LEARNING OUTCOMES:

This course has been designed to enable students to be familiar with:

- Basic logic gates, number system.
- Digital integrated circuit and flip-flop.
- Common combination and sequential circuits.
- Various memory system.

COURSE CONTENTS

1 BASIC LOGIC CIRCUITS (10 hours)

1.1 Digital signals.
1.2 Digital Logic
1.3 Logic Levels
1.4 Positive and Negative Logic
1.5 More than two level Logic
1.6 AND, OR, NOT gates, their truth tables and symbols
1.7 NAND, NOR, truth tables and symbols
1.8 De Morgan theorem
1.9 Min term and Max term
1.10 Sum of Product (SOP) & Product of Sum (POS) Circuits
1.11 Introduction of K-map

2 NUMBER SYSTEMS AND BINARY CODES (8 hours)

2.1 Binary, decimal, octal, hexadecimal number systems
2.2 Inter conversion of number system in objective 2.1
2.3 BCD, Alpha numeric 8421, X3,
2.4 Parity codes
2.5 Gray Code
2.6 1's and 2's complements

3 DIGITAL ICs (7 hours)

3.1 Introduction to ICs
3.2 Integrated resistors and capacitors
3.3 Integrated transistors and diodes
3.4 Hybrid and monolithic ICs
3.5 SSI, MSI, LSI, VLSI
3.6 Logic families
3.7 Comparison of TTL, ECL, CMOS

4 COMBINATIONAL LOGIC CIRCUITS (8 hours)

4.1 Half Adder
4.2 Full Adder
4.3 Subtractor (half ,full)
4.4 Decoder
4.5 Encoder
4.6 Multiplexer
4.7 Demultiplexer

5 MULTIVIBRATOR (MV) (9 hours)

5.1 Monostable Multivibrator
- 5.1.1 Introduction
- 5.1.2 Monostable multivibrator Working
- 5.1.3 Applications of monostable multivibrator

5.2 Astable Multivibrator
- 5.2.1 Introduction
- 5.2.2 Astable multivibrator Working
- 5.2.3 Applications of Astable MV
- 5.2.4 The 555 IC timer

5.3 Bistable multivibrator
- 5.3.1 Introduction of Bistable
- 5.3.2 Bistable multivibrator Working

6 FLIP-FLOP (8 hours)

6.1 Difference between Flip Flop & Latch
6.2 RS, T and D flip flop
6.3 JK flip flop
6.4 Master salve Flip Flop
6.5 Applications of flip flop
- 6.5.1 Data storage
- 6.5.2 Transfer of data
- 6.5.3 Frequency division
- 6.5.4 Counters

7 REGISTERS AND COUNTERS (7 hours)

7.1 Introduction and types
7.2 Bi-directional shift register
7.3 Asynchronous and synchronous shift register
7.4 Binary counter
7.5 Up/Down counter
7.6 IC counter

8 MEMORY SYSTEMS (4 hours)

8.1 Semiconductor memories
8.2 Read only memories (ROM, PROM), EPROM, EE PROM
8.3 Random Access memories (RAM) or RW memories
8.4 Static and dynamic memories
8.5 Introduction to sequential access storage
8.6 ROM and Programmed Logic Array (PLA)
8.7 SSD and its types and applications

9 ADC AND DAC CONVERSION (3 hours)

9.1 Analog signal
9.2 Digital signal
9.3 Conversion
  9.3.1 Digital-to-Analog conversion (Weighted resistor DAC circuit)
  9.3.2 Analog-to-Digital conversion (Ramp generator method)

RECOMMENDED REFERENCE BOOKS

1. Digital Design, Latest Edition by M.Morris Mano
2. Logic and Computer design Fundamentals by Charles R.Kime and M.Morris Mano
3. Digital Principles and logic design by A.Saha and N.Manna

Tel-213 DIGITAL LOGIC DESIGN

INSTRUCTIONAL OBJECTIVES

1 BASIC LOGIC CIRCUITS

1.1 Understand the representation and characteristics of digital signals.
1.2 Learn the fundamental concepts of digital logic.
1.3 Identify and distinguish between different logic levels, such as high and low states, in digital circuits.
1.4 Understand the difference between positive and negative logic systems based on voltage levels and their corresponding logic states.
1.5 Explore the concept of multi-level logic systems beyond the typical two-level binary logic.
1.6 Learn the symbols, truth tables of AND, OR, and NOT gates in digital circuits.
1.7 Understand the symbols, truth tables for NAND and NOR gates in digital systems.
1.8 Apply De Morgan's laws to simplify Boolean expressions involving AND, OR, and NOT operations.
1.9 Understand the concepts of minterms and maxterms in Boolean algebra for constructing logical expressions.
1.10 Learn how to express Boolean functions in Sum of Products (SOP) and Product of Sums (POS) forms.
1.11 Gain an understanding of Karnaugh Maps (K-maps) as a tool for simplifying Boolean expressions visually.

2 NUMBER SYSTEMS AND BINARY CODES

2.1 Understand the representation in binary, decimal, octal, and hexadecimal number systems.
2.2 Learn how to convert numbers between binary, decimal, octal, and hexadecimal systems.
2.3 Study Binary Coded Decimal (BCD), Alphanumeric 8421 code, and X3 codes used for digital encoding.
2.4 Learn how parity bits are used to detect errors in digital data transmission by checking for even or odd parity.
2.5 Understand the Gray code system, where only one bit changes at a time between successive values.
2.6 Learn how to find the 1's and 2's complements of binary numbers for performing subtraction and representing negative values.

3 DIGITAL ICs

3.1 Understand the basic concepts and applications of Integrated Circuits (ICs).
3.2 Learn how resistors and capacitors are integrated into ICs and their functional roles.
3.3 Explore the integration of transistors and diodes within ICs
3.4 Differentiate between hybrid and monolithic ICs, including their uses.
3.5 Recognize the differences between SSI, MSI, LSI, and VLSI technologies.
3.6 Identify and compare basic logic families used in digital electronics (TTL, ECL & CMOS)
3.7 Compare the key features, advantages, and limitations of TTL, ECL, and CMOS logic families.

4 COMBINATIONAL LOGIC CIRCUITS

4.1 Understand the operation and design of a half adder for adding two single-bit binary numbers.
4.2 Learn how a full adder works to add three binary inputs and produce a sum and carry output.
4.3 Understand the operation of binary subtractors, including half and full subtractors.
4.4 Learn the function and applications of a decoder in converting binary input into a specific output pattern.
4.5 Understand the operation of an encoder for converting multiple inputs into a smaller binary code.
4.6 Explore the working principle of a multiplexer for selecting one of many inputs and directing it to a single output.
4.7 Understand the function of a demultiplexer in directing a single input to one of several outputs based on control signals.

5 MULTIVIBRATOR (MV)

5.1 **Monostable Multivibrator**
5.1.1 Learn the concept and characteristics of a monostable multivibrator.
5.1.2 Understand the working of a monostable multivibrator.
5.1.3 Explore the practical uses of monostable multivibrator in electronics.
5.2 **Astable Multivibrator**
5.2.1 Learn the definition and characteristics of an astable multivibrator.
5.2.2 Understand the working of an astable multivibrator.
5.2.3 Explore the practical applications of astable multivibrators in electronic circuits.
5.2.4 Learn the working of the 555 timer IC
5.3 **Bistable Multivibrator**
5.3.1 Learn about the basic characteristics and states of a Bistable multivibrator.

6 FLIP-FLOP

6.1 Understand the key differences between flip-flops and latches
6.2 Learn the operation and characteristics of RS, T, and D flip-flops in digital circuits.
6.3 Understand the working and functionality of the JK flip-flop
6.4 Learn the design and working of the master-slave flip-flop
6.5 Explore the various practical applications of flip-flops in digital systems.
6.6 Understand how flip-flops are used for storing binary data in digital circuits.
6.7 Learn how flip-flops facilitate the transfer of data in sequential logic circuits.
6.8 Explore how flip-flops are used in frequency division circuits
6.9 Understand the role of flip-flops in the operation of binary counters.

7 REGISTERS AND COUNTERS

7.1 Understand the basic concept of shift registers and the different types used in digital circuits.
7.2 Learn the operation and applications of bi-directional shift registers, which can shift data in both directions.
7.3 Compare the working principles and differences between asynchronous and synchronous shift registers.

7.4 Understand the working and design of binary counters used for counting in digital systems.
7.5 Learn the operation of up/down counters and their use in counting both upwards and downwards.
7.6 Explore the functionality and applications of integrated circuit (IC) counters in digital electronics.

8 MEMORY SYSTEM

8.1 Understand the basic concept and types of semiconductor memory used for data storage in digital systems.
8.2 Learn the different types of read-only memories, including ROM, PROM, EPROM, and EEPROM, and their characteristics.
8.3 Understand the working of RAM, or read-write memory
8.4 Learn the differences between static and dynamic memory types in terms of operation
8.5 Understand the concept of sequential access storage in storing and retrieving data in a specific order.
8.6 Learn about ROM and the functionality of Programmed Logic Arrays (PLAs) in implementing logic functions.
8.7 Explore how RAM is used in various applications, including its integration with multiplexers for efficient data handling.
8.8 Explain SSD and its type and applications

9 ADC and DAC Conversion

9.1 Understand the characteristics and properties of analog signals, which vary continuously over time.
9.2 Learn the characteristics of digital signals, which represent data in discrete values.
9.3 Understand the process of converting signals between analog and digital formats.
9.4 Learn how a weighted resistor DAC circuit converts digital signals to analog signals.
9.5 Understand the working principle of the ramp generator method for converting analog signals to digital format.

Tel-213 DIGITAL LOGIC DESIGN

LIST OF PRACTICALS **96 HRs**

1. Verifying truth tables of AND, OR, NAND,
2. Verifying truth tables of NOR, NOT
3. Verifying truth tables of Exclusive OR Exclusive NOR.
4. Construct a BCD to seven segment convertor.
5. Verifying De Morgan's theorem.
6. Construct a monostable MV with the help of 555 IC.
7. Construct a flip-flop using discrete components.
8. Construct a flip-flop using NAND, NOR Logic gates
9. Construct Half adder circuit using logic gates
10. Construct Half subtractor circuit using logic gates
11. Construct full adder circuit using XOR gates and verify its truth tables
12. Construct full adder circuit using NAND gates and verify its truth tables
13. Construct full subtractor circuit using XOR gates and verify its truth tables
14. Construct full subtractor circuit using NAND gates and verify its truth tables
15. Demonstrate the working of Multiplexer
16. Demonstrate the working of de-multiplexer
17. Construct a binary counter register by using Flip Flops
18. Construct an up/down counter
19. Study the working of encoder and decoder Circuits.
20. Study different types of memories devices.

Tel-223 MEASURING INSTRUMENTS

	T	P	C
Total Contact Hrs: 160	2	3	3

Theory: 64 Hours
Practical: 96 Hours

LEARNING OUTCOMES:
After completing this course, student will be able to:

1. Understand measurement concepts, errors, and their types.
2. Explain the working principles of indicating instruments and digital meters.
3. Analyze bridge circuits for resistance, inductance, and capacitance measurements.
4. Understand the operation of signal generators, oscilloscopes, and analyzers.
5. Apply calibration techniques for accurate instrument measurements.

COURSE CONTENTS:

1. MEASUREMENTS AND ERROR (1 Hours)

1.1 Precision of measurements.
1.2 Types of errors.
1.3 Accuracy rating of instruments.
1.4 Application of the concepts.

2. INDICATING INSTRUMENTS (10 Hours)

2.1 Introduction to meters.
2.2 D`Ansonval Meter movements
2.3 Ammeters, millimeters, micrometer and shunts.
2.4 Shunt calculations.
2.5 Voltmeter, multiplier and sensitivity.
2.6 Basic Ohmmeter (Conversion of ammeter into ohmmeter)
2.7 Volt-Ohm-Milliammeter
2.8 Ac meters (rectifier, moving iron-vane, electrodynamometer, and thermocouple)

3. TRANSISTOR VOLTMETER (03 Hours)

3.1 Introduction to Basic TVM, FET, MOSFET
3.2 Balance bridge transistor voltmeter, BJT-type
3.3 Balance bridge transistor voltmeter FET- type
3.4 Applications.

4. BRIDGES. (08 Hours)

4.1 Introduction.
4.2 Whetstone bridge and Guarded Whetstone Bridge.
4.3 Types of AC bridges
4.4 Maxwell bridge.
4.5 Hay Wien bridge

5. SIGNAL GENERATORS. **(08 Hours)**

5.1 Introduction to oscillator circuit
5.2 AF generator.
5.3 RF generator.
5.4 AM generator.
5.5 FM generator.
5.6 Sweep generator.
5.7 Square and Pulse generator.
5.8 Function generator.

6. OSCILLOSCOPES. **(06 Hours)**

6.1 Introduction to Cathode Ray Tube
6.2 Single/dual trace (general purposes) oscilloscope.
6.3 Triggered Sweep.
6.4 Storage oscilloscope.
6.5 Sampling oscilloscope

7. DIGITAL INSTRUMENTS. **(04 Hours)**

7.1 Digital Multimeter
7.2 Digital Frequency meter
7.3 Digital LCR meter.
7.4 Digital I.C. tester.

8. ANALYZERS. **(06 Hours)**

8.1 Wave Analyzer
8.2 Distortion Analyzer
8.3 Logic Analyzer
8.4 Spectrum Analyzer
8.5 Application

9. MISCELLANEOUS TEST INSTRUMENTS **(06 Hours)**

9.1 Energy meter, induction type
9.2 Watt meter, RF
9.3 Volume Unit (VU) meter
9.4 Pulse counter
9.5 Clamp meter

10. Optical Power Meter (OPM) **(04 hours)**

10.1 Introduction
10.2 Working Principle
10.3 Types of OPM
10.4 OPM test procedure
10.5 How to Use Fiber Optical Power Meter
10.6 Optical Laser Source (OLS)

11. Optical Time Domain Reflectometer **(04 hours)**

11.1 Introduction
11.2 Working Principle of OTDR
11.3 Testing method and procedure of OTDR
11.4 OTDR Types
11.5 Parameters
11.5.1 Pulse Width
11.5.2 Dead Zones
11.5.3 Distance Range
11.5.4 Averaging Time
11.5.5 Refractive Index
11.6 Key features and functions of an OTDR

12. PROBES (02 hours)

12.1. High Voltage Probes
12.2. Oscilloscope Probes
12.3. Logic Probes
12.4. Application

13. CALIBRATION OF INSTRUMENTS: (02 hours)

13.1 Standard of Calibration
13.2 Techniques of calibration

REFERENCE BOOKS

1. **A Course in Electrical and Electronic Measurements and Instrumentation** by A.K. Sawhney
2. E**lectronic Instrumentation and Measurements** by David A. Bell
3. **Measurement Systems: Application and Design** by Ernest O. Doebelin & Dhanesh N. Manik

Tel-223 MEASURING INSTRUMENTS

INSTRUCTIONAL OBJECTIVES

1. MEASUREMENTS AND ERROR

1.1 What is instrument?
. 1.2 Define Precision and accuracy
1.3 Discuss difference between precision and accuracy
1.4 Define errors and its types
1.5 Discuss Gross Error, Systematic Error and Random Error
1.6 Discuss source of errors

2. INDICATING INSTRUMENTS

2.1 Define Electrical instrument also discuss its types.
2.2 Describe the working principle of D'Arsonval meter movements and also explain PMMC meter.
2.3 What is ammeter and shunt Identify and explain the functions of ammeters, millimeters, micrometers.
2.4 Calculate the appropriate values of shunts with different examples.
2.5 Explain the working of voltmeters, the role of multipliers, and the concept of sensitivity.
2.6 Describe how an ammeter is converted into an ohmmeter and its working principle also discuss the types of ohm-meter.
2.7 Define VOM meter and why it is used.
2.8 Draw a block diagram illustrating the internal components of a VOM.
2.9 Explain the working principles and applications of rectifier, moving iron-vane, electrodynamometer, thermocouple

3. TRANSISTOR VOLTMETER

3.1 What is TVM meter, explain why TVMs are preferred for testing transistors and electronic circuits.
3.2 Study the basic block diagram of TVM circuitry showing its components.
3.3 Define the balance bridge concept for BJT TVM and explain with circuit
3.4 Define the balance bridge concept for FET transistors. Also Discuss circuit diagram for a balance bridge FET-type TVM
3.5 Explain the differences between BJT-type and FET-type TVMs.

4. BRIDGES AND BRIDGE- TYPE EQUIPMENT.

4.1 What is bridges and why we use it
4.2 Define Wheatstone bridge and its application in resistance measurement.
4.3 Discuss the guarded wheat stone bridge and why we use it.
4.4 Explain the concept of AC bridges for measuring inductance, capacitance, and impedance
4.5 Derive basic formula for general AC bridge.
4.6 Define Maxwell Bridge, Discuss the working principle and derive the equation for it.
4.7 Define Hays bridge also explain its working principle.

5. SIGNAL GENERATORS.

5.1 **Define oscillator**

5.2 Explain with block diagram what an audio frequency generator is and its purpose.

5.3 Describe an RF generator and its frequency range. And explain with block diagram

5.4 **What is AM generator,** its purpose? Block diagram and its working principal.

5.5 **What is FM generator,** its purpose? Block diagram and its working principal.

5.6 Explain the concept of a sweep generator, their block diagram and its purpose in signal analysis.

5.7 Describe square and pulse generators with block diagram and explain it.

5.8 Define what a function generator is and discuss it with block diagram.

6. OSCILLOSCOPES.

6.1 Define the term oscilloscope. Explain CRT Tube

6.2 Discuss general block diagram of an CRT Tube

6.3 Discuss the oscilloscope block diagram and its working

6.4 Discuss several controls of an oscilloscope like vertical position, horizontal position, trigger control, power supply and Time base.

6.5 Explain working of dual trace oscilloscope

6.6 Explain the concept of a triggered sweep and how it stabilizes signal display on the screen.

6.7 What are **s**torage oscilloscopes and explain its working with bock diagram.

6.8 Explain the sampling principle, Discuss the basic diagram of a sampling oscilloscope setup.

7. DIGITAL INSTRUMENTS.

7.1 What are digital instruments and its types

7.2 Define A digital multimeter (DMM), block diagram, explain its working principles and functions, such as auto-ranging and mode selection.

7.3 Define frequency counter, show a typical block diagram, including signal input, conditioning, and counting circuitry. Discuss how frequency counters detect and count signal pulses over a time interval.

7.4 A digital LCR meter measures inductance (L), capacitance (C), and resistance (R) of components. Discuss basic diagram showing the measurement process

7.5 Discuss the principles of measuring L, C, and R using test signals.

7.6 What is digital IC tester, Block Diagram**,** discuss how IC testers apply test signals to the IC under test and analyze responses.

8. ANALYZERS.

8.1. Define analyzer, discuss types of analyzers.

8.2. Discuss wave analyzer typical block diagram showing input signal processing, filter, and output display.

8.3. Explain that distortion analyzers with basic block diagram showing signal input, reference signal, distortion detector, and output.

8.4. Define logic analyzers, explain it with block diagram and working of logic analyzer. Explain working of spectrum analyzer

9. MISCELLANEOUS TEST INSTRUMENTS

9.1 Define induction-type energy meters and their role in electrical energy measurement and explain it with block diagram of an induction-type energy meter.

9.2 Define RF watt meters and explain it with block diagram, also discuss the construction and working. Define VU (Volume Unit) meters, and explain its working using block diagram.

9.3 Define pulse counters and explain its working through block diagram.

9.4 Define pulse counters and explain its working through block diagram.

9.5 Define clamp on AC meter.

9.6 Explain the working of Clamp meter with block diagram.

10. OPTICAL POWER METER (OPM)

10.1 What are Optical Power Meters (OPM) and their importance in fiber optic communication systems.
10.2 Explain the basic working principle of an Optical Power Meter.
10.3 Discuss the different types of Optical Power Meters. Include handheld, laboratory, and portable types based on their application and features.
10.4 How to Use Fiber Optical Power Meter.
10.5 Define optical Laser Source (OLS) and its role in fiber optic testing.
10.6 Explain how OLS is used to inject a stable optical signal into the fiber during testing with the OPM.
10.7 Discuss basic block diagram showing the connection between the OPM and OLS in a test setup.

11. OPTICAL TIME DOMAIN REFLECTOMETER (OTDR)

11.1. Define OTDR (Optical Time Domain Reflectometer) and its role in fiber optic testing.
11.2. Explain the fundamental working principle of OTDR,
11.3. Explain how OTDR measures the length of fiber optic cables.
11.4. Discuss how distance is measured in the optical fiber cable.
11.5. Define various types of OTDRs (such as single-mode and multi-mode OTDRs).
11.6. Define dead zones and explain why they occur in OTDR measurements.
11.7. Explain the concept of distance range in OTDR measurements. Also discuss how OTDRs are capable of measuring varying distances,
11.8. Define averaging time in the context of OTDR measurements
11.9. Explain the refractive index of the fiber and its role in OTDR measurements.

12. PROBES

12.1 Define probe and its types.
12.2 What is high voltage probe also discuss the working principle of high voltage

probes.

12.3 Define oscilloscope probes Explain the working principle of oscilloscope probes

12.4 Discuss Block Diagram of an oscilloscope probe setup.

12.5 Define logic probes and their use in digital circuit testing also discusses its block diagram and its operation.

13. CALIBRATION OF INSTRUMENTS

13.1 Define the importance of calibration standards and their role in ensuring accurate measurements.

13.2 Identify and explain the different techniques used in calibration processes.

13.3 Describe the components of a calibration report and its significance in quality control and documentation.

Tel-223 MEASURING INSTRUMENTS

LIST OF PRACTICAL **96 HRs**

1. Demonstrate Various PMMC METER.
2. Demonstrate the working of a PMMC meter.
3. Demonstrate and use of Digital Clamp on meter.
4. Use wattmeter to measure single phase AC power.
5. Use signal generator to generate different type of waves
6. Demonstrate and perform function of oscillator
7. Use AF and RF signal generator to create different AF and RF signals
8. Use AM and FM signal generator to observe Study AM and FM signals
9. Demonstrate use of IC tester to check different ICs
10. Observe and use different controls of oscilloscope
11. Use Frequency counter and perform its different operations
12. Use Energy meter to calculate energy usage
13. Use lux meter for light intensity calculation
14. Use LCR meter to calculate values of different inductor, capacitors.
15. Use ohm meter to calculate different values of resistances
16. Find voltage and frequency of a signal using oscilloscope
17. Test logic signal using logic probe
18. Use logic analyzer Study digital circuits
19. Demonstrate AVO meter calibration
20. Find the distance of a signal using OTDR meter
21. Find the strength of a signal using Optical power meter

Tel-233 MICROCONTROLLER APPLICATIONS

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

Learning Outcomes:

The students will be able to

- Understand microcontroller fundamentals and differentiate microcontrollers from microprocessors, trace their evolution, and identify their applications.
- Analyze microcontroller architecture, interpret the block diagram, types, and memory organization of microcontrollers, and understand their programming concepts using assembly and high-level languages.
- Specify microcontroller families and gain in-depth knowledge of the 8051, ATMEL (AVR series), and PIC microcontrollers, including their architecture
- Develop skills and familiarize with the Arduino platform, its various boards (e.g., Uno, Nano, and Mega), pin configurations, and practical applications in projects.

COURSE CONTENTS

1 INTRODUCTION TO MICROCONTROLLER (04 Hours)

1.1 Introduction to Microprocessor
1.2 Definition and explanation of microcontrollers
1.3 Difference between microcontrollers and microprocessors
1.4 Brief history and evolution of microcontrollers
1.5 Applications and importance of microcontrollers in telecom and other field

2 BASIC OF MICROCONTROLLER (6 Hours)

2.1 Block diagram of a microcontroller
2.2 Types of microcontrollers (8-bit, 16-bit, 32-bit and higher)
2.3 Microcontroller programming concepts (assembly language, high-level language)
2.4 Memory organization and types (RAM, ROM, EEPROM)

3 8051 MICROCONTROLLER (10 Hours)

3.1 Introduction to 8051
3.2 Architecture of 8051
3.3 Pin diagram of 8051
3.4 Basic Programming concepts and debugging for 8051

4 ATMEL MICROCONTROLLER (15 Hours)

4.1 Introduction to ATMEL Family
4.2 Introduction to microcontrollers (AVR series)
4.3 Features and applications of ATMEL microcontrollers

4.4 Basic Programming concepts and debugging for ATMEL
4.5 Input/output ports and their configurations in ATMEL Family
4.6 Interfacing of sensors with microcontroller

5 PIC MICROCONTROLLER (12 Hours)

5.1 Introduction to PIC Family
5.2 Basic concept of microcontrollers (PIC16, PIC18 series)
5.3 Features and applications of PIC microcontrollers
5.4 Basic Programming concept and debugging for PIC microcontrollers

6 COMMUNICATION PROTOCOLS (07 Hours)

6.1 Serial communication protocol UART and its Working
6.2 Serial communication protocol SPI and its Working
6.3 Wireless communication protocol Bluetooth
6.4 Wireless communication protocol Wi-Fi

7 INTRODUCTION TO ARDUINO MICRO CONTROLLER (10 Hours)

7.1 Overview of Arduino platform
7.2 Types of Arduino boards (e.g., Uno, Nano, Mega)
7.3 Components of an Arduino Uno board
7.4 Understanding analog pins of Arduino UNO
7.5 Understanding digital/PWM pins of Arduino UNO
7.6 Understanding ports Arduino UNO
7.7 Applications of different Arduino Boards (e.g., Uno, Nano, Mega)

RECOMMENDED REFERENCE BOOKS

1. Microcontroller Theory and Applications: HC12 and S12 by Daniel J. Pack and Steven F. Barrett.
2. 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin McKinlay.
3. AVR Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi.
4. Designing Embedded Systems with PIC Microcontrollers by Tim Wilmshurst
5. Getting Started with Arduino by Massimo Banzi and Michael Shiloh.

Tel-233 MICROCONTROLLER APPLICATIONS

INSTRUCTIIONAL OBJECTIVES

1 INTRODUCTION TO MICROCONTROLLER

1.1 Understand the basic concept and definition of a microprocessor.
1.2 Learn the definition and working principles of microcontrollers.
1.3 Explain the key differences between microcontrollers and microprocessors.
1.4 Explore the history and development of microcontrollers over time.
1.5 Recognize the significance and diverse applications of microcontrollers in telecom and various industries.

2 BASIC OF MICROCONTROLLER

2.1 Understand in a microcontroller's block diagram.
2.2 Learn the basic differences between 8-bit, 16-bit, and 32-bit microcontrollers and higher
2.3 Understand assembly language and high-level languages use to program Microcontrollers.
2.4 Learn about the different types of memory (RAM, ROM, EEPROM) used in microcontrollers

3 8051 MICROCONTROLLER

3.1 Understand the basic features of the 8051 microcontrollers.
3.2 Learn the structure and functional blocks of the 8051 microcontroller architecture.
3.3 Identify and understand the function of each pin in the 8051 microcontroller pin diagram.
3.4 Learn the basic programming and debugging methods for 8051 microcontroller.

4 ATMEL MICROCONTROLLER

4.1 Understand the basic features of ATMEL Family
4.2 Understand the basic features and capabilities of AVR series microcontrollers.
4.3 Learn about the key features and practical applications of ATMEL microcontrollers.
4.4Explore the basic programming concepts and debugging techniques for ATMEL microcontrollers.
4.5 Understand the input/output ports and their configurations in ATMEL microcontrollers.
4.6 Understand how to interface various sensors with a microcontroller for data acquisition and control.

5 PIC MICROCONTROLLER

5.1 Understand the basic features of the PIC microcontroller family.
5.2 Learn the core differences between the PIC16 and PIC18 microcontroller series.
5.3 Explore the key features and practical applications of PIC microcontrollers.
5.4 Learn the basic programming concepts and debugging techniques for PIC microcontrollers.

6 COMMUNICATION PROTOCOLS

6.1 Understand the UART serial communication protocol and how it operates for data transmission.

6.2 Learn the principles and operation of the SPI serial communication protocol for device communication.
6.3 Explore the Bluetooth wireless communication protocol and its use in short-range data transfer.
6.4 Understand the Wi-Fi wireless communication protocol and its application in long-range network connectivity.

7 INTRODUCTION TO ARDUINO MICRO CONTROLLER

7.1 Understand the basic features, components, and functionalities of the Arduino platform.
7.2 Learn about the different types of Arduino board's basics and their specific uses.
7.3 Identify and understand the key components of the Arduino Uno board.
7.4 Learn how to use and understand the analog pins on the Arduino Uno for reading sensor data.
7.5 Explore the digital and PWM pins on the Arduino Uno and their functions in controlling devices.
7.6 Understand the different ports available on the Arduino Uno for communication and interfacing.
7.7 Explore the various applications and projects suited for different Arduino boards like Uno, Nano, and Mega.

Tel-233 MICROCONTROLLER APPLICATIONS

LIST OF PRACTICAL **96 HRs**

1. Demonstrate the Pin configuration of 8051 microcontroller
2. Demonstrate how to Burn a program in 8051 microcontroller
3. Write a program to Blink Led in 8051 microcontroller
4. Write a program on button controlled LED on ATMEL
5. Make a counter using ATMEL through seven segment display
6. Demonstrate the Pin configuration of PIC microcontroller
7. Demonstrate how to Burn a program in PIC microcontroller
8. Write a program to Blink Led in PIC microcontroller
9. Write a program on button controlled LED on PIC
10. Make a counter using PIC through seven segment display
11. Demonstrate different commonly used Arduino board types
12. Install the Arduino IDE
13. Set up IDE and uploading your first sketch
14. Introduction to Arduino starter kit
15. Write a program to Blink Led in Arduino
16. Project on Arduino

Tel-243 TELECOMMUNICATION NETWORKS

T	P	C
2	3	3

Total Contact Hours : 160

Theory : 64 Hours
Practical : 96 Hours

Learning Outcomes: This course has been designed to enable students to be familiar with:

- Telecommunication networks.
- Types of Telecommunication networks.
- Access networks.
- Network Protocols
- Network security

COURSE CONTENTS

1 TELECOM NETWORKS (12 hours)

1.1 Key components of telecom networks.
- 1.1.1. Access
- 1.1.2. Switching
- 1.1.3. Transmission
- 1.1.4. Signaling

1.2 Introduction to network devices
- 1.2.1. Hub
- 1.2.2. Router
- 1.2.3. Switches
- 1.2.4. Repeaters
- 1.2.5. Bridge/ Gateway

1.3 Types of networks.
- 1.3.1. LAN
- 1.3.2. MAN
- 1.3.3. WAN
- 1.3.4. PAN
- 1.3.5. VPN

1.4 Access networks and their role.

1.5 Working principles of access network

1.6 Types of access network
- 1.6.1. Wired (DSL, Fiber Optics, Ethernet)
- 1.6.2. Wireless (Wi-Fi, Cellular, Satellite)
- 1.6.3. Hybrid

1.7 Advancement in access network technologies
- 1.7.1 FTTH
- 1.7.2 5G

1.7.3 Software-Defined Networking (SDN)
1.7.4 IoT
1.7.5 Edge Computing
1.7.6 Wireless sensor network

2 INTELLIGENT NETWORKS (6 hours)

2.1 General Descriptions.
2.2 Block diagram of IN
2.3 IN Services.
2.4 Future uses of IN

3 NETWORK MODELS AND PROTOCOLS (15 Hours)

3.1 Introduction to host, client and server
3.2 OSI model
3.3 IEEE 802 networking models
3.4 Internet access network
3.5 Introduction to Protocol and the functions of Protocols
3.4 Protocol Standards
3.5 Internet Protocol (IP)
3.6 IP Network (IPv4, IPv6)
3.7 High level Data Link Control
3.8 TCP/IP protocol Architecture
3.9 OSI vs TCP/IP
3.10 Legacy in Telecom network
3.11 Classless inter domain routing (CIDR)

4 NETWORK SECURITY (5 Hours)

4.1 Network Security features.
4.2 Network security techniques.
4.2.1 Prevention through planning
4.2.2 Backing up the network
4.2.3 Security
4.2.4 Standardization
4.2.5 Upgrades

5 IP MULTIMEDIA SUBSYSTEM (IMS) (8 Hours)

5.1 Introduction to VoIP
5.2 Introduction to IMS
5.3 IMS Architecture
5.3.1. Access Network
5.3.2. Core Network
5.3.2.1 Application Layer Application Server
5.3.2.2 Control Layer
5.3.2.2.1. Home Subscriber Server (HSS)

5.3.2.2.2. Call Session Control Function (CSCF)
5.3.2.2.3. Media Resource Function (MRF)
5.3.2.2.4. Signaling Gateway (SGW)
5.3.3 Transport Layer
5.3.3.1. IP network
5.3.3.2. PSTN
5.4 Functions of IMS
5.5 Types of IMS Protocols
5.5.1 Session Initiated Protocol (SIP)
5.5.2 Real Time Transport Protocol (RTP)
5.5.3 Diameter Protocol (DP)
5.6 Advantages of IMS

6 IP MULTIMEDIA SUBSYSTEM (IMS) PROTOCOLS (10 Hours)

6.1 Introduction to Session Initiation Protocol (SIP)
6.2 Working of SIP Protocol
6.3 SIP request
6.3.1 Invite
6.3.2 Update
6.3.3 Cancel
6.3.4 End
6.4 Elements of SIP network
6.4.1 User Agent
6.4.2 Register Services
6.4.3 Location services
6.5 Difference between SIP and VoIP
6.6 Benefits of SIP protocol
6.7 Introduction to Real Time Transport Protocol (RTP)
6.8 RTP packet format
6.9 Applications of RTP
6.10 Introduction to Diameter Protocol (DP)

7 NETWORK MANAGEMENT (8 hours)

7.1 Introduction to Network Management
7.2 Functions of Network Management
7.2.1 Fault Management
7.2.2 Configuration Management
7.2.3 Performance Management
7.2.4 Security Management
7.2.5 Accounting Management
7.3 Network Traffic management centers and function
7.4 Network Management systems
7.4.1. TMN-Telecom Management Network.
7.4.2. Simple Network Management Protocol (SNMP)
7.5 Introduction to software defined network (SDN)
7.5.1 Architecture of SDN
7.5.2 Advantages of SDN
7.5.3 Difference between SDN and IoT

RECOMMENDED BOOKS:

1. Computer Networks; A top-down approach by James.F. koroze

2. Telecomunication Essentials by Illian

Tel-243 TELECOMMUNICATION NETWORKS

INSTRUCTIONAL OBJECTIVES

1. TELECOM NETWORKS

1.1 Briefly Describe components of telecom networks (Access, switching, transmission, signaling)

1.2 Define and explain the purpose of network devices (hub, Routers, switches, repeaters, and bridge/gateway)

1.3 Explain the types of networks (LAN, MAN, WAN, PAN, VPN)

1.4 Define Access networks and their role.

1.5 Describe the Working principles of access network

1.6 Enlist the types of access network (wired, wireless and hybrid)

1.7 Define DSL. Explain its types.

1.8 Explain the types of wireless access network (Wi-Fi, cellular, satellite)

1.9 Explain hybrid access network

1.10 Enlist the access network technologies

1.11 Define FTTH

1.12 Define 5G

1.13 Describe Software-Defined Networking (SDN)

1.14 Define IoT

1.15 Define Edge Computing

1.16 Describe Wireless sensor network

2. INTELLIGENT NETWORKS

2.1 Describe intelligent network.

2.2 Draw block diagram of Intelligent Network system

2.3 Explain Intelligent network Services.

2.4 Explain the future uses of intelligent network

3. NETWORK MODELS AND PROTOCOLS

3.1 Define the host, client and server

3.2 Describe the Seven Layers of the OSI Model

3.3 Describe the IEEE 802 networking models

3.4 Define Internet access network

3.5 Describe Protocol and the functions of Protocols

3.4 Describe common network Protocol Standards

3.5 Define Internet Protocol (IP)

3.6 Explain IP Network (IPv4, IPv6)

3.7 Describe the High level Data Link Control (HDLC)

3.8 Explain the TCP/IP protocol Architecture

3.9 Differentiate between OSI and TCP/IP

3.10 Define Legacy in Telecom network

3.11 Define Classless inter domain routing (CIDR)

3.12 Explain the CIDR blocks and notations

3.13 Explain the advantages of CIDR

4. NETWORK SECURITY

4.1 Define Network Security and briefly describe its features.
4.2 Describe the Network security techniques
4.2.1. Prevention through planning
4.2.2. Backing up the network
4.2.3. Security
4.2.4. Standardization
Upgrades

5. IP MULTIMEDIA SUBSYSTEM (IMS)

5.1 Define VoIP
5.2 Define IMS
5.3 Explain the IMS Architecture
5.4 Briefly describe Functions of IMS
5.5 Explain the Types of IMS Protocols (SIP, RTP, DP)
5.6 Explain Advantages of IMS

6. IP MULTIMEDIA SUBSYSTEM (IMS) PROTOCOLS

6.1 Define the Session Initiation Protocol (SIP)
6.2 Describe the Working of SIP Protocol
6.3 Describe SIP request (Invite, Update, Cancel, End)
6.4 Explain the Elements of SIP network (user Agent, Register Services, Location Services)
6.5 Differentiate between SIP and VoIP
6.6 Explain the Benefits of SIP protocol
6.7 Define the Real Time Transport Protocol (RTP)
6.8 Describe RTP packet format
6.9 Describe the Applications of RTP
6.10 Define the Diameter Protocol (DP)
6.11 Describe the working of Diameter Protocol
6.12 Describe the Applications of Diameter Protocol

7. NETWORK MANAGEMENT

7.1. Define Network Management
7.2. Explain the Functions of Network Management (fault, configuration, performance, Security, Account)
7.3. Describe Network Traffic management centers and function
7.4. Define Network Management systems
7.5. Describe TMN-Telecom Management Network.
7.6. Describe the Simple Network Management Protocol (SNMP)
7.7. Describe the software defined network (SDN)
7.8. Draw and labeled the Architecture of SDN
7.9. Explain Advantages of SDN
7.10. Explain the Difference between SDN and IoT

Tel-243 TELECOMMUNICATION NETWORKS

LIST OF PRACTICALS **96 HRs**

1. Identify various types of network accessories
2. Identifying the one way and bi directional links.
3. Prepare a straight cable and Identify a Fault in a straight cable using Cable Testers.
4. Prepare a Cross Over cable and Identify a Fault in a cross cable using Cable Testers.
5. Configure the Wi-Fi router
6. Demonstrate CMD and its commands.
7. Configuration of IPv4 and IPv6
8. Demonstration Lab View / Wire Shark simulator.
9. Demonstration Packet tracer simulator.
10. Create a simple wired network using simulator
11. IP configuration of network devices in simple network
12. Create a Hub LAN with the help of simulator.
13. Create a simple wired network using simulator
14. Create a simple wireless network using simulator
15. Connect a wired and wireless LAN using simulator
16. Create and configure a Virtual local area network (VLAN)
17. Demonstrate of video conferencing telephone.
18. Demonstrate the use of IN services like – Toll free, VAN pre – paid calling card, Virtual Private Network.
19. Visit Telecom Installation site for focus on Network Operations Centers (NOC) and monitor the network tools to locate packet errors, traffic analysis and error logging and reporting.
20. Visit to Telecom Installation for Demonstration of Network Security Measures and examine firewall rules and configuration process, Intrusion Detection System (IDS) and access control.

Tel-253 POWER SYSTEMS

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

Learning Outcomes: By the end of this course, students will be able to:

- Understand the characteristics and requirements of power supply systems for telecom equipment.
- Identify and analyze various primary and backup power sources, including renewable energy solutions.
- Explain the working principles of rectifiers, voltage regulators, and inverter systems.
- Gain knowledge of battery technologies, charging techniques, and maintenance procedures.
- Comprehend solar power generation, system components, and modern advancements.
- Learn about telecom protection systems, earthing techniques, and control mechanisms for ensuring reliable operation.

COURSE CONTENTS

1. POWER SUPPLY SYSTEM FOR TELECOM EQUIPMENT (06 Hours)

1.1 Introduction to Power Supply in Telecom
- 1.1.1 Overview of Telecom Power Systems
- 1.1.2 Block Diagram of a Typical Telecom Power Supply

1.2 Voltage Standards and Permissible Variations
- 1.2.1 Standard Operating Voltage Levels
- 1.2.2 Acceptable Voltage Fluctuations and Their Impact

1.3 Waveform Purity
- 1.3.1 Importance of Pure Waveform in Telecom Equipment
- 1.3.2 Causes and Effects of Waveform Distortions

1.4 Power Distribution System: Voltage Drop and Induction
- 1.4.1 Factors Affecting Voltage Drop
- 1.4.2 Effects of Inductive Interference on Telecom Systems

2. PUBLIC MAINS CONDITIONS OF SUPPLY (03 Hours)

2.1 Voltage and Frequency Standards
- 2.1.1 Standard Voltage and Frequency Limits
- 2.1.2 Permissible Variations in Supply

2.2 Types of Power Supply and Distortions
- 2.2.1 Single-Phase and Three-Phase Supply
- 2.2.2 Waveform Distortion and Its Effects

2.3 Ensuring Reliability of Main Power Supply
- 2.3.1 Power Backup Systems
- 2.3.2 Protection Against Power Fluctuations

3. PRIMARY POWER SOURCE (06 Hours)

3.1 Thermal Power Generation
3.2 Diesel Engine Power Generation
3.3 Gas Engine Power Generation
3.4 Petrol Engine Power Generation
3.5 Green Energy Sources for Remote Locations
  3.5.1 Wind Mill Power Generation
  3.5.2 Solar Cell Power Generation
3.6 Alternators
  3.6.1 Construction and Working of an Alternator
  3.6.2 Importance of Stationary Armature (Stator) in Alternators
3.7 Field Excitation Methods
  3.7.1 Self-Excited and Separately Excited Systems

4. STORAGE BATTERIES (08 Hours)

4.1 Lead Acid Batteries
  4.1.1 Types of Lead Acid Batteries
4.2 Battery Charging Techniques
  4.2.1 Trickle Charging
  4.2.2 Fast charging
  4.2.3 Float charging
4.3 Alkaline Batteries
4.4 Nickel-Based Batteries
  4.4.1 Nickel-Cadmium (Ni-Cd) Batteries
  4.4.2 Nickel-Metal Hydride (Ni-MH) Batteries
4.5 Lithium-Ion and Other Dry Batteries
  4.5.1 Lithium-Ion Batteries
  4.5.2 Other Dry Cell Technologies
4.6 Specialized Battery Types
  4.6.1 Deep Cycle Batteries
  4.6.2 Tubular Batteries
4.7 Battery Maintenance

5. RECTIFICATION AND RECTIFIER CIRCUITS (06 Hours)

5.1 Basic Rectifier Circuits
  5.1.1 Half-Wave Rectifier
  5.1.2 Full-Wave Rectifier (Center-Tapped & Bridge)
5.2 Voltage Doubler Circuit
  5.2.1 Half-Wave Voltage Doubler
  5.2.2 Full-Wave Voltage Doubler
5.3 Three-Phase Rectifier
5.4 Thyristor Rectifier
5.5 Switch-Mode Power Supply (SMPS)

5.6 Transformer-Based Power Supply

6. FILTERS **(02 Hours)**

6.1 Filtration Process
6.2 Types of Filters
- 6.2.1 Low-Pass Filters (LPF) (T, π, L Configurations)
- 6.2.2 High-Pass Filters (HPF)
- 6.2.3 Band-Pass Filters (BPF)

7. VOLTAGE REGULATORS **(07 Hours)**

7.1 Voltage regulation.
7.2 Zener diode regulator.
7.3 BJT regulator.
7.4 OP AMP voltage regulator.
7.5 Integrated circuit voltage regulator
- 7.5.1 Positive voltage regulators.
- 7.5.2 Negative voltage regulators.

7.6 Application of IC voltage regulator.
7.7 Voltage Stabilization

8. SOLAR POWER GENERATION **(07 Hours)**

8.1 Evolution and importance of Renewable energy
8.2 Solar radiation and its characteristics.
8.3 Principle of solar power system
8.4 Solar power system components.
- 8.4.1 Types of solar panels /cell technologies.
- 8.4.2 Inverters
  - 8.4.2.1 Grid Tie
  - 8.4.2.2 Off Grid
  - 8.4.2.3 Hybrid

8.5 Installation Process
8.6 Emerging Solar Technologies

9. CHOPPER AMPLIFIERS **(06 Hours)**

9.1 Introduction to Chopper Amplifiers
9.2 Working Principle of Chopper Amplifier
9.3 Block diagram of Chopper Amplifier
9.4 FET Chopper.

10. INVERTER AND PROTECTION SYSTEM **(08 Hours)**

10.1 Automatic Transfer Switch (ATS) and Changeover Systems
- 10.1.1 Components and Functions of ATS

10.1.2 Types of Changeover Mechanisms
10.2 Role of Smart Switches in Load Management
10.3 Maximum Power Point Tracking (MPPT) Charge Controllers
10.3.1 Working Principle of MPPT
10.3.2 Advantages Over Traditional Charge Controllers
10.4 DC-AC Inverter Systems and Advancements in PV Solar Systems
10.4.1 Working of DC-AC Inverters
10.4.2 Integration with Modern Solar Power Systems
10.5 Uninterruptible Power Supply (UPS)
10.5.1 Applications

11. CONTROL & PROTECTION SYSTEM (02 Hours)

11.1 Closed and open loop system.
11.2 Surge arrester and lightning arrester.
11.3 Circuit Breakers and its types.

12. EARTHING SYSTEMS & ITS INSTALLATION (03 Hours)

12.1 Importance of Earthing for Telecom Equipment
12.2 Types of Earthing (Plate, Rod, Strip)
12.3 Separate Earth Connection for Telecom Equipment
12.4 Purpose and Benefits of earthing

RECOMMENDED /REFERENCE BOOKS:

1. Telecom Power Systems by Dorin O. Neacșu. Latest Edition, Publisher: CRC Press
2. Power Electronics in Renewable Energy Systems and Smart Grid: Technology and Applications by Bimal K. Bose, Latest Edition, Publisher: Wiley-IEEE Press
3. Power Supply in Telecommunications by Hans Gumhalter. Latest Edition, Publisher: Springer

Tel-253 POWER SYSTEMS

INSTRUCTIONAL OBJECTIVES

1. POWER SUPPLY SYSTEM FOR TELECOM EQUIPMENT

1.1 Explain the importance of power supply systems in telecom and interpret a typical block diagram.

1.2 Identify standard operating voltage levels and analyze the impact of voltage fluctuations.

1.3 Describe waveform purity, its significance, and the effects of distortion on telecom systems.

1.4 Describe the voltage drop and inductive interference in power distribution systems.

2 PUBLIC MAINS CONDITIONS OF SUPPLY

2.1 Identify standard voltage and frequency limits and analyze permissible variations in supply.

2.2 Differentiate between single-phase and three-phase power supplies and evaluate the effects of waveform distortion.

2.3 Explain methods to ensure the reliability of the main power supply, including backup systems and protection against fluctuations.

3. PRIMARY POWER SOURCES

3.1 Explain the principles of thermal power generation using diesel, gas, and petrol engines.

3.2 Describe the role of renewable energy sources, including wind and solar power, in remote locations.

3.3 Explain the construction and working of an alternator.

3.4 Describe the importance of the stationary armature (stator) in alternators.

3.5 Differentiate between self-excited and separately excited field excitation systems.

4. STORAGE BATTERIES

4.1 Describe various types of lead acid batteries (flooded, sealed, AGM, gel)

4.2 Explain battery charging methods (Trickle charging, Fast charging, Float charging)

4.3 Describe alkaline batteries Composition, working principle, and common applications

4.4 Compare Nickel-Cadmium (Ni-Cd) and Nickel-Metal Hydride (Ni-MH) batteries

4.5 Explain the working principle, Composition, charging/discharging process of lithium-ion batteries.

4.6 Define dry cell battery and their applications (Zinc-carbon, silver-oxide, zinc-air).

4.7 Explain deep cycle batteries and their applications in renewable energy.

4.8 Describe tubular batteries and their advantages.

4.9 Describe the importance and key practices of battery maintenance to ensure longevity, efficiency, and reliable performance.

5. RECTIFICATION AND RECTIFIER CIRCUITS

5.1 Define rectification

5.2 Explain the working of a half wave rectifier

5.3 Explain the working of a full wave rectifier circuits using center tapped transformer.

5.4 Explain the working of a bridge rectifier

5.5 Explain the working of a half wave voltage doubler

5.6 Explain the working of a full wave voltage doubler

5.7 Define three-phase rectifiers and write their applications.

5.8 Explain the block diagram of Switch-Mode Power Supply (SMPS) and its components

5.9 State the difference between switch mode and transformer-based power supply

5.10 Explain the working of a half wave thyristor rectifier

5.11 Explain the working of a full wave thyristor rectifier

6. FILTERS

6.1 Define the process of filtration

6.2 Describe the working and configurations of low-pass filters (LPF), including T, π, and L.

6.3 Describe the working of high-pass filters (HPF) and band-pass filters (BPF).

6.4 Explain the importance of ripple free DC power supply for telecom

7. VOLTAGE REGULATORS

7.1 Define voltage regulators.

7.2 Explain a simple Zener diode regulator.

7.3 Explain the working of a BJT regulator.

7.4 Explain the working of an OP AMP voltage regulator.

7.5 Describe the integrated circuit (IC) voltage regulators (Positive and Negative).

7.6 State the applications of IC voltage regulator.

7.7 Define voltage stabilization.

8 SOLAR POWER GENERATION

8.1 Explain the evolution and significance of renewable energy in modern power systems.

8.2 Describe solar radiation and its characteristics.

8.3 Explain the working principle of a solar power system.

8.4 Explain the key components of a solar power system, including solar panel, inverter, charge controller, and batteries.

8.5 Explain the different types of solar panels (Monocrystalline, Polycrystalline, Thin-Film) and cell technologies (PERC, Bifacial, Tandem).

8.6 Differentiate between various types of solar inverters (Grid-Tie, Off-Grid, and Hybrid) and their applications.

8.7 Explain the installation process of a solar power system for optimal efficiency.

8.8 Define emerging solar technologies (such as perovskite solar cells, bifacial panels, and solar tracking systems).

9. CHOPPER

9.1 Define chopper amplifier

9.2 Explain the working principle of chopper amplifier

9.3 Draw and explain the block diagram of chopper amplifier

9.4 Explain the operation of FET chopper amplifier

10. INVERTER AND PROTECTION SYSTEM

10.1 Explain the working principles and components of Automatic Transfer Switch (ATS)

10.2 Compare and contrast different types of changeover mechanisms, including manual, automatic, and static switch systems.

10.3 Explain the working principle of Maximum Power Point Tracking (MPPT) charge controllers and compare them with traditional charge controllers.

10.4 Explain the working principle of DC-AC inverters and their integration with modern solar power systems.

10.5 Explain the UPS systems with the help of block diagram.

10.6 Identify various applications of UPS systems

11. CONTROL & PROTECTION SYSTEM

11.1 Explain Closed and open loop system.

11.2 Explain Surge arrester and lightning arrester.

11.3 Describe the function and importance of surge arresters and lightning arresters in telecom field.

11.4 Define circuit Breakers. Explain types of circuit breakers.

12. EARTHING SYSTEMS & ITS INSTALLATION

12.1 Explain the importance of earthing in telecom equipment

12.2 Explain the various types of earthing methods, including plate, rod, and strip earthing.

12.3 Describe the need for a separate earth connection in telecom systems.

Tel-253 POWER SYSTEMS

List of Practical 96 HRs

1. Measure Voltage Drop Across Different Cable Lengths and Loads
2. Measure of Voltage and Frequency of Public Mains Supply Using a Multimeter
3. Study of Diesel Engine Power Generation and Performance Testing
4. Measurement of Power Output from a Solar Cell Under Different Light Conditions
5. Hands-on Study of Green Energy sources, i.e., Wind Mill Power Generation System
6. Temperature Monitoring of a Battery Using an Infrared Thermometer
7. Charging and Discharging Cycle Testing of a Battery Using a Battery Analyzer
8. Deep Cycle Battery Performance Evaluation Using a Hydrometer and Voltmeter
9. Battery Health Diagnosis Using a Battery Tester
10. Test a Half-Wave & full wave Rectifier Using an Oscilloscope
11. Load Testing of a Voltage Stabilizer Using Different Electrical Appliances
12. Measurement of Solar Radiation Using a Pyranometer
13. Effect of Angle and Orientation on Solar Panel Efficiency
14. Comparative Analysis of Different Types of Solar Panels (Monocrystalline, Polycrystalline, Thin Film)
15. Study and Testing of a Grid-Tie, Off-Grid, Hybrid Inverter in a Solar Power System
16. Step-by-Step Installation of a Small-Scale Solar Power System
17. Study and Testing of an Automatic Transfer Switch (ATS) in a Backup Power System
18. Implementation of Smart Switches for Load Prioritization in a Power System
19. Install a Tall tubular battery with MPPT charge controller
20. Load Testing of a UPS System and Battery Backup Time Calculation
21. Hands-on Study of Different Types of Circuit Breakers (MCB, MCCB, ELCB, etc.)
22. Identification and Study of Surge Arresters and Lightning Arresters
23. Measurement of Earth Resistance Using an Earth Resistance Tester (Megger Meter)

3rd YEAR

اسلامیات/مطالعہ پاکستان

نصاب سال سوئم

GEN 301

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کل وقت 20 گھنٹے

حصہ اول اسلامیات

حصہ دوئم مطالعہ پاکستان

موضوعات:

1۔ قرآن مجید:

سورۃ الفاتحہ، آیت الکرسی، سورۃ البقرہ کی آخری آیات از امن الرسول ﷺ تا آخر اور سورۃ اخلاق مع ترجمہ وتشریح

2۔ دس منتخب احادیث کا ترجمہ (تشریح)

() بنی الا سلام علی خمس شهادت انا الا اله الا لمراقلم الصلوته و ایتا الزکوة و حج البیت و صوم رمضان

() الدین النصیحته

() المنشاء موتمن

() للمومن علی المومن سنت خصال یعود ماذا مرض و تژهده اذا مات و یحیبه اذا دعا

() لیسلم علیه اذا لقیه و لیثمته اذا عطس و فصیحله اذا غاب او شهد

() لا تخن من خانک

() لا یدخل الجنته قاتع

() ان الله حرم علیکم عقوق المهات و اضاعته المال

() لیسر اولا تعسر اولا تنفر

() ذاق طعم الایمان من مرضی بالله و با الا سلام دینابمجمدنبیا

() افضل الذکر لا اله الا الله

3۔ حقوق وفرائض:

حصول تعلیم بطور فرض، والدین اور اولاد کے حقوق وفرائض، ہمسایہ کے حقوق، بچوں کے حقوق، عورتوں کے حقوق، بزرگ شہریوں کے حقوق، مخنث افراد کے حقوق۔

4۔ اسلام کی اخلاقی اقدار:

صبر واستقلال، عفو ودرگزر، ایفائے عہد، اخوت، ایثار وقربانی۔

سال سوئم

حصہ اول اسلامیات

تدریس مقاصد

قرآن حکیم:

عمومی مقاصد: منتخب سورتوں اور آیات کی روشنی میں اسلام کے بنیادی مقاصد اور عبادات جان سکے

خصوصی مقاصد: طالب علم اس قابل ہو جائے گا کہ۔

سورۃ الفاتحہ، آیت لکرسی، سورۃ بقرہ کی آخری آیات ازمن الرسول سے اور سورۃ اخلاق کا ترجمہ وتشریح کر سکے

طالب علم درج ذیل کا مفہوم بیان کر سکے

() رب العالمین صرف اللہ تعالیٰ ہے

() اللہ رحم کرنے والا ہے

() قیامت کے دن بادشاہی اللہ کی ہوگی

() عبادات اور استعانت کا حقدار صرف اللہ ہے

() طالب علم درج ذیل کا مفہوم بیان کر سکے

() اللہ پاک ہر عیب سے پاک ہے

() اللہ کے اسمائے حسنہ حق اور قیوم ہیں

() تمام انبیاء پر ایمان لانا ضروری ہے

() رسول، ملائکہ، کتب، سماویہ، پر ایمان لانا فرض ہے

() اطاعت حقیقی صرف اللہ کے لیے ہے

() اسلامی احکامات پر عمل کرنا امسانی بساط میں ہے

() کفر کو اللہ کی مدد کے بغیر شکست نہیں دی جا سکتی

() اللہ ایک ہے

() اللہ کسی کا محتاج نہیں نہ اسکا کوئی شریک ہے

منتخب احادیث:

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

خصوصی مقاصد:

() احادیث کا ترجمہ بیان کر سکے

() احادیث کی تشریح کر سکے

() معاشرتی اور انفرادی زندگی میں احادیث سے رہنمائی حاصل کر سکے

حقوق و فرائض:

عمومی مقاصد:

() اسلامی معاشرے کا ایک اچھا فرد بن سکے

خصوصی مقاصد:

() والدین کے حقوق و فرائض بیان کر سکے

() ہمسائیوں کے حقوق بیان کر سکے

() بچوں کے حقوق بیان کر سکے

() عورتوں کے حقوق کی پاسداری کر سکے

() بزرگ شہریوں کے حقوق کا خیال رکھ سکے

() محنت حضرات کے حقوق جان سکے اور ان کے حقوق کی پاسداری کر کے انہیں معاشرے کا ایک مفید فرد بنایا جا سکے

() اسلام میں حقوق و فرائض کی آگاہی کی صورت میں اپنے اندر خدمت خلق کا جذبہ پیدا کر سکے

اسلامی اقدار:

عمومی مقاصد:

() طالب علم جان سکے گا کہ تعلیم کا مقصد حسن اخلاق سے متصف ہونا ہے

خصوصی مقاصد:

() اخلاق کے معنی و مفہوم کو بیان کر سکے

() اسلام میں حسن و اخلاق کی اہمیت بیان کر سکے

() قرآن و سنت کی روشنی میں صبر و استقلال کی اہمیت بیان کر سکے

() ایفائے عہد کی اہمیت بیان کر سکے

() اخوت کے معنی و مفہوم بیان کر سکے

() اخوت اسلامی کی اہمیت بیان کر سکے

() اسلام کی اعلیٰ اقدار کو اپنا کر مثالی معاشرہ پیدا کر سکے

مطالعہ پاکستان (حصہ دوئم)

قیام پاکستان

تدریس مقاصد:

عمومی مقاصد:

() قیام پاکستان کے بعد درپیش مسائل سے آگاہی حاصل کرے اور بیان کرے

خصوصی مقاصد:

() باؤنڈری کمیشن تشکیل اور اس کے فرائض بیان کر سکے

() ریڈکلف اور اس کے ایوارڈ کے بارے بیان کر سکے

() بنگال اور کلکتہ کی تقسیم کی وجوہات بیان کر سکے

() پنجاب کی تقسیم کی تفصیل بیان کر سکے

() مہاجرین کی آمد سے جو مسائل پیدا ہوئے انہیں بیان کر سکے

() ریاستوں کے الحاق کے بارے میں تفصیل بیان کر سکے

() ریاست جموں کشمیر کے بارے میں بیان کر سکے

() نہری پانی کے تنازعہ کو بیان کر سکے

() قرارداد مقاصد کی تفصیلات بیان کر سکے

() 22 علماء کے متفقہ اسلامی نکات بیان کر سکے

() 1973 کے آئین میں انسانی حقوق کی دفعات (28-8)۔ اقلیتوں کے حقوق اور دیگر محروم طبقات کے حقوق کے بارے میں جان سکے

() قیام پاکستان کے بعد نفاذ اسلام کی کوششوں کو بیان کر سکے

() پاکستان کے محل وقوع اور اس کی جغرافیائی اہمیت بیان کر سکے اور GSP+ کے تعارف اور عملی طریقہ کار بیان کر سکے

() پاکستان میں قدرتی وسائل (تیل، گیس، کوئلہ) کے بارے میں بیان کر سکے

غیر مسلم طلباء کے لیے

نصاب اخلاقیات

GEN301

سال سوئم

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1	0	1

کل وقت 20 گھنٹے

موضوعات:

() احساس ذمہ داری

() مثبت ذہن

() عدل وانصاف

() قومی خدمت کا جذبہ

() ذکر ونظر کی پاکیزگی

() احترام آدمیت

() شائستگی

() عفوودرگذر

() بردباری

() خودانحصاری

() اثر ونفوذ

() جامعیت

() اپنی ذات کی معرفت (بذریعہ ہم عمر طلباء، اساتذہ، اہم شخصیات)

() بچوں کے حقوق

() عورتوں کے حقوق

() بزرگ شہریوں کے حقوق

() محنت حضرات کے حقوق

غیر مسلم طلباء کے لیے

نصاب اخلاقیات (سال سوئم)

تدریس مقاصد:

عمومی مقاصد:

() ملکی ترقی کے لیے اعلیٰ اوصاف کے ساتھ بہتر طور پر ملک وملت کی خدمت کر سکے

خصوصی مقاصد: طالب علم اس قابل ہو سکے کہ

() موضوعات کا مطلب بیان کر سکے

() عملی زندگی سے مثالوں کی نشاندہی کر سکے

() موضوعات کی اہمیت بیان کر سکے

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

() مثبت ذہن کے ساتھ کام کر سکے

() عدل وانصاف سے ادارہ میں، دفتر میں بہتر ماحول پیدا کر سکے

() ماحول کو اخلاقی طور پر پاکیزہ بنائے

() کارکنوں کی بہتر طور پر دل جوئی کر سکے

() کارکردگی میں اضافہ کر سکے

() باہمی احترام کی برکات سے استفادہ کر سکے

() بچوں کے حقوق بیان کر سکے

() عورتوں کے حقوق کی پاسداری کر سکے

() بزرگ شہریوں کے حقوق کا خیال رکھ سکے

() مخنث حضرات کے حقوق جان سکے اور ان کے حقوق کی پاسداری کر کے انہیں معاشرے کا ایک مفید فرد بنایا جا سکے

Mgm-371 ENTREPRENEURSHIP AND MANAGEMENT

Total Contact Hrs: 32	T	P	C
	1	0	1

Theory: 32 Hours

LEARNING OUTCOME:

The students will be able to

1. Understand the basic concept of Entrepreneurship in Telecom field
2. Understand market research and business models of Telecom industry
3. Understand the basic marketing and sales strategies
4. Understand the project management and execution in Telecom field

COURSE CONTENTS

1. INTRODUCTION TO ENTREPRENEURSHIP **(04 Hours)**

1.1 Definition and importance of entrepreneurship
1.2 Characteristics of a successful entrepreneur
1.3 Types of entrepreneurships (startup, small business, social enterprise)
1.4 Business opportunities in the telecom sector

2. BUSINESS PLANNING AND DEVELOPMENT **(06 Hours)**

2.1 Recognizing your strengths and specializations within telecom field
2.2 Identifying business ideas in telecommunication
2.3 Conducting market research and feasibility analysis
2.4 Conduct competitor analysis
2.5 Developing a business plan (objectives, strategies, financial planning)
2.6 Validating your business idea through customer research
2.7 Understanding business registration and legal requirements

3. BASICS OF BUSINESS MANAGEMENT **(08 Hours)**

3.1 Principles of management in a telecom business
3.2 Leadership styles and decision-making skills
3.3 Importance of teamwork and communication in business
3.4 Time management and productivity in entrepreneurship
3.5 Financial management: budgeting, pricing, and record-keeping
3.6 Risk management and problem-solving strategies

4. MARKETING AND SALES STRATEGIES **(06 Hours)**

4.1 Basics of marketing and promotion for small businesses
4.2 Digital marketing and social media promotion
4.3 Customer relationship management (CRM)
4.4 Effective sales techniques and negotiation skills

5. BUSINESS OPERATIONS AND GROWTH **(05 Hours)**

5.1 Setting up and managing daily business operations
5.2 Understanding supply chain and resource management
5.3 Strategies for business expansion and scaling
5.4 Case studies of successful telecom entrepreneurs

6. PROJECT MANAGEMENT AND EXECUTION (3Hours)

6.1 Project management tools and methodologies for effectively managing business projects.
6.2 Importance of professional ethics with emphasis on honesty and transparency, confidentiality, integrity in deliverables, respectful communication and conflict resolution.
6.3 Case studies and scenarios for understanding how to make ethical decisions in various freelancing situations.

RECOMMENDED BOOKS:

1. "Entrepreneurship" – Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd
2. "Innovation and Entrepreneurship" – Peter F. Drucker
3. "Entrepreneurship in Pakistan: Challenges and Opportunities" – Syed Kashif Raza, Dr. Syed Muhammad Javed
4. "Business and Entrepreneurship in Pakistan" – Shahid Amjad Chaudhry

Mgm-371 ENTREPRENEURSHIP AND MANAGEMENT

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO ENTREPRENEURSHIP

1.1 Define entrepreneurship and its importance in the telecom sector.
1.2 Identify the qualities and characteristics of a successful entrepreneur.
1.3 Differentiate between different types of entrepreneurships.
1.4 Explore business opportunities in telecommunication.

2. BUSINESS PLANNING AND DEVELOPMENT

2.1 Identify and evaluate business ideas related to telecommunication.
2.2 Explain basic market research and analyze business feasibility.
2.3 Develop a structured business plan, including objectives, strategies, and financial planning.
2.4 Explain the legal and registration process for starting a telecom business.

3. BASICS OF BUSINESS MANAGEMENT

3.1 Explain the basic functions of management in a telecom business.
3.2 Demonstrate leadership and decision-making skills.
3.3 Explain teamwork and communication strategies in business operations.
3.4 Explain the Manage time effectively for increased productivity.
3.5 Describe financial management principles, including budgeting, pricing, and record-keeping.
3.6 Explain risks in business and problem-solving strategies.

4. MARKETING AND SALES STRATEGIES

4.1 Describe the importance of marketing in business success.
4.2 Develop a marketing strategy for a telecom business.
4.3 Explain digital marketing and social media for business promotion.
4.4 Describe customer relationship management (CRM) techniques.
4.5 Demonstrate sales and negotiation skills to attract and retain customers.

5. BUSINESS OPERATIONS AND GROWTH

5.1 Organize and manage daily business operations efficiently.
5.2 Explain supply chain and resource management in a telecom business.
5.3 Identify strategies for business expansion and scaling.
5.4 Analyze case studies of successful telecom entrepreneurs for real-world insights.

6. PROJECT MANAGEMENT AND EXECUTION

6.1 Discuss Project management tools and methodologies for effectively managing business projects.
6.2 Explain Importance of professional ethics with emphasis on honesty and transparency, confidentiality, integrity in deliverables, respectful communication and conflict resolution.

Tel-313 SWITCHING SYSTEMS

T	P	C
2	3	3

Total contact hours: 160
Theory : 64 Hours
Practical : 96 Hours

LEARNING OUTCOMES:

The subject has been designed so that the student will be able to:-

1. Understand the working of electromechanical and electronic telephone exchanges
2. Understand and practice the switching systems

COURSE CONTENTS

1. INTRODUCTION TO SWITCHING SYSTEM (8 Hours)

1.1 Introduction to switching system
1.2 Elements of communication system
- 1.2.1. Access/End system
- 1.2.2. Switching system
- 1.2.3. Transmission system
- 1.2.4. Signaling

1.3. Access/End System (Telephone Instrument)
- 1.3.1 Definition of telephone
- 1.3.2 Development of telephone
- 1.3.3 Parts of telephone set
- 1.3.4 Power source
- 1.3.5 Switch hook (On hook, Off hook)
- 1.3.6 Dialer
- 1.3.7 Ringer
- 1.3.8 Transmitter
- 1.3.9 Receiver
- 1.3.10 Side and anti-side tone circuit

1.4 Digital Dialing Systems/types of dial
- 1.4.1 Pulse dialing
- 1.4.2 Multi Frequency dialing

1.5 Signaling Tones
- 1.5.1 Dial tone
- 1.5.2 Ringing tone
- 1.5.3 Busy tone
- 1.5.4 Routing or call in progress
- 1.5.5 Number unobtainable tone

1.6. Types of telephone system
- 1.6.1. Hosted telephone systems
- 1.6.2. On-premise PBX telephone systems

1.6.3. Hybrid VoIP telephone systems

1.7. Traffic, Trunking and Grading Principles
- 1.7.1. Busy Hour calling rate
- 1.7.2. Holding Time
- 1.7.3. Traffic unit – Erlang
- 1.7.4. Advanced Trunking Systems
- 1.7.5. Grading Principles in Digital Networks

1.8 Basic steps to process a call
- 1.8.1. Idle state
- 1.8.2. Call request identification
- 1.8.3. Providing dial tone
- 1.8.4. Address analysis
- 1.8.5. Called line Identification
- 1.8.6. Status of called subscriber
- 1.8.7. Ringing
- 1.8.8. Path setup
- 1.8.9. Supervision
- 1.8.10. Clear signal

1.9 Fundamentals of VoIP Technology
- 1.9.1 Introduction to VoIP, Cloud PBX, and SIP Trunks
- 1.9.2 How VoIP Works (Protocols: SIP, RTP, H.323)
- 1.9.3 Benefits and Challenges of VoIP Systems

2. TELEPHONE EXCHANGES (10 Hours)

2.1. Introduction to Telephone exchange (Switching system)

2.2. Elements of switching system

2.2.1 Transmitter and receiver
- 2.1.1 Analog vs. Digital Transmission in Modern Networks
- 2.1.2 Role of CODECs in Digital Voice Communication

2.2.2 Switches

2.2.2.1 Input
1. Trunk interface (E1, T1, ISDN, SIP Trunks)
2. Subscriber line interface (Analog Subscriber Lines (POTS) vs. Digital Subscriber Lines (DSL, ISDN, FTTH)
3. Service circuit interface (DTMF, IVR (Interactive Voice Response) & Voicemail Systems

2.2.2.2 Output
1. Trunk interface (SIP, PRI, and VoIP Trunks for Modern Exchanges)
2. Virtual Private Networks (VPNs) for Telecom
3. Subscriber line interface (ONT, FTTH))
4. Service circuit interface (Digital IVR, Call Recording, Integration of Call Centers with Cloud-based PBX)

2.2.3 Control system

2.3. Switching matrix/switching network
2.4. Types of telephone exchanges
    2.4.1. Manual
    2.4.2. Automatic
2.5. Manual Exchange
    2.5.1. Local battery (LB) exchange
    2.5.2. Central battery (CB) exchange
2.6. Automatic Exchange
    2.6.1. Electromechanical Exchange
        2.6.1.1. Strowger switching
        2.6.1.2. Crossbar switching
        2.6.1.3. Electronic exchange (SPC)
2.7. Strowger Switch
    2.7.1. Basic elements of strowger switch
        2.7.1.1. Uni selector
        2.7.1.2. Two motion selector
2.8. Crossbar Switch
        2.8.1. Basic principle
        2.8.2. Crossbar switching matrix
2.9 Electronic Exchange (Stored Program Control – SPC)
2.10 Early Digital Exchanges (Ericsson AXE, Alcatel E10B, Nortel DMS)
2.11 Modern Softswitches (Asterisk, FreePBX, 3CX, Cisco Call Manager)

3. ELECTRONIC EXCHANGES (7 Hours)

3.1. Types of Electronic Exchanges,
        3.1.1. Analogue
        3.1.2. Digital

3.2 Digital Exchange
    3.2.1. Components
        3.2.1.1. Analog to digital converter
        3.2.1.2. Digital switching system
        3.2.1.3. Database and Processor
        3.2.1.4. Interfaces
        3.2.1.5. Power supplies

3.3 Hardware subsystem
        3.3.1. Digital line unit (DLU)
        3.3.2. Line Trunk group (LTG)
        3.3.3. Switching Network (SN)
        3.3.4. Coordination Processor (CP)
        3.3.5. Common Channel Signaling Network Control (CCNC)

3.4 Advantages of digital exchange

3.5 Switching Synchronization
- 3.5.1 Need for synchronization in switch-based networks
- 3.5.2 Types of synchronization

4 DIGITAL SWITCHING SYSTEM (5 Hours)

4.1 Introduction to Digital Switching Systems:
- 4.1.1. Overview of the transition from analog to digital switching in telecom exchanges.

4.2 Advantages of digital switching System

4.3 Digital switching facilitates features
- 4.3.1. Call waiting
- 4.3.2. Conferencing.

4.4 Digital Switching in Next-Generation Networks**:**
- 4.4.1 Role of digital switching in the context of Next-Generation Networks (NGN).
- 4.4.2 Integration of digital switching in NGN for advanced services like multimedia communication

5. DIGITAL EXCHANGE (6 Hours)

5.1 SPC System Architecture

5.2 Features and Services Enabled by SPC

5.3 SPC Exchange Operation
- 5.3.1. Call setting up function
- 5.3.2. Digital Exchange Sub systems functions
- 5.3.3. Hierarchic / Level of Exchanges
- 5.3.4. Fundamental Plans

5.4 Control system
- 5.4.1. System Structure
- 5.4.2. Centralized / Distributed Control
- 5.4.3. Parallel Synchronous / Load Sharing Working
- 5.4.4. Software

6. MULTIPLEXING (6 Hours)

6.1 Introduction to multiplexing

6.2 Types of multiplexing
- 6.2.1. Frequency Division Multiplexing (FDM)
- 6.2.2. Time Division Multiplexing (TDM)
- 6.2.3. Wavelength Division Multiplexing (WDM)
- 6.2.4. Space division multiplexing (SDM).
- 6.2.5. Code Division multiplexing (CDM)

7 SWITCHING TECHNIQUES (6 Hours)

7.1 Introduction to switching techniques

7.2 Classification of switching techniques

7.2.1. Circuit switching
7.2.1.1. Time division switching
7.2.1.2. Space division switching
7.2.2. Advantages and disadvantages of circuit switching
7.2.3. Packet switching
7.2.3.1. Switched virtual circuit (SVC)
7.2.3.2. Permanent virtual circuit (PVC)
7.2.4. Advantages and disadvantages of Packet Switching
7.3. Definition of routing
7.4 Types of routing system
7.4.1. Static routing system
7.4.2. Dynamic routing system
7.5 Difference between switching and routing
7.6 Introduction to Soft switch.
7.7 Difference between soft switch and PABX

8 INTERNET PROTOCOL SWITCHING (8 Hours)

8.1 Introduction to IP Switching
8.2 Working of IP switching
8.3 Benefits of IP switching
8.4 Limitations of IP switching
8.5 Difference between packet switching and IP switching
8.6 Applications of IP switching
8.7 Introduction to label switching

9 SIGNALING (8 Hours)

9.1. Introduction to signaling
9.2. Types of signaling
9.2.1. In band signaling
9.2.2. Out of band signaling
9.2.3. Common Channel signaling
9.2.4. Channel associated signaling
9.2.5. Subscriber loop signaling
9.2.6. Interexchange signaling
9.2.7. Intraexchange signaling
9.2.8. Customer Line Signaling
9.2.9. Inter – Exchanger Signaling
9.2.10. Line and Register Signaling.
9.3. SS7 Nodes
9.3.1. SSP
9.3.2. SCP
9.3.3. STP
9.4 Working of Common Channel Signaling (CCS)
9.4.1 CCS network parts.
9.4.1. Signaling Point. SP

9.4.2. Destination Point Code (DPC)
9.4.3. Originating Point Code. OPC
9.5 Channel Associated Signaling. CAS

RECOMMENDED BOOKS:

1. Telecommunications switching systems and networks by thiagarajan viswanathan
2. Digital telephony by john c bellamy

Tel-313 SWITCHING SYSTEMS

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO SWITCHING SYSTEM

1.1 Define Switching system.
1.2 Define a communication system and its key elements (access/end system, switching system, transmission system, signaling).
1.3 Describe the evolution and development of the telephone instrument.
1.4 Describe the functions of different components within a telephone set (e.g., transmitter, receiver, dialer, ringer).
1.5 Differentiate between pulse dialing and multi-frequency dialing.
1.6 Define the significance of various signaling tones (dial tone, ringing tone, busy tone, etc.).
1.7 Describe different types of telephone systems (hosted, on-premise PBX, hybrid VoIP).
1.8 Define key traffic parameters: busy hour calling rate, holding time, and Erlang.
1.9 Explain basic grading principles in digital networks.
1.10 Describe the basic steps involved in processing a telephone call.
1.11 Define the fundamental concepts of VoIP, Cloud PBX, and SIP Trunks in modern communication.
1.12 Compare the functionalities of traditional PBX and Cloud PBX and their impact on telecom networks.
1.13 Describe the **importance of switching systems** in traditional and modern telecom infrastructures.
1.14 Explain the working principles of SIP, RTP, and H.323 protocols in VoIP communication.
1.15 Illustrate the role of soft switches and IP-PBX in VoIP call processing.
1.16 Describe the **key advantages of VoIP technology.**

2. TELEPHONE EXCHANGES

2.1 Explain the differences between analog and digital transmission in telecom networks.
2.2 Compare the advantages of digital transmission (VoIP, fiber optics) over analog systems.
2.3 Define commonly used CODECs in VoIP (G.711, G.729, Opus) and their applications.
2.4 Define analog and digital trunking technologies (E1, T1, ISDN, SIP Trunks).
2.5 Compare analog subscriber lines (POTS) with digital alternatives (DSL, ISDN, FTTH)
2.6 Define DTMF, IVR, and voicemail systems in telecom networks.
2.7 Describe how VPNs secure telecom networks and enable remote connectivity.
2.8 Describe the role of Optical Network Terminals (ONTs) in fiber-optic networks and their working principles.
2.9 Explain the migration process from copper-based networks to FTTH.
2.10 Explain how digital IVR, call recording.

2.11 Explain the integration of call centers with cloud-based PBX systems for enhanced efficiency.
2.12 Explain the concept of a switching matrix and its role in establishing communication paths.
2.13 Define the types of Telephone Exchanges
2.14 Explain the mechanism of Strowger switching and how it automated call switching.
2.15 Explain the fundamental operation of crossbar switching and its role in automating telephone exchanges.
2.16 Describe the role of early digital exchanges in transitioning from electromechanical to computerized systems.
2.17 Define Ericsson AXE, Alcatel E10B, and Nortel DMS.
2.18 Describe how modern softswitch platforms (Asterisk, FreePBX, 3CX, Cisco Call Manager) are used for VoIP communication.

3. ELECTRONIC EXCHANGES

3.1 Differentiate between analog and digital telephone exchanges.
3.2 Explain the key components of a digital exchange (ADC, digital switching system, database, interfaces, power supplies).
3.3 Describe the functions of hardware subsystems in a digital exchange (DLU, LTG, SN, CP, CCNC).
3.4 Explain the advantages of digital exchanges over analog exchanges.
3.5 Describe the need for synchronization in switch-based networks.
3.6 Describe different types of synchronization techniques used in telecommunication networks.

4. DIGITAL SWITCHING SYSTEM

4.1 Describe the transition from analog to digital switching in telecommunication networks.
4.2 Explain the key advantages of digital switching systems.
4.3 Explain advanced features enabled by digital switching (e.g., call waiting, conferencing).
4.4 Describe the role of digital switching in Next-Generation Networks (NGN).
4.5 Describe how digital switching enables advanced services like multimedia communication in NGN.

5. DIGITAL EXCHANGE

5.1 Describe the SPC System Architecture
5.2 Describe the Features and Services Enabled by SPC
5.3 Explain the SPC Exchange Operation **(**call setting up function, digital Exchange sub system, functions, Level of Exchanges, fundamental plans)
5.4 Explain the Control system of switching (System Structure, Centralized / Distributed Control, Parallel Synchronous / Load Sharing Working, Software)

6. MULTIPLEXING

6.1 Describe multiplexing
6.2 Explain the Types of multiplexing (FDM, TDM, WDM, SDM, CDM)

7. SWITCHING TECHNIQUES

7.1 Define switching techniques
7.2 Explain the Classification of switching technique (Circuit switching, Time Division switching, space division switching)
7.3 Explain the Advantages and disadvantages of circuit switching
7.4 Describe Packet switching (Switched virtual Circuit SVC, Permanent Virtual Circuit PVC)
7.5 Explain the Advantages and disadvantages of Packet Switching
7.3. Define the routing
7.4 Explain the Types of routing system (static routing system, Dynamic routing system)
7.5 Explain the Differentiate between switching and routing
7.6 Define the Soft switch.
7.7 Explain the Differentiate between soft switch and PABX

8 INTERNET PROTOCOL SWITCHING

8.1 Define the IP Switching
8.2 Describe the Working of IP switching
8.3 Explain advantages IP switching
8.4 Describe Limitations of IP switching
8.5 Explain Differentiate between packet switching and IP switching
8.6 Explain the Applications of IP switching
8.7 Describe label switching

9 SIGNALING

9.1 Define signaling
9.2 Define the Types of signaling
- 9.2.1. In band signaling
- 9.2.2. Out of band signaling
- 9.2.3. Common Channel signaling
- 9.2.4. Channel associated signaling
- 9.2.5. Subscriber loop signaling
- 9.2.6. Interexchange signaling
- 9.2.7. Intra exchange signaling
- 9.2.8. Customer Line Signaling
- 9.2.9. Inter – Exchanger Signaling
- 9.2.10. Line and Register Signaling.

9.3. Describe SS7 Nodes (SSP, SCP, STP)
9.4 Explain the Working of Common Channel Signaling..CCS
9.5 Explain the CCS network parts (signaling point, Destination Point Code, Originating point code)
9.6 Describe the Channel Associated Signaling. CAS

Tel-313 SWITCHING SYSTEMS

LIST OF PRACTICALS **96 HRs**

1. Identify the parts of Electro-Mechanical Telephone set.
2. Demonstration of the working of Microphone as Telephone transmitter
3. Demonstration of the working of Speaker as Telephone receiver
4. Study the working of Anti-side tone circuit.
5. Demonstration of the types of dialing system:
   a) Rotary dialing / Pulse dialing.
   b) touch tone dialing / DTMF Dialing
6. Identify the parts of digital telephone set, and draw its block diagram.
7. Demonstration of call establishment process between two telephone users via automatic telephone exchange/PABX.
8. Testing Call Setup, Ringing, and Call Termination in a PBX
9. Study the EWSD digital exchange.
10. Demonstrate the speech circuit using IC and its interface to the line.
11. Demonstrate the DTMF circuit using IC and its interface to the line.
12. Demonstrate the Pulse dialing circuit using IC and its interface to the line.
13. Demonstrate the tone generator.
14. Demonstrate the dual tone ring generator circuit using IC and its interface to the line.
15. Demonstrate the switching mechanism of incoming and outgoing call between subscriber.
16. Demonstrate the working of Time switch.
17. Demonstrate the working of the Space switch.
18. Setting Up a Basic VoIP System.
19. Demonstration of ISDN (Integrated Services Digital Network) and Its Applications
20. Demonstration Fiber Optic Communication in Telephone Networks
21. Visit a PTCL Telephone Exchange and write a report on its signaling system.

Tel-323 TELECOMMUNICATION SERVICES AND TERMINAL EQUIPMENT

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

LEARNING OUTCOMES:

1. **Explain** various telecommunication services, terminal equipment, and their applications in modern communication systems.
2. **Describe** customer relationship and complaint management systems, highlighting their role in enhancing telecom service quality.
3. **Identify** and **explain** the basic concepts of automatic identification technologies, Centrex/PABX systems, and CCTV systems along with their practical applications.

COURS CONTENTS:

1 **TELECOM SERVICES** **(16 Hours)**

- 1.1 Telecom Services
  - 1.1.1 Voice
  - 1.1.2 Data
  - 1.1.3 Video
  - 1.1.4 Text
- 1.2 Telephony Services
  - 1.2.1 Through Copper
  - 1.2.2 Through Fiber
- 1.3 Data Services
  - 1.3.1 DSL
    - 1.3.1.1 Through Copper
    - 1.3.1.2 Through Fiber
  - 1.3.2 Types of DSL
    - 1.3.2.1 ADSL
    - 1.3.2.2 HDSL
    - 1.3.2.3 VDSL
    - 1.3.2.4 SDSL
    - 1.3.2.5 SHDSL
  - 1.3.3 FTTH/Flash Fiber
  - 1.3.4 DOCSIS
  - 1.3.5 EVO
  - 1.3.6 Dongle
  - 1.3.7 Char G
- 1.4 Video Services
  - 1.4.1 IPTV
  - 1.4.2 Cable TV
- 1.5 Internet Services
  - 1.5.1 Internet Development
  - 1.5.2 Domain Name System
  - 1.5.3 Levels of Connectivity
  - 1.5.4 Facilities of Internet
  - 1.5.5 Layered Network Protocol

- 1.5.6 Group Communication
- 1.6 Point to Point Protocol over Ethernet
- 1.7 Corporate Telecom Services
  - 1.7.1 Business DSL
  - 1.7.2 VPN
  - 1.7.3 Data lease line for BTS
  - 1.7.4 ATM
  - 1.7.5 One Link Services
  - 1.7.6 Surveillance Services
- 1.8 Over the Top (OTT) Services
  - 1.8.1 Web TV
  - 1.8.2 Whats app
  - 1.8.3 Instagram
  - 1.8.4 Tik tok
  - 1.8.5 Facebook
  - 1.8.6 Live Streaming
  - 1.8.7 Voice over OP
  - 1.8.8 SIP Phone
- 1.9 Bill Payment Related Services
  - 1.9.1 Bill Payment and Recharge
  - 1.9.2 Methods of Bill Payment and Recharge
  - 1.9.3 Print/View Duplicate Bill
  - 1.9.4 Concept of Smart Shop
- 1.10 Corporate Customer Centers
- 1.11 Value Added Services
- 1.12 UAN Number Service
- 1.13 Toll Free Service 0800

2 **TELECOM TERMINAL EQUIPMENT** **(14 Hours)**

- 2.1 Telecom Terminal Equipment
- 2.2 Types of Terminal Equipment
- 2.3 Key Components of Terminal Equipment
  - 2.3.1 Microphones and Speakers
  - 2.3.2 User Interface
  - 2.3.3 Signal Transceiver
  - 2.3.4 Power management
  - 2.3.5 Display
- 2.4 Standard and Regulations for Telecom Terminals
- 2.5 Landline Telephone Terminal Equipment
  - 2.5.1 With Copper
  - 2.5.2 With Fiber
  - 2.5.3 Standard Installation Procedure
  - 2.5.4 Instructions and Safety Precautions for Installation
- 2.6 Terminal Equipment for DSL
  - 2.6.1 With Copper
  - 2.6.2 With Fiber
  - 2.6.3 Standard Installation/Configuration Procedure
  - 2.6.4 Instructions and Safety Precautions for Installation

2.7 Terminal Equipment EVO/Dongle/CharG
- 2.7.1 Standard Installation Procedure
- 2.7.2 Instructions and Safety Precautions for Installation

2.8 Data Terminal Equipment
- 2.8.1 Routers
- 2.8.2 Modems
- 2.8.3 Network Interface Cards

2.9 Mobile Phone/Smart Devices Equipment

2.10 Troubleshooting Common issues of Terminal Equipment

3 CUSTOMER RELATIONSHIP AND COMPLAINT MANAGEMENT SYSTEM (14 Hours)

3.1 Definition of Customer Relationship Management (CRM)

3.2 Importance of CRM

3.3 Role of CRM in Business

3.4 Key Components of Telecom CRM System

3.5 Telecom CRM Technologies and Tools
- 3.5.1 Software

3.6 Customer Lifecycle
- 3.6.1 Customer Acquisition
- 3.6.2 Customer Retention

3.7 Complaint Management System (CMS)

3.8 Importance of CMS

3.9 Tools and Technologies for CMS

3.10 Types of Complaints
- 3.10.1 Service Quality
- 3.10.2 Billing
- 3.10.3 Network Issues

3.11 Directory Assistance

3.12 Complaint Resolution Timeframes

3.13 Handling Customer Complaint
- 3.13.1 Methods for Complaint Registration
- 3.13.2 Best Practices for Complaint Handling

3.14 Complaint Management
- 3.14.1 Physical Visits
- 3.14.2 Robo Call

3.15 CRM and CMS Key Performance Indicator

3.16 User Friendliness in CRM

3.17 Future Trends in CRM and CMs
- 3.17.1 AI and Machine Learning
- 3.17.2 Customer Self Service Portals
- 3.17.3 Pro-active Complaint Management
- 3.17.4 Predictive Analytics

4 AUTOMATIC IDENTIFICATION TECHNOLOGY (06 Hours)

4.1 Definition, Importance and Role

4.2 Barcode Technology

4.3 RFID Technology
- 4.3.1 Working Principle
- 4.3.2 Components
  - 4.3.2.1 Tags

- 4.3.2.2 Reader
- 4.3.2.3 Antennas
- 4.3.3 Applications in various Fields
- 4.3.4 Test case: M-tag

4.4 Biometric Technology
- 4.4.1 Classification
  - 4.4.1.1 Fingerprint Recognition Technology
  - 4.4.1.2 Face Recognition Technology
- 4.4.2 Characteristics

4.5 QR Code
- 4.5.1 Structure
- 4.5.2 Functionality
- 4.5.3 Applications

5 CENTREX AND PABX (08 Hours)

5.1 Overview

5.2 Difference between CENTREX and PABX

5.3 Architecture of CENTREX and PABX
- 5.3.1 Components
- 5.3.2 Switching System
- 5.3.3 Service Features
  - 5.3.3.1 Call Routing
  - 5.3.3.2 Voice Mail
  - 5.3.3.3 Conferencing
  - 5.3.3.4 Other Services

5.4 Advanced Features of CENTREX and PABX
- 5.4.1 Call Center Integration
- 5.4.2 Interactive Voice Response
- 5.4.3 Mobility

5.5 Types of PABX
- 5.5.1 Analog PABX
- 5.5.2 Digital PABX
- 5.5.3 IP-PABX

5.6 Comparison between CENTREX and PABX
- 5.6.1 Maintenance
- 5.6.2 Flexibility and Scalability
- 5.6.3 Features

5.7 Future Trend
- 5.7.1 CENTREX and PABX in 5G Networks
- 5.7.2 Role of Artificial Intelligence
- 5.7.3 Challenges and Opportunities

6 CCTV SYSTEMS AND THEIR MANAGEMENT (06 HOURS)

6.1 Introduction to CCTV Systems

- 6.1.1 Definition and purpose of CCTV
- 6.1.2 Importance of CCTV in security and surveillance

6.1.3 Applications of CCTV in telecom, business, and public safety

6.2 Components of a CCTV System

6.2.1 Types of CCTV cameras (Analog, IP, PTZ, Dome, Bullet)

6.2.2 DVR (Digital Video Recorder) and NVR (Network Video Recorder)
6.2.3 Cables and connectors (Coaxial, Ethernet, Fiber Optic)
6.2.4 Power supply and backup solutions

RECOMMENDED REFERENCE BOOKS:

1. "Telecommunication Switching, Traffic and Networks" by J. E. Flood
2. "Customer Relationship Management: Concepts and Technologies" by Francis Buttle
3. “RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication” by Klaus Finkenzeller and Dorte Muller
4. "Telecommunication Networks: Protocols, Modeling, and Analysis" by Mischa Schwartz

Tel-323 TELECOMMUNICATION SERVICES AND TERMINAL EQUIPMENT

INSTRUCTIONAL OBJECTIVES:

1 **TELECOM SERVICES**

1.1 Explain different types of telecom services and their applications in modern communication
1.2 Compare the copper and fiber telephony
1.3 Discuss the data services
1.3.1 Discuss DSL technology and their deployment over copper and fiber
1.3.2 Discuss types of DSL technology
1.3.3 Describe fiber-to-the-home technology and its benefits. Identify various data services and their devices, emphasizing their usage scenarios
1.4 Outline video services like IPTV and Cable TV and explain their working principles
1.5 Explain internet development, DNS, and connectivity levels, focusing on layered network protocols and group communication
1.6 Describe Point-to-Point Protocol over Ethernet and its role in internet access
1.7 Discuss corporate telecom services, including business DSL, VPN, and surveillance solutions
1.8 List OTT services and explain their significance in modern communication
1.9 Explain various bill payment methods and the concept of smart shops
1.10 Describe the role of corporate customer centers in telecom services
1.11 Outline value-added services and their customer benefits
1.12 Explain UAN Number Service and its working
1.13 Explain Toll Free Service 0800 and its importance

2 **TELECOM TERMINAL EQUIPMENT**

2.1 Define Telecom Terminal Equipment
2.2 Explain different types of Terminal Equipment
2.3 Explain the functions of key components like microphones, speakers, and power management in telecom devices
2.4 Explain the standard and Regulations for Telecom Terminals and their importance
2.5 Explain the installation procedure of Landline Telephone Terminal Equipment with copper and fiber
2.6 Describe DSL terminal equipment and outline installation/configuration procedures
2.7 Demonstrate the installation and safety precautions for mobile data devices
2.8 Explain the functions of routers, modems, and network interface cards
2.9 Describe the components and operation of mobile and smart devices
2.10 Identify common issues in terminal equipment and suggest troubleshooting methods

3 **CUSTOMER RELATIONSHIP AND COMPLAINT MANAGEMENT SYSTEM (7 Hours)**

3.1 Define CRM and explain its role in business success
3.2 Explain importance of CRM
3.3 Explain the role of CRM in Business
3.4 Explain the Key Components of Telecom CRM System
3.5 Explain the Telecom CRM Technologies and Tools

3.6 Explain customer acquisition and retention strategies
3.7 Explain Complaint Management System (CMS)
3.8 Describe the Importance of CMS
3.9 Discuss the Tools and Technologies for CMS
3.10 Explain the Types of Complaints
3.11 Discuss the importance of Directory Assistance
3.12 Study the Complaint Resolution Timeframes and their importance
3.13 Study the methods for Handling Customer Complaint and best practices in it
3.14 Describe the Complaint Management through physical and robo-call
3.15 CRM and CMS Key Performance Indicator
3.16 Explain the importance of User Friendliness in CRM
3.17 Analyze the Future Trends in CRM and CMs

4 AUTOMATIC IDENTIFICATION TECHNOLOGY

4.1 Define automatic identification technology and explain its significance
4.2 Explain the basics of barcode technology and its applications
4.3 Describe RFID technology, its components, and its applications, using M-tag as a test case
4.4 Classify biometric technologies and explain fingerprint and face recognition systems
4.5 Explain the structure and functionality of QR codes and discuss their applications

5 CENTREX AND PABX

5.1 Give a brief Overview of Centrex and PABX
5.2 Compare the CENTREX and PABX
5.3 Explain the architecture and features of Centrex and PABX systems, including call routing and voicemail
5.4 Discuss advanced features like call center integration and IVR
5.5 Differentiate between analog, digital and IP-PABX
5.6 Compare Centrex and PABX in terms of maintenance, flexibility, and features
5.7 Discuss future trends, including AI integration and the role of Centrex and PABX in 5G networks

6 CCTV SYSTEMS AND THEIR MANAGEMENT

1. Introduction to CCTV Systems
1.1 Definition and purpose of CCTV
1.2 Importance of CCTV in security and surveillance
1.3 Applications of CCTV in telecom, business, and public safety

2. Components of a CCTV System
2.1 Types of CCTV cameras (Analog, IP, PTZ, Dome, Bullet)
2.2 DVR (Digital Video Recorder) and NVR (Network Video Recorder)
2.3 Cables and connectors (Coaxial, Ethernet, Fiber Optic)
2.4 Power supply and backup solutions

Tel-323 TELECOMMUNICATION SERVICES AND TERMINAL EQUIPMENT

LIST OF PRACTICAL **96 HRs**

1. Visit a PTCL Customer Service Centre or cellular mobile operator office and write a report on the following facilities.
    a) Bill Payment and Recharge
    b) Bill Payment Options
    c) Print and view duplicate bill
    d) Smart Shop
    e) Sales Outlets
    f) Corporate Customer Centers
    g) Service Changes
    h) International / Domestic Tariff
    i) Taxes and Charges
2. Visit to complaint management system of any telecom service provider and observe following services and write a report regarding visit,
    a) Complain registration method
    b) Tools for handling customer complaints
    c) Support customer accounts
    d) Handling customer returns
    e) Maintaining a database of customer information
3. Demonstrate the Installation of a Telephone Connection with copper and Fiber.
4. Demonstrate the Installation of a DSL Connection with copper.
5. Demonstrate the Installation of a DSL/ IPTV Connection with Fiber.
6. Demonstrate how a complaint is registered for telecom service interruption. (Telephone & DSL Connection).
7. Demonstrate the process of bill payment is its management
8. Demonstrate working of Robo Call complaint management system works
9. Demonstrate the facilities available on modern telephone set.
10. Demonstrate the facilities available on modern Mobile Phone.
11. Demonstrate the normal facilities provided by PTCL and cellular mobile operator telephone users.
12. Demonstrate the working of data terminal equipment, i.e., routers, modems, network cards
13. Demonstrate the operation of QR Code scanner.
14. Demonstrate the operation of Bar Code scanner.
15. Demonstrate the operation of Biometric machine.
16. Demonstrate the operation of fingerprint recognition technology.
17. Demonstrate the working of RFID system and its components (transmitter, tag, receiver, communication technology etc.)
18. Perform PABX planning, installation, and maintenance.
19. Install and configure a CCTV camera (Analog/IP) with DVR/NVR.
20. Conduct a site survey for optimal camera placement. Adjust camera angles for maximum coverage and performance.

21. Set up a DVR/NVR for recording video footage. Configure remote access and mobile viewing.
22. Identify and fix problems like blurry footage, camera not recording, or network connectivity issues.
23. Design a small-scale CCTV network and integrate it into an existing telecom network.

Tel-333 TRANSMISSION SYSTEM

T	P	C
2	3	3

Total Contact Hrs:160

Theory: 64 Hours

Practical: 96 Hours

LEARNING OUTCOMES:

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

- To understand the different types of transmission lines, and their electrical parameters.
- To analyze and compare various communication technologies, including optical fiber networks, SDH, antennas, and microwave communication, and their real-world applications.
- To demonstrate knowledge of satellite communication, different satellite orbits, VSAT, and their role in global connectivity.

COURSE CONTENTS

1 INTRODUCTION TO COMMUNICATION SYSTEM (4 Hours)

Basic elements of communication system

1.1 Types of communication systems (Definitions)

1.1.1 Wired communication system

1.1.2 Wireless communication system

1.1.3 Analog communication system

1.1.4 Digital Communication system

1.1.5 Baseband communication system

1.1.6 Carrier communication system

1.3 Transmission Modes

1.3.1 Simplex

1.3.2 Half Duplex

1.3.3 Full Duplex

2 FUNDAMENTALS OF TRANSMISSION LINE (5 Hours)

2.1 Introduction to transmission line

2.2 Electrical Parameters of a transmission line

2.2.1 Line Resistance (R)

2.2.2 Line inductance (L)

2.2.3 Shunt capacitance (C)

2.2.4 Shunt Conductance (G)

2.3 Transmission Line Equations

2.3.1 Propagation Constant

2.3.2 Current

2.3.3 Voltage

2.3.4 Characteristic Impedance

2.3.5 Reflection Co-efficient

2.3.6 SWR/VSWR

2.4 Efficiency of transmission line

2.5 Impedance Matching

2.5.1 Losses due to Impedance Mismatch

2.5.2 Attenuation loss

2.5.3 Reflection loss

2.5.4 Transmission loss

2.5.5 Return loss

2.5.6 Insertion loss

3 TYPES OF TRANSMISSION LINE (6 Hours)

3.1 Types of Transmission Line (Definition level)

3.1.1 Parallel Wire line

3.1.2 Coaxial line

3.1.3 Micro Strip line

3.1.4 Wave guide

3.1.5 Optical fiber

3.2 Balanced Two-wire transmission line

3.2.1 Structure

3.2.2 Characteristics

3.2.3 Applications

3.2.4 Merits and Demerits

3.3 Coaxial transmission line

3.3.1 Structure

3.3.2 Characteristics

3.3.3 Applications

3.3.4 Merits and Demerits

3.4 Micro Strip line

3.4.1 Structure

3.4.2 Characteristics

3.4.3 Applications

3.4.4 Merits and Demerits

3.5 Waveguide

3.5.1 Structure

3.5.2 Applications

3.5.3 Merits and Demerits

4 INTRODUCTION TO FIBER OPTICS (6 Hours)

4.1 Introduction to optical fiber communication

4.2 Structure of optical fiber

4.3 Basic terms related to light propagation in optics

4.3.1 Refractive Index

4.3.2 Incident ray

4.3.3 Incident angle
4.3.4 Refraction
4.3.5 Internal Reflection
4.3.6 Critical angle
4.3.7 Total internal reflection
4.4 Working principle of optical fiber
4.5 Propagation of light in optical fiber
4.6 Types of optical fiber
4.7 Modes of optical fiber
4.8 Optical fiber Communication System
4.8.1 Block diagram of optical fiber communication system
4.8.2 Components of optical fiber communication system
4.9 Optical Sources
4.9.1 LED
4.9.2 LASER
4.10 Optical Detector
4.11 WDM vs DWDM

5 SYNCHRONOUS DIGITAL HIERARCHY (SDH) (5 Hours)

5.1 Introduction to PDH
5.2 PDH deficiencies
5.3 Introduction to SDH
5.4 Frame structure of SDH
5.5 Synchronous Transport Module (STM)
5.6 Interconnection of STM
5.7 SDH network elements
5.8 SDH network topologies
5.9 SONET vs SDH vs DWDM (Features in table form)

6 OPTICAL FIBER NETWORKS (10 Hours)

6.1 Introduction to FTTH
6.2 Types of optical network
i Active optical Network (AON)
ii. Passive optical network (PON)
6.3 Passive optical network (PON)
6.4 Components of PON/Architecture of PON
i. Optical line terminal (OLT)
ii. Optical network unit (ONU)
iii. Optical Splitter
iv. Optical distribution frame (ODF)
v. Optical fiber cable
6.5 Types of PON
i. Asynchronous transfer (APON)
ii. Broadband PON (BPON)

iii. Ethernet PON (EPON)

iv. Gigabit PON (GPON)

7 ANTENNAS (10 Hours)

7.1 Introduction to antenna

7.2 Working principal of antennas

7.3 How do antennas work?

7.4 Fundamentals of an antenna

- 7.4.1 Radiation pattern
- 7.4.2 Antenna Gain
- 7.4.3 Directivity
- 7.4.4 Bandwidth
- 7.4.5 Polarization
- 7.4.6 Antenna Efficiency
- 7.4.7 Aperture Efficiency
- 7.4.8 Radiation Intensity
- 7.4.9 Major lobe & Minor lobe
- 7.4.10 Radiation Field

7.5 Types of antennas (Construction and uses)

- 7.5.1 Yagi antenna
- 7.5.2 Horn antenna
- 7.5.3 Dipole and folded dipole antenna
- 7.5.4 Parabolic antenna

7.6 Antenna Array

8 MICROWAVE COMMUNICATION (8 Hours)

8.1 Introduction to microwave communication

8.2 Different bands of microwave (C, X, KU and KA bands)

8.3 Block diagram of microwave communication

8.4 Antennas for Microwave transmission

- 8.4.1 Parabolic Dish Antennas
- 8.4.2 Horn Antennas

8.5 Receivers and Demodulators

8.6 Low-Noise Amplifiers (LNAs)

8.7 Mixers and Detectors

8.8 Application of microwave communication

8.9 Merits and Demerits

9 SATELLITE COMMUNICATION (10 Hours)

9.1 Introduction to satellite communication

- 9.1.1 Frequency bands
- 9.1.2 Communication satellite
- 9.1.3 Footprint of a satellite
- 9.1.4 Satellite earth station
- 9.1.5 Uplink

- 9.1.6 Downlink
- 9.2 Satellite Orbits
  - 9.2.1 Low Earth orbit (LEO)
  - 9.2.2 Medium Earth orbit (MEO)
  - 9.2.3 Geostationary orbit (GEO)
  - 9.2.4 Sun-synchronous orbit (SSO)
  - 9.2.5 Geostationary Transfer orbit (GTO)
  - 9.2.6 High Elliptical Earth orbit (HEO)
- 9.3 Types of satellites w.r.t functions: (Definition level)
  - 9.3.1 Communication Satellites (e.g. Star links)
  - 9.3.2 Earth Observation Satellites
  - 9.3.3 Navigation Satellites
  - 9.3.4 Astronomical Satellites
- 9.4 Block diagram and working of a typical communication satellite
- 9.5 Block diagram and working of a typical Satellite Earth Station
- 9.6 Types of small satellites w.r.t mass and size
  - 9.6.1 Minisats
  - 9.6.2 Microsats
  - 9.6.3 Nanosats
  - 9.6.4 Picosats
  - 9.6.5 Femtosats
- 9.7 Types of Satellite Earth Stations
- 9.8 Satellite to satellite communication
- 9.9 Satellite constellation
  - 9.9.1 Navigational satellite constellations
  - 9.9.2 Communications satellite constellations
- 9.10 Introduction to VSAT
- 9.11 Applications, advantages and disadvantages of satellite communication.

RECOMMENDED BOOKS:

1. Principles of Communication Systems" by Herbert Taub, Donald L. Schilling, and Goutam Saha. Latest Edition, Publisher: McGraw-Hill Education.

2. Optical Fiber Communications by Gerd Keiser. Latest Edition, Publisher: McGraw-Hill Education

Tel-333 TRANSMISSION SYSTEM

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO COMMUNICATION SYSTEM

1.1 What are the basic elements of a communication system?
1.2 Define each type of communication system
- 1.2.1 Wired communication system
- 1.2.2 Wireless communication system
- 1.2.3 Analog communication system
- 1. 2.4 Digital Communication system
- 1.2.5 Baseband communication system
- 1.2.6 Carrier communication system

1.3 What are the transmission modes, including simplex, half-duplex, and full-duplex, and how do they differ?

2. FUNDAMENTALS OF TRANSMISSION LINE

2.1 What is the role of a transmission line in the transfer of electrical signals, and why is it important?
2.2 Define the following parameters of transmission lines
- 2.2.3 Electrical parameters
  1. Line Resistance (R)
  2. Line inductance (L)
  3. Shunt capacitance (C)
  4. Shunt Conductance (G)

2.3 What are the transmission line equations, and how do the propagation constant, current, and voltage relate to signal transmission?
- 2.3.1 Define Characteristics Impedence (Zo) for
  1. **Z0** for Parallel wire line
  2. **Z0** for Coaxial line
- 2.3.2 What is the reflection coefficient?
- 2.3.3 What are SWR (Standing Wave Ratio) and VSWR (Voltage Standing Wave Ratio),how do they differ?
- 2.3.4 What is return loss, and how does it indicate the efficiency of signal reflection in a transmission line?

2.4 Define impedance matching, and how does stub matching help minimize signal reflection in transmission lines?
- 2.4.1 Define each loss due to impedance mismatching
  1. Attenuation loss
  2. Reflection loss
  3. Transmission loss
  4. Return loss
  5. Insertion loss

3 TYPES OF TRANSMISSION LINE

3.1 Define each transmission line
1. Parallel Wire line

2. Coaxial line
3. Micro Strip line
4. Wave guide
5. Optical fiber

3.2 What is a balanced two-wire transmission line, and what are its structure, characteristics, applications, merits, and demerits?

3.3 How is a coaxial transmission line structured, and what are its characteristics, applications, merits, and demerits?

3.4 What are the structural elements, characteristics, uses, and benefits and limitations of a microstrip line?

3.5 What is a waveguide, and what are its structure, characteristics, applications, merits, and demerits?

3.6 Define each type of waveguide

1. Rectangular waveguide
2. Circular Waveguide
3. Elliptical waveguide
4. Single-ridged waveguide
5. Double-ridged waveguide

4 INTRODUCTIONS TO FIBER OPTICS

4.1 What is optical fiber communication, and why is it a revolutionary technology in modern communication systems?

4.2 How is an optical fiber structured?

4.3 Define the basic terms related to light propagation in optics

1. Refractive Index
2. Incident ray
3. Incident angle
4. Refraction
5. Internal Reflection
6. Critical angle
7. Total internal reflection

4.4 State the working principle of optical fiber

4.5 How does light propagate through an optical fiber, and what factors influence its transmission?

4.6 Identify the types of optical fiber

4.7 What are the different modes of optical fiber?

4.8 What is an Optical Fiber Communication system (OFC).

4.9 Draw the block diagram of Optical Fiber Communication system (OFC).

4.10 Explain each component of optical fiber communication system (OFC)

4.11 Define Optical Sources

4.12 What is an LED, and how does it function in optical fiber communication systems?

4.13 What is a LASER, and what role does it play in enhancing optical fiber communication systems?

4.14 What are optical detectors, and how do they work in the context of OFC?

4.15 Compare between WDM (Wavelength Division Multiplexing) and DWDM (Dense Wavelength Division Multiplexing).

5 SYNCHRONOUS DIGITAL HIERARCHY (SDH)

5.1 Define PDH

5.2 What were the deficiencies in PDH that impact telecom network performance and reliability?

5.3 How does SDH improve network performance compared to PDH in telecom systems?

5.4 Introduce the key features of SDH
5.5 What are the standard bit rates used in SDH?
5.6 Explain the frame structure of SDH and the organization of its data.
5.7 Describe the Synchronous Transport Module (STM) and its role in SDH.
5.8 How is the interconnection of Synchronous Transport Modules (STM) achieved in SDH networks?
5.9 List and define the key network elements used in an SDH system.
5.10 How do SDH-based networks operate and what are their key components?
5.11 What are the different SDH network topologies?
5.12 What are the key differences in features, data rates, and applications between SONET, SDH, and DWDM?

6 OPTICAL FIBER NETWORKS

6.1 What is FTTH (Fiber to the Home) and how does it provide high-speed internet connectivity?
6.2 Define following optical network types
1. Active optical Network (AON)
2. Passive optical network (PON)

6.3 How does a Passive Optical Network (PON) function, and what advantages does it offer for broadband communication?
6.4 Define the following components of PON
- 6.4.1 Optical line terminal (OLT)
- 6.4.2 Optical network unit (ONU)
- 6.4.3 Optical Splitter
- 6.4.4 Optical distribution frame (ODF)
- 6.4.5 Optical fiber cable

6.5 Describe the following types of PON
1. Asynchronous transfer (APON)
2. Broadband PON (BPON)
3. Ethernet PON (EPON)
4. Gigabit PON (GPON)

7 ANTENNAS

7.1 What is an antenna?
7.2 What is the working principle of antennas.
7.3 How do antennas convert electrical signals into electromagnetic waves for transmission and vice versa for reception?
7.4 Define the following fundamentals of an antenna
- 7.4.1 Radiation pattern
- 7.4.2 Antenna Gain
- 7.4.3 Directivity
- 7.4.4 Bandwidth
- 7.4.5 Polarization
- 7.4.6 Antenna Efficiency
- 7.4.7 Aperture Efficiency
- 7.4.8 Radiation Intensity
- 7.4.9 Major lobe & Minor lobe
- 7.4.10 Radiation Field

7.5 Differentiate these antennas in terms of construction and uses:
- 7.5.1 Yagi antenna

7.5.2 Horn antenna
7.5.3 Dipole and folded dipole antenna
7.5.4 half wave and quarter wave dipole antenna
7.5.5 Micro Strip patch antenna
7.5.6 Parabolic antenna

7.6 What is an antenna array?

8 MICROWAVE COMMUNICATION

8.1 What is microwave communication?
8.2 What are the different microwave bands (C, X, Ku, and Ka bands), and how do they vary in terms of frequency range and applications?
8.3 Explain the block diagram of microwave communication
8.5 Define following antennas for microwave transmission
8.6.1 Parabolic Dish Antennas
8.6.2 Horn Antennas
8.6 What are the roles of receivers and demodulators in microwave communication systems?
8.7 What are Low-Noise Amplifiers (LNAs), and how do they work?
8.8 How do mixers and detectors work in microwave communication systems.
8.9 What are the main applications of microwave communication?
8.10 What are the advantages and disadvantages of microwave communication in terms of performance, cost, and limitations?

9 SATELLITE COMMUNICATION

9.1 Define the following term
1. Frequency bands
2. Communication satellite
3. Footprint of a satellite
4. Satellite earth station
5. Uplink
6. Downlink
7. Footprint of a satellite

9.2 Sate following satellite orbits
1. Low Earth orbit (LEO)
2. Medium Earth orbit (MEO)
3. Geostationary orbit (GEO)
4. Sun-synchronous orbit (SSO)
5. Geostationary Transfer orbit (GTO)
6. High Elliptical Earth orbit (HEO)

9.3 Define these Types of satellites w.r.t functions.
1. Communication Satellites
2. Earth Observation Satellites
3. Navigation Satellites
4. Astronomical Satellites

9.4 Explain the block diagram and working of a typical communication satellite.
9.5 Explain the block diagram and working of a Satellite Earth Station.
9.6 List types of small satellites w.r.t mass and size

1. Minisats
2. Microsats
3. Nanosats
4. Picosats
5. Femtosats

9.7 What are the different types of satellite earth stations, and how do they differ?

9.8 How does satellite-to-satellite communication work?

9.9 Define following satellite constellation

1. Navigational satellite constellations
2. Communications satellite constellations

9.10 Give a brief introduction to VSAT (Very Small Aperture Terminal).

9.11 What are the applications, advantages, and disadvantages of satellite communication in modern technology?

Tel-333 TRANSMISSION SYSTEM

LIST OF PRACTICALS **96 HRs**

1. To identify the modes of communication used in our daily life communication systems.
2. Demonstration of baseband & carrier communication.
3. To identify the types of transmission lines used in our daily life communication systems.
4. a). To identify the types of two-wire lines.

b). To identify the types of coaxial lines.

5. To identify the types of waveguides.
6. To identify the types of optical fiber cable.
7. To measure the input impedance of a parallel wire line.
8. To measure the characteristics impedance of a parallel wire line.
9. To measure reflection coefficient and attenuation coefficient.
10. To study the characteristics of stationary wave.
11. To identify different types of antennas.
12. Plot the polar directivity pattern for folded dipole antenna
13. To measurement the current from Yagi antenna.
14. To measure gain, directivity and radiation intensity of Yagi antenna.
15. Study and establish satellite communication link.
16. To familiarize students with microwave components and equipment.
17. Measure frequency and wavelength using waveguide.
18. To study the construction and working of parabolic antenna/dish antenna.
19. Establish the microwave communication link.
20. To familiarize students with the components, tools and equipment used for the installation of optical fiber connection.
21. Perform splicing of optical fiber.
22. Measure the attenuation of fiber optic fiber cable.
23. Verify your current location by using any GPS enabled device.
24. Draw the block diagram of a typical satellite communication system and write the function of its each block.
25. Visit to a satellite earth station and write report.

Tel -343 MOBILE COMMUNICATION

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

LEARNING OUTCOMES:

1. **Explain** the fundamentals, types, and applications of wireless communication, including cellular and satellite systems.
2. **Describe** GSM and LTE architectures, their components, services, and communication procedures.
3. **Identify** key components of mobile phones, their functions, repairing and advancements in mobile communication technologies.

COURSE CONTENTS:

1. WIRELESS COMMUNICATION FUNDAMENTALS (08 hours)

1.1 Introduction

- 1.1.1 Features of Wireless Communication
- 1.1.2 Advantages & Disadvantages
- 1.1.3 Applications and Uses

1.2 Wireless Propagation

- 1.2.1 Modes of Wireless Propagation
  - 1.2.1.1 Ground-wave propagation
  - 1.2.1.2 Sky-wave propagation
  - 1.2.1.3 Line-of-sight propagation
- 1.2.2 Basic Propagation Mechanisms
  - 1.2.2.1 Reflection
  - 1.2.2.2 Diffraction
  - 1.2.2.3 Scattering

1.3 Fading in wireless communication

- 1.3.1 Large Scale Fading
  - 1.3.1.1 Path Loss
  - 1.3.1.2 Shadowing
- 1.3.2 Small Scale Fading
  - 1.3.2.1 Multipath Delay Spread
  - 1.3.2.2 Doppler Spread

1.4 Frequency Bands and their Applications

2. TYPES OF WIRELESS COMMUNICATION (08 hours)

2.1 Types of Wireless Communication

2.2 Radio Communication

2.3 Radio Paging

2.4 Microwave Communication

2.5 Cellular Mobile Communication

2.6 Satellite Communication

2.7 Global Positioning System (GPS)

2.8 Wi-Fi Communication

2.9 Bluetooth Communication

2.10 Zigbee

2.11 Infrared Communication

2.12 Radio Frequency Identification (RFID)

2.13 Private mobile radio / Trunked radio system

2.14 Digital Enhanced Cordless Telephone (DECT) System

3. CELLULAR TELEPHONE SYSTEM (12 hours)

3.1 Introduction

3.2 Cellular Concepts /Terms

3.2.1 Cell

3.2.2 Cell Structure

3.2.3 Cellular System

3.2.4 Cell Site

3.2.5 Adjacent Cells

3.2.6 Co-Channel Cells

3.2.7 Cluster

3.2.8 Cluster Size

3.2.9 Frequency Reuse

3.2.10 Frequency Reuse Factor

3.2.11 Minimum Reuse Distance

3.2.12 Mobile Station

3.2.13 Base Station

3.2.14 Base Transceiver Station/BS/Cell Cite

3.2.15 Cell Splitting

3.2.16 Sectoring

3.2.17 Traffic Channel (Forward & Reverse)

3.2.18 Control Channel (FCC & RCC)

3.2.19 Frequency Hoping

3.3 Channel Assignment Strategies

3.3.1 FCA (Fixed Channel Assignment)

3.3.2 DCA (Dynamic Channel Assignment)

3.3.3 HCA (Hybrid Channel Assignment)

3.4 Generations of GSM

3.4.1 1G Cellular Systems

3.4.1.1 Salient features of Analog / 1G Cellular Systems

3.4.1.2 AMPS (Advance Mobile Phone system)

3.4.1.3 TACS (Total access communication system)

3.4.1.4 NMT (Nordic mobile Telephone)

3.4.2 2G Cellular Systems

3.4.2.1 Salient features of Second Generation (2G) Systems

3.4.2.2 D-AMPS (Digital-AMPS)

3.4.2.3 GSM (Global System for Mobile Communications)

3.4.2.4 IS-95 (cdmaOne)

3.4.3 3G Cellular Systems

3.4.3.1 UMTS (Features and Architecture)

3.4.3.2 CDMA2000 (Features)

3.4.4 Fourth Generation (4G) System

3.4.4.1 LTE (Features and Architecture)

3.4.5 Fifth Generation (5G) System

3.4.5.1 NR (Features and Architecture)

3.4.5.2 Key features

3.4.5.3 Applications

3.4.5.4 Challenges and Limitations

3.4.6 Sixth Generation (6G) System

3.4.6.1 Introduction

3.4.6.2 Key features

3.4.6.3 Applications

3.4.6.4 Challenges and Limitations

3.4.6.5 6G comparison to 5G

4. GLOBAL SYSTEM FOR MOBILE COMMUNICATION (12 hours)

- 4.1 Introduction
- 4.2 GSM Architecture
  - 4.2.1 Block Diagram
  - 4.2.2 MS (Mobile Station)
    - 4.2.2.1 ME (Mobile Equipment)
    - 4.2.2.2 SIM (Subscriber Identity Module)
    - 4.2.2.3 eSIM
  - 4.2.3 BSS (Base Station sub-system)
    - 4.2.3.1 BSC (Base Station Controller)
    - 4.2.3.2 BTS (Base Transceiver Station)
  - 4.2.4 NSS (Network & Switching sub-systems)
    - 4.2.4.1 MSC (Mobile Switching Centre)
    - 4.2.4.2 HLR (Home Location Register)
    - 4.2.4.3 VLR (Visitor Location Register)
    - 4.2.4.4 EIR (Equipment Identity Register)
    - 4.2.4.5 AμC / AC (Authentication Centre)
  - 4.2.5 OSS (Operation & Support sub-system)
- 4.3 GSM Air Interface
- 4.4 GSM Channels
  - 4.4.1 Physical Channel
  - 4.4.2 Logical Channel
    - 4.4.2.1 Types of Traffic Channels (TCH)
      - 4.4.2.1.1 Full Rate Speech Channel (TCH/FS)
      - 4.4.2.1.2 Half Rate Speech Channel (TCH/HS)
      - 4.4.2.1.3 Full Rate Data Channel
      - 4.4.2.1.4 Half Rate Data Channel
  - 4.4.3 Control Channels (CCH)
    - 4.4.3.1 Broadcast control channel (BCCH)
    - 4.4.3.2 Common control channel (CCCH)
    - 4.4.3.3 Dedicated control channel (DCCH)
- 4.5 GSM Handover
  - 4.5.1 Intra BTS / Intra Cell handover
  - 4.5.2 Intra-BSC / Inter Cell handover

4.5.3 Inter-BSC / Intra MSC handover

4.5.4 Inter-MSC handover

4.6 GSM Services

4.6.1 Telephony services / Teleservices

4.6.2 Data services / Bearer services

4.6.3 Supplementary services

4.7 GSM Call Routing

5. LONG TERM EVOLUTION (LTE) (10 hours)

5.1 Introduction

5.2 Key features and benefits

5.2.1 Importance

5.3 Architecture overview

5.3.1 Core network (EPC) and Radio Access Network (eNodeB)

5.3.2 User Equipment (UE) component

5.4 Air Interface

5.4.1 OFDMA and SC-FDMA modulation.

5.4.2 Frame structure essential

5.5 Mobility and Handover

5.5.1 Management principles

5.5.2 Handover Procedure overview

5.6 LTE Advanced

5.6.1 Multi antenna techniques

5.7 Application and services

5.7.1 Impact on mobile broadband and IoT

6. MOBILE SATELLITE COMMUNICATIONS (10 hours)

6.1 Introduction

6.1.1 Block Diagram of Satellite Communication System

6.2 Satellite Earth Orbits

6.2.1 Low earth orbits (LEO).

6.2.2 Medium earth orbit (MEO).

6.2.3 Geostationary earth orbit (GEO).

6.2.4 High elliptical earth orbit (HEO).

6.3 Global Positioning System (GPS)

6.4 Aeronautical Communication

6.4.1 Aeronautical Communication Systems

6.4.1.1 Air Traffic Control System

6.4.1.2 Air Control Communication System

6.4.1.3 Aircraft Telephone

6.4.1.4 Radio Navigation System

6.4.1.5 Aircraft Landing System

6.4.1.6 Aircraft-loaded Radio Equipment (Navigation Equipment, Communication Equipment)

6.4.2 Aircraft Communication Types

6.4.2.1 Communication

6.4.2.2 Navigations

6.4.2.3 Surveillance

6.5 Global Maritime Distress & Safety System (GMDSS).

6.5.1 Features/Functions of GMDSS

6.5.2 Components of GMDSS

6.5.3 GMDSS Sea Areas

6.6 Merits and Demerits of Satellite Communication

7 Fundamentals of Mobile Phone (4 hours)

7.1 Introduction to Mobile Phones

7.1.1 Evolution of mobile phones
7.1.2 Types of mobile phones (Feature phones, Smartphones)
7.1.3 Basic components of a mobile phone

7.2 Mobile Phone Hardware

7.2.1 Mobile phone internal parts (PCB, ICs, Display, Battery.)
7.2.2 Function of major components (CPU, RAM, ROM, Power IC)

7.3 Mobile Phone Software

7.3.1 Mobile operating systems (Android, iOS)

RECOMMENDED REFERENCE BOOKS:

1. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport
2. "Mobile Communications" by Jochen Schiller Latest edition
3. "Satellite Communications" by Dennis Roddy Latest edition

Tel -343 MOBILE COMMUNICATION

INSTRUCTION OBJECTIVES:

1. WIRELESS COMMUNICATION FUNDAMENTALS

1.1 Introduce the fundamentals of wireless communication, features, advantages and disadvantages along with its applications

1.2 Explain Wireless Propagation, its modes and mechanism

1.5 Describe fading in wireless communication and its types

1.4 Discuss the Frequency Bands and their Applications

2. TYPES OF WIRELESS COMMUNICATION

2.1 Describe various types of Wireless Communication

2.2 Explain radio Communication and its applications

2.3 Introduce the concept of radio Paging

2.4 Explain microwave Communication and its applications in wireless communication along with antenna considerations

2.5 Briefly explain the cellular Mobile Communication

2.6 What is satellite Communication and what are its application, which frequency bands are used for it

2.7 Introduce Global Positioning System (GPS), how a precise location is determined

2.8 Explain the Wi-Fi Communication, its applications and basic installation

2.9 Explain Bluetooth Communication and various parameter for its protocol

2.10 Explain the Zigbee protocol

2.11 Discuss various applications of Infrared Communication

2.12 Explain Radio Frequency Identification (RFID), its components and block diagram

2.13 Explain Private mobile radio / Trunked radio system

2.14 Describe the Digital Enhanced Cordless Telephone (DECT) System

3. CELLULAR TELEPHONE SYSTEM

3.1 Introduce the basic structure of cellular communication with the help of block diagram

3.2 Explain the Cellular Concepts /Terms in detail related to cell, frequency, channel, BTS etc

3.3 Explain various Channel Assignment Strategies and compare them

3.4 Provide a detailed comparison of different generations of GSM, their applications, protocols, requirements, and need

4. GLOBAL SYSTEM FOR MOBILE COMMUNICATION

4.1 Introduce the GSM system in global context

4.2 Explain GSM Architecture through a block diagram and explain each block in detail

4.3 Explain MS (Mobile Station) i..e, mobile equipment, SIM and eSIM

4.4 Explain the BSS (Base Station sub-system)

4.5 Explain the NSS (Network & Switching sub-systems),its sub systems/modules and their function

4.6 Explain the OSS (Operation & Support sub-system) of GSM

4.7 Explain the GSM Air Interface

4.8 Describe GSM physical, logical and control Channels

4.9 Discuss the inter/intra GSM Handovers

4.10 Explain the services of GSM

4.11 Explain the complete procedure of a GSM Call Routing

5. LONG TERM EVOLUTION (LTE)

5.1 Introduce the LTE

5.2 Explain Key features and benefits of LTE

5.4 Explain the Architecture of LTE

5.8 Describe the Air Interface

5.9 Describe the concept of mobility and Handover in LTE

5.10 Give detailed comparison between LTE and LTE Advanced

5.11 Describe Application and services of LTE

6. MOBILE SATELLITE COMMUNICATIONS

6.1 Introduce the concept by using the block diagram

6.2 Explain various Satellite Earth Orbits

6.3 Describe the Global Positioning System (GPS)

6.4 Explain Aeronautical Communication its air traffic control, communication navigation and landing system

6.2.1 Explain types of Aircraft Communication

6.5 Explain Global Maritime Distress & Safety System (GMDSS), its features, components and applications

6.6 Discuss the Merits and Demerits of Satellite Communication

7 **FUNDAMENTALS OF MOBILE PHONES**

7.1 Explain the evolution of mobile phones and their technological advancements.

7.2 Differentiate between feature phones and smartphones based on functionality and design.

7.3 Identify and describe the basic components of a mobile phone and their purposes.

7.4 Recognize the internal parts of a mobile phone, including PCB, ICs, display, and battery.

7.5 Explain the functionality of major mobile phone components, such as CPU, RAM, ROM, and Power IC.

7.6 Describe different mobile operating systems (Android, iOS) and their key features.

Tel -343 MOBILE COMMUNICATION

LIST OF PRACTICAL: 96 HRs

1 Identification and Study of Frequency Bands and Their Applications
2 Setup and testing of Wi-Fi Communication Network
3 Demonstration of Bluetooth Communication for Data Transfer
4 Infrared Communication using IR Transmitters and Receivers
5 Hands-on Experience with GPS and Cellular Network-Based Location Tracking
6 Comparison of 1G, 2G, 3G, 4G, and 5G Technologies using Network Simulators
7 Demonstration of Call Handover Mechanism in a Cellular Network
8 Real-Time Simulation of GSM Call Setup and Call Flow
9 Study of GSM Signal Strength Measurement and Network Optimization
10 Hands-on Demonstration of Mobile Station (MS) Components – ME, SIM, eSIM
11 Testing Voice over LTE (VoLTE) Call Establishment and Quality
12 Simulation of LTE Handover Procedures and Mobility Management
13 Observation of LTE Call Setup and Data Transmission
14 Demonstration of Aeronautical Communication Systems (ATC, Radio Navigation, Aircraft Telephone)
15 Understanding and Using Mobile Repair Tools
16 Measuring Voltage, Resistance, and Current in Mobile Circuits
17 Soldering and Desoldering Techniques for Mobile PCB Components
18 Identifying and Testing Various Mobile PCB Components
19 Repairing and Replacing Damaged Charging Ports
20 Troubleshooting and Replacing Faulty Mobile Batteries
21 Diagnosing and Fixing Microphone and Speaker Issues
22 Flashing and Updating Mobile Phone Firmware
23 Diagnosing and Repairing Network Signal Problems
24 Testing and Fixing Issues with Mobile Vibration Motors
25 Repairing Water-Damaged Mobile Phones
26 Assembling and Disassembling Mobile Phones

Tel-353 EMERGING TECHNOLOGIES

T	P	C
2	3	3

Total Contact Hrs: 160
Theory : 64 Hours
Practical : 96 Hours

LEARNING OUTCOMES:

By the end of this course, students will be able to:

- Explain fundamental telecom technologies, including data communication, network topologies, transmission methods, and fiber-optic networks (FTTH, PON, OTN).
- Assess the role of cloud computing, IoT, AI, and machine learning in enhancing telecom services.
- Identify and mitigate cyber threats, including network attacks, phishing, malware, and DDoS in telecom networks.

COURSE CONTENTS

1. CORE TELECOM TECHNOLOGIES (4 HOURS)

1.1 Introduction to emerging technologies:
1.2 Data communication
1.3 Fiber to the Home (FTTH)
1.4 Cloud Computing
1.5 Internet of Things (IoT)
1.6 Cyber Security
1.7 Artificial Intelligence (AI)
1.8 Machine learning (ML)

2. DATA COMMUNICATION (8 HOURS)

2.1 Basic component of data communication
- 2.1.1 DTE/DCE
- 2.1.2 Media
- 2.1.3 Network
- 2.1.4 Link
- 2.1.5 Interface
- 2.1.6 Network terminating unit

2.2 Transmission modes
- 2.2.1 Simplex
- 2.2.2 Half duplex

2.2.3 Full duplex

2.3 Transmission methods

2.3.1 Serial

2.3.2 Parallel

2.4 Transmission techniques

2.4.1 Asynchronous

2.4.2 Synchronous

2.5 Evolution of computer network

2.6 Types of networks

2.6.1 LAN

2.6.2 MAN

2.6.3 WAN

2.7 LAN Topologies

2.7.1 Bus

2.7.2 Star

2.7.3 Ring

2.7.4 Tree

2.8 Ethernet

2.9 CSMA/ CSMA-CD

3. FIBER TO THE HOME (10 HOURS)

3.1 Introduction to FTTH

3.1.1 ODN Design

3.2. Types of optical network

3.2.1. Active optical Network (AON)

3.2.2. Passive optical network (PON)

3.3. Working of Passive optical network (PON)

3.4. Components of PON

3.4.1. Optical line terminal (OLT)

3.4.2. Optical network unit (ONU)

3.4.3. Optical Splitter

3.4.4. Distribution frame

3.4.5. Optical fiber cable

3.5. Types of PON

3.5.1. Asynchronous transfer PON

3.5.2. Broadband PON (BPON)

3.5.3. Ethernet PON (EPON)

3.5.4. Gigabit PON (GPON)

3.6. Multi-Service Access Gateway (MSAG)

3.7. EPON Architecture

3.8. GPON Architecture

3.9. ODN Diagram

3.10. Optical Add Drop multiplexer (OADM)

3.11. Types of OADM

3.11.1. ROADM

3.11.2. FOADM

3.12. Introduction to optical transport network (OTN)
3.13. Introduction to Optical line protection (OLP)
3.14. Introduction to Muxponder

4. CLOUD COMPUTING (6 HOURS)

4.1 Introduction to Cloud Computing.
4.2 Cloud Service Models
    4.2.1 IaaS
    4.2.2 PaaS
    4.2.3 SaaS
4.3 Cloud Deployment models
4.4 NFV and Cloud
4.5 Cloud security
4.6 Examples of cloud-based services in telecom

5. INTERNET OF THINGS (IoT) (10 HOURS)

5.1 Introduction to IoT
  5.1.1 Definition and basic principals
  5.1.2 Evolution of IoT
5.2 IoT Architecture
  5.2.1 Edge computing
  5.2.1 Cloud Computing
5.3 Protocols in IoT
  5.3.1 Wireless protocols (MQTT,CoAP, Zigbee, LoRa, NB-IoT)
  5.3.2 Cellular Network protocols (3G, 4G, 5G)
  5.3.3 Standardization bodies (e.g. IEEE, IETF)
5.4 Infrastructure
  5.4.1 Integration of IoT with exiting telecom networks
5.5 Security and Privacy in IoT
5.6 Introduction to web socket
5.7 Characteristics of IoT
  5.7.1 Unique Identity.
  5.7.2 Connectivity.
  5.7.3 Dynamic Nature.
  5.7.4 Sensing.
  5.7.5 Heterogeneity.
5.8 IoT Applications

6. CYBER SECURITY (8 HOURS)

6.1 Introduction to cyber security
6.2 Basic principle of cyber security
6.3 Basic cyber safety rules
6.4 Enlist the Types of cyber security
  6.4.1 Network security
  6.4.2 Application security
  6.4.3 Information security
  6.4.4 Operational security

6.4.5 Mobile security
6.5 Introduction to security lifecycle
6.6 Introduction to network security
6.7 Introduction to cloud security
6.8 Introduction to threat modeling process
6.9 Types of cyber attacks
6.9.1 Distributed denial of service (DDoS)
6.9.2 Malware.
6.9.3 Phishing.
6.9.4 Spoofing.
6.9.5 Identity-Based Attacks.
6.9.5 Code Injection Attacks
6.9.6 Supply Chain Attacks.
6.9.7 Social Engineering Attacks.
6.10 Basic of cyber ethics

7. ARTIFICIAL INTELLIGENCE (AI) (10 HOURS)

7.1 History of AI
7.2 Definition of AI
7.3 Types of AI w.r.t capabilities and functionalities
7.3.1 Artificial Narrow intelligence (ANI)
7.3.2 Artificial General intelligence (AGI)
7.3.3 Artificial Super intelligence (ASI)
7.4 Applications of AI
7.5 Challenges the telecom industry facing and how AI solved them
7.5.1 Increasing operational expenses
7.5.2 Managing and interpreting Big Data
7.5.3 Security and data breaches
7.5.4 Network quality and optimization
7.5.5 Effective product planning and marketing
7.6 Impact of AI in telecom
7.6.1 5G Deployment and Management
7.6.2 Virtual Assistants and Chatbots
7.6.3 Edge Computing and AI
7.6.4 Resource Optimization
7.6.5 Regulatory Compliance
7.6.6 Collaboration with Other Industries
7.7 Introduction to Natural Language Processing (NLP)
7.8 Applications of NLP

8. MACHINE LEARNING (ML) (8 HOURS)

8.1 Definition of machine learning (ML)
8.2 Introduction to Machine learning process
8.3 Steps in machine learning process with flow chart
- 8.3.1 Define objective
- 8.3.2 Data gathering
- 8.3.3 Preparing data
- 8.3.4 Building a model
- 8.3.5 Training and Validation
- 8.3.6 Model evaluation
- 8.3.7 Predictions

8.4 Types of Machine Learning (ML)
- 8.4.1 Supervised learning
- 8.4.2 Unsupervised learning
- 8.4.3 Reinforcement learning

8.5 Limitations of machine learning
8.6 Introduction to Deep learning
8.7 Introduction to Neural network
8.8 Introduction to Single layer and multilayer perceptron
- 8.8.1. Types of Neural networks
- 8.8.2. Recurrent neural network (RNN)
- 8.8.3. Convolutional neural network (CNN)
- 8.8.4. Feed Forward neural network (FNN

RECOMMEMDED BOOKS:

1. Data and Computer Communications by William Stallings. Latest Edition, Publisher**:** Pearson

2. Artificial Intelligence: A Guide for Thinking Humans (Latest Edition) by Melanie Mitchell Publisher: Farrar, Straus and Giroux

Tel-353 EMERGING TECHNOLOGIES

INSTRUCTIONAL OBJECTIVES

1. CORE TELECOM TECHNOLOGIES

1.1 Introduce (Define) the following emerging technologies
- 1.1.1 Data communication
- 1.1.2 Fiber to the Home (FTTH)
- 1.1.3 Cloud Computing
- 1.1.4 Internet of Things (IoT)
- 1.1.5 Cyber Security
- 1.1.6 Artificial Intelligence (AI)
- 1.1.7 Machine learning (ML)

2. DATA COMMUNICATION

2.1 Define the following component of data communication
- 2.1.1. DTE/DCE
- 2.1.2. Media
- 2.1.3. Network
- 2.1.4. Link
- 2.1.5. Interface
- 2.1.6. Network terminating unit

2.2 What are the transmission modes in data communication, and how do simplex, half-duplex, and full- duplex differ?

2.3 What is the difference between serial and parallel transmission methods in data communication?

2.4 Explain these transmission techniques
- 2.4.1 Asynchronous
- 2.4.2. Synchronous

2.5. How have computer networks evolved throughout history?

2.6 Explain following types of Networks
- 2.6.1. LAN
- 2.6.2. MAN
- 2.6.3. WAN

2.7 Demonstrate the following LAN topologies
- 2.7.1. Bus
- 2.7.2. Star
- 2.7.3. Ring
- 2.7.4. Tree

2.8 How does Ethernet work, and what are its key features in networking?

2.9 How do CSMA and CSMA-CD protocols ensure efficient data transmission in networks?

3. FIBER TO THE HOME

3.1. What is FTTH (Fiber to the Home), and how does ODN (Optical Distribution Network) design play a role in its implementation?

3.2. Briefly explain following types of optical networks
- 3.2.1. Active optical Network (AON)
- 3.2.2. Passive optical network (PON)

3.3. How does a Passive Optical Network (PON) work, and what are the advantages in fiber optic communication?

3.4. Introduce the following components of PON
- 3.4.1. Optical line terminal (OLT)
- 3.4.2. Optical network unit (ONU)
- 3.4.3. Optical Splitter
- 3.4.4. Distribution frame
- 3.4.5. Optical fiber cable

3.5. Explain each type of PON
- 3.5.1. Asynchronous transfer PON
- 3.5.2. Broadband PON (BPON)
- 3.5.3. Ethernet PON (EPON)
- 3.5.4. Gigabit PON (GPON)

3.6. What is a Multi-Service Access Gateway (MSAG) and how does it enable the delivery of multiple services in a network?

3.7. Explain the EPON Architecture

3.8. Explain the GPON Architecture

3.9. Explain the components of an Optical Distribution Network (ODN) and provide a diagram illustrating its structure?

3.10. What is the Optical Add Drop Multiplexer (OADM), and its advantages?

3.11. Define the following types OADM
- 3.11.1. ROADM
- 3.11.2. FOADM

3.12. Introduction to optical transport network (OTN)

3.13. Introduction to Optical line protection (OLP)

3.14. Introduction to Muxponder

4. CLOUD COMPUTING

4.1 Introduction to Cloud Computing

4.2 Explain the cloud services models
- 4.2.1. IaaS
- 4.2.2. PaaS
- 4.2.3. SaaS

4.3. List the names of cloud deployment models.

4.4. What is the relationship between Network Functions Virtualization (NFV) and cloud computing in enhancing network efficiency and flexibility?

4.5. Define cloud security and why it is important?

4.6. Give examples of cloud-based services used in the telecommunications industry?

5. INTERNET OF THINGS (IOT)

5.1 Define IoT
- 5.1.1. Basic principles of the Internet of Things (IoT)

5.1.2 How has the Internet of Things (IoT) evolved over time
5.2 What is the architecture of the Internet of Things (IoT)
5.2.1. What is Edge Computing?
5.2.2 What is Cloud Computing?
5.3 Define each protocol in IoT
5.3.1. Wireless protocols (MQTT,CoAP, Zigbee, LoRa, NB-IoT)
5.3.2. Cellular Network protocols (3G, 4G, 5G)
5.3.3. Standardization bodies (e.g. IEEE, IETF)
5.4. What is the infrastructure required for supporting IoT systems.
5.4.1 How can the Internet of Things (IoT) be integrated with existing telecom networks to enhance connectivity, data management, and service delivery?
5.5. What are the key security and privacy challenges in the Internet of Things (IoT), and how can they be addressed to protect devices and data?
5.6. Define web socket
5.7. Define these characteristics of IoT
5.7.1. Unique Identity.
5.7.2. Connectivity.
5.7.3. Dynamic Nature.
5.7.4. Sensing.
5.7.5. Heterogeneity.
5.8. Examples of IoT applications

6 CYBER SECURITIES

6.1. What is cyber security
6.2. Introduce the basic principles of cyber security.
6.3. What are the basic cyber safety rules to follow in order to stay safe online?
6.4. Define the types of cyber security
6.4.1 Network security
6.4.2 Application security
6.4.3 Information security
6.4.4 Operational security
6.4.5 Mobile security
6.5. Give the basic introduction to security lifecycle
6.6. Define network security
6.7. Introduce cloud security
6.8. Introduce threat modeling process
6.9. Define each type of cyber attacks
6.9.1. Distributed denial of service (DDoS)
6.9.2. Malware.
6.9.3. Phishing.
6.9.4. Spoofing.
6.9.5. Identity-Based Attacks.
6.9.6. Code Injection Attacks.
6.9.7. Supply Chain Attacks.
6.9.8. Social Engineering Attacks.
6.10. What are the basics of cyber ethics, and how do they guide responsible and respectful

behavior in the digital world?

7. ARTIFICIAL INTELLIGENCE (AI)

7.1. Introduce the History of AI.
7.2. Definition of AI
7.3. Define these types of AI w.r.t capabilities and functionalities
    7.3.1 Artificial Narrow Intelligence (ANI)
    7.3.2 Artificial General Intelligence (AGI)
    7.3.3 Artificial Super Intelligence (ASI)
7.4. Give applications of AI
7.5. State these challenges the telecom industry facing and how AI solved them
    7.5.1 Increasing operational expenses
    7.5.2 Managing and interpreting Big Data
    7.5.3 Security and data breaches
    7.5.4 Network quality and optimization
    7.5.5 Effective product planning and marketing
7.6. Discuss impact of AI in following areas of telecom
    7.6.1 5G Deployment and Management
    7.6.2 Virtual Assistants and Chatbots
    7.6.3 Edge Computing and AI
    7.6.4 Resource Optimization
    7.6.5 Regulatory Compliance
    7.6.6 Collaboration with Other Industries
7.7. Introduction to Natural Language Processing (NLP)
7.8. Give some applications of NLP

8. MACHINE LEARNING (ML)

8.1 Define machine learning (ML)
8.2 What are the Machine Learning Processes?
8.3. Make a flow chart to depict each steps in machine learning process
    8.3.1 Define objective
    8.3.2 Data gathering
    8.3.3 Preparing data
    8.3.4 Building a model
    8.3.5 Training and Validation
    8.3.6 Model evaluation
    8.3.7 Predictions
8.4 Define each type of Machine Learning (ML)
    8.4.1 Supervised learning
    8.4.2 Unsupervised learning
    8.4.3 Reinforcement learning
8.5. What are the limitations of machine learning?
8.6 Introduction to Neural network
8.7. Introduce Deep learning
8.8 What is the difference between a single-layer and a multi-layer perceptron.

8.9 Define each type of neural network

- 8.9.1 Recurrent neural network (RNN)
- 8.9.2 Convolutional neural network (CNN)
- 8.9.3 Feed Forward neural network (FNN)

Tel-353 EMERGING TECHNOLOGIES

LIST OF PRACTICAL 96 HRs

1. To identify network components (routers, switches, hubs, and access points.)
2. Creation and testing of straight-through and crossover cables.
3. Set up a basic communication link between a DCE device and a DTE device.
4. Implementation of serial and parallel data communication.
5. Assigning IP addresses to devices and calculating subnet masks.
6. Setting up a small local area network (LAN) with multiple devices.
7. Setting up and testing a wireless network.
8. Study of FTTH network elements like OLT (Optical Line Terminal), ONT (Optical Network Terminal), splitters, and connectors.
9. Performing and testing fiber optic splicing.
10. Practicing termination techniques for fiber cables with connectors (SC, LC, etc.).
11. Measuring optical power loss and light signal quality using an optical power meter and light source.
12. Conducting a test with an Optical Time-Domain Reflectometer to locate faults, measure loss, and check fiber quality.
13. Design an FTTH point-to-point network.
14. Exploring cloud service providers like AWS, Google Cloud, and Microsoft Azure.
15. Demonstrate the sign up process on cloud platform
16. Understanding the basic components of an IoT system, including sensors, actuators, microcontrollers (like Arduino, Raspberry Pi), and communication protocols.
17. Demonstrate how to Install and configure Python and essential AI libraries like NumPy, Pandas, Matplotlib, and Scikit-learn.
18. Write a program to display your bio data using Python
19. Perform arithmetic operations using Python
20. Write a program to convert the temperature (Celsius degree to Fahrenheit degree).
21. Demonstrate how to clean and prepare datasets for machine learning, including handling missing values, normalization, and encoding categorical variables, using Python.

Tel-363 QUALITY OF SERVICE AND MAINTENANCE

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

LEARNING OUTCOMES:

1. **Explain** key concepts of Quality of Service (QoS), network performance metrics, and their significance in telecom.
2. **Describe** Service Level Agreements (SLAs), maintenance strategies, fault management procedures, and troubleshooting techniques in telecom networks.
3. **Demonstrate** understanding of ethical considerations in service delivery, QoS maintenance, and customer trust in the telecom industry.

COURSE CONTENTS:

1 **QUALITY OF SERVICE IN TELECOM** **(10 Hours)**

- 1.2 Define Quality of Service (QoS)
- 1.3 Importance of QoS in Telecom
- 1.4 National and International Standards of QoS Measurement
- 1.5 National standards and operators' performance targets
- 1.6 Key QoS Parameters
  - 1.6.1 Latency
  - 1.6.2 Jitter
  - 1.6.3 Bandwidth
  - 1.6.4 Packet Loss
- 1.7 Factors Affecting QoS
  - 1.7.1 Network Congestion
  - 1.7.2 Bandwidth Availability
  - 1.7.3 Traffic Management
- 1.8 QoS in Different Networks
  - 1.8.1 Wired
  - 1.8.2 Wireless
    - 1.8.2.1 WiFi
    - 1.8.2.2 LTE
    - 1.8.2.3 5G and beyond
  - 1.8.3 Mobile
  - 1.8.4 Satellite Networks
  - 1.8.5 IP Networks
- 1.9 Role of QoS in customer Satisfaction
- 1.10 User Scheduling for QoS
  - 1.10.1 FIFO
  - 1.10.2 Round Robin
  - 1.10.3 Weighted Fair Queuing

- 1.11 Resource Reservation Protocol
- 1.12 Application Layer QoS
  - 1.12.1 VoIP
  - 1.12.2 Video Streaming
  - 1.12.3 Real Time Applications

2 NETWORK PERFORMANCE METRICS AND TOOLS (08 Hours)

- 2.1 Network Performance Metrics
  - 2.1.1 Throughput
  - 2.1.2 Schedule Length
  - 2.1.3 Maximum Waiting for Service
- 2.2 QoS Measurement Techniques
  - 2.2.1 Active
  - 2.2.2 Passive
- 2.3 QoS Monitoring and Analysis
  - 2.3.1 Simple Network Management Protocol
  - 2.3.2 NetFlow
- 2.4 Performance Testing and Benchmarking
- 2.5 End to End QoS Monitoring in Telecom
- 2.6 Reliability of Series, Parallel and Standby Systems

3 SERVICE LEVEL AGREEMENTS (SLAS) (08 hours)

- 3.1 Introduction to SLAs
- 3.2 Defining QoS Requirements in SLAs
  - 3.2.1 Terms and Conditions
- 3.3 Monitoring and managing SLAs in Telecom
- 3.4 Penalties and Compliance with SLAs
- 3.5 Procedure for fault reporting and shutdowns
- 3.6 Role of SLAs in QoS
- 3.7 Real Life Examples of Telecom SLAs
- 3.8 Operation and Maintenance Contracts
  - 3.8.1 Periodic Checkups and Repairs
  - 3.8.2 Labor Contracts

4 MAINTENANCE AND FAULT MANAGEMENT IN TELECOM NETWORKS (16 Hours)

- 4.1 Types of Maintenance
  - 4.1.1 Preventive Maintenance
  - 4.1.2 Corrective Maintenance
  - 4.1.3 Predictive Maintenance
- 4.2 Importance of Regular Maintenance
- 4.3 Telecom Network Maintenance Life Cycle
- 4.4 Equipment manufacturer recommendations

- 4.5 Maintenance instruction card
- 4.6 Record maintaining and history sheets
- 4.7 Maintenance schedule and procedure
- 4.8 Maintenance Strategies
  - 4.8.1 For Wired Networks
  - 4.8.2 For Wireless Networks
- 4.9 Impact of Maintenance on QoS
- 4.10 Safety Considerations in Telecom Maintenance
- 4.11 Definition and Types of Faults in Telecom
  - 4.11.1 Hardware Faults
  - 4.11.2 Software Faults
  - 4.11.3 Signals Issues
- 4.12 Fault Detection Techniques
  - 4.12.1 Alarms
  - 4.12.2 Probes
  - 4.12.3 Logging System
- 4.13 Procedure for Fault Diagnosis
- 4.14 Fault Rectification and Repair
  - 4.14.1 Module Level
  - 4.14.2 Component Level
- 4.15 Causes of Faults
  - 4.15.1 Temperature and Humidity
  - 4.15.2 Dust and Other Particles
  - 4.15.3 Noise Induction
  - 4.15.4 Power Line Problems
  - 4.15.5 Corrosion
  - 4.15.6 Mal-Handling
- 4.16 Importance of Fault Management
- 4.17 Tools for Fault Management
- 4.18 Probability of Failure
  - 4.18.1 Mean Time Between Failure
  - 4.18.2 Mean Time to Repair
- 4.19 Fault Management in Telecom (Real Cases)
- 4.20 Inventory Control
- 4.21 Critical Spares and Consumables
- 4.22 Stocking Arrangements

5 **TROUBLESHOOTING AND MAINTENANCE TOOLS (12 Hours)**

- 5.1 Overview of Tools for Network Troubleshooting
  - 5.1.1 Signal Analyzer
  - 5.1.2 Cable Tester
  - 5.1.3 Spectrum Analyzer
- 5.2 Troubleshooting Common Network Issues
  - 5.2.1 Signal Loss
  - 5.2.2 Interference
  - 5.2.3 Low Speed
- 5.3 Log Analysis in Fault Diagnosis

5.4 Software Tools Introduction
    5.4.1 Cisco Network Assistant
5.5 Case studies in Troubleshooting

6. ETHICAL BEHAVIOR IN QOS AND MAINTENANCE (10 Hours)

6.1 Ethics in Service Delivery
6.2 Importance of Ethics in QoS
6.3 Impact of Ethics on QoS and Customer Trust
6.4 Understanding ethical behavior, principles and standards
6.5 Integrity in Fault Reporting
6.6 Transparency in Contracts
6.7 Fair and Transparent Billing
6.8 Ethical Consideration in Handling Complaints
    6.8.1 Prompt Response
    6.8.2 Respectful Behavior
    6.8.3 Customer Privacy
        6.8.3.1 Home Privacy
        6.8.3.2 Data Privacy
        6.8.3.3 Security
6.9 Workplace safety and environmental responsibility
6.10 Case studies on Ethical Failures and Consequences
6.11 Case studies of Successful Companies and their Ethical Values

RECOMMENDED REFERENCE BOOKS

1. "Telecommunication System Engineering" by Roger L. Freeman
2. "Ethics in Information Technology" by George W. Reynolds
3. “Quality of Service in Wireless Networks Over Unlicensed Spectrum” by Klara Nahrstedt
4. “Managing Projects in Telecommunication services” by Mustafa Hashem Sherif

Tel-363 QUALITY OF SERVICE AND MAINTENANCE

INSTRUCTIONAL OBJECTIVES

1 QUALITY OF SERVICE IN TELECOM

1.2 Define Quality of Service (QoS)
1.3 Explain the Importance of QoS in Telecom
1.4 Explain the National and International Standards of QoS Measurement
1.5 What are the National standards and operators performance targets
1.6 Explain the Key QoS Parameters in telecom
1.7 Explain the Factors that Affect QoS
1.8 Describe the QoS in wired and wireless networks
1.9 Discuss the role of QoS in customer Satisfaction
1.10 Enlist user Scheduling for QoS and compare them
1.11 Resource Reservation Protocol
1.12 Explain the Application Layer QoS

2 NETWORK PERFORMANCE METRICS AND TOOLS

2.1 Discuss the Network Performance Metrics
2.2 What are the QoS Measurement Techniques
2.3 Explain the protocols for QoS Monitoring and Analysis
2.4 Performance Testing and Benchmarking
2.5 How we monitor End to End QoS in Telecom
2.6 Compare the Reliability of Series, Parallel and Standby Systems

3 SERVICE LEVEL AGREEMENTS (SLAS)

3.1 Introduce the SLAs
3.2 Define the Requirements QoS in SLAs and its terms and conditions
3.3 Explain the monitoring and management of SLAs in Telecom
3.4 Explain the penalties and compliance with SLAs
3.5 Explain the procedure for fault reporting and shutdowns
3.6 Describe the role of SLAs in QoS
3.7 Discuss at least three real Life Examples of Telecom SLAs
3.8 Explain the components of operation and Maintenance Contracts

4. MAINTENANCE AND FAULT MANAGEMENT IN TELECOM NETWORKS

4.1 Explain various types of Maintenance
4.2 Describe the importance of Regular Maintenance
4.3 Explain the telecom Network Maintenance Life Cycle
4.4 Discuss the equipment manufacturer recommendations
4.5 What is importance of maintenance instruction card
4.6 Develop some record maintaining and history sheets

4.7 Prepare the maintenance schedules and their procedure
4.8 Explain the maintenance strategies for wired and wireless networks
4.9 What is the impact of Maintenance on QoS
4.10 Explain the safety Considerations in Telecom Maintenance
4.11 Define and explain various types of Faults in Telecom
4.12 Explain the procedure for fault detection and various techniques of it
4.13 What is the procedure for Fault Diagnosis?
4.14 Explain the module level and component level fault rectification and its repairing
4.15 Explain at least six causes of faults
4.16 What is the importance of Fault Management?
4.17 Which tools are used for fault Management? Explain each of them.
4.18 Explain probability of failure, calculate the mean time between failure and repair
4.19 Discuss various fault Management cases in Telecom (Real life)
4.20 What is inventory Control, why we use it?
4.21 Enlist the critical spares and Consumables in telecom and their basic applications
4.22 Explain the stocking Arrangements

5 **TROUBLESHOOTING AND MAINTENANCE TOOLS**

5.1 Explain the functions of various tools used for Network Troubleshooting
5.2 Explain the procedure for troubleshooting the Common Network Issues (three issues)
5.3 What is log Analysis in Fault Diagnosis
5.4 Introduce the students with Cisco network assistant
5.5 Discuss various case studies in Troubleshooting

6 **ETHICAL BEHAVIOR IN QOS AND MAINTENANCE**

6.1 What are the basic ethics in Service Delivery?
6.2 Explain the Importance of Ethics in QoS
6.3 What is the impact of Ethics on QoS and Customer Trust?
6.4 What is ethical behavior, its principles and standards
6.5 What is integrity in Fault Reporting and why it is important
6.6 How to ensure transparency in Contracts?
6.7 Why fair and Transparent Billing is necessary?
6.8 What is the ethical Consideration in Handling the Complaints?
6.9 How we can ensure workplace safety and what is environmental responsibility in this regard?
6.10 Discuss various case studies on Ethical Failures and their Consequences
6.11 Discuss various case studies of Successful Companies and their Ethical Values

Tel-363 QUALITY OF SERVICE AND MAINTENANCE

LIST OF PRACTICAL **96 HRs**

1. Visit a complaint center of PTCL telephone exchange and study the recording and rectification procedures and write a report on preparation of fault dockets and remedial action.
2. Study technical manuals of various telecom and testing equipment for upkeep and repair procedures and draw a schedule for preventive maintenance.
3. Draft a Maintenance Instruction Card for any type of electronic equipment or power plant.
4. Draft history/sheet/card for any type of electronic equipment, testing devices or power plant.
5. Prepare list of spare parts, modules and units required for maintaining the reliability targets and the preventive maintenance schedules.
6. Study the consumption/procurement records in telecom facility center and write a report on stacking arrangements.
7. Study the existing/available service level agreement and then develop a need-based SLA of your own.
8. Develop a sample contract for a telecom maintenance firm.
9. Introduce a fault in available telecom equipment and using the learnt techniques, detect and repair it.
10. Repair various types of faults in PABX.
11. Repair various types of faults in underground cables.
12. Repair various types of faults in overhead cable, drop wire and cable terminations.
13. Visit a Microwave Station and write report on antenna/feeder and equipment maintenance procedures.
14. Remove various types of faults in Petrol Engines.
15. Repair faults in Rectifier.
16. Use the available network troubleshooting tools, i.e., signal analyzer, cable tester etc.
17. Repair faults in UPS and voltage stabilizers.
18. Study the causes of faults in storage batteries, their symptoms and remedial measures.
19. Perform observations for preventive maintenance of air conditioning system.
20. Set up a small network and test connectivity using cisco network assistant
21. Implement static routing to enable communication between networks.

Tel-372 FINAL YEAR PROJECT

Total Contact Hours:192		T	P	C
Theory:	00	0	6	2
Practical:	192 Hours			

LEARNING OUTCOMES:

- Enable students to practically apply their knowledge and skills in telecommunications.
- Encourage students to conduct independent surveys to identify industrial problems and explore solutions.
- Provide hands-on experience in network design, signal processing, IoT, and wireless technologies.
- Help students develop innovative solutions for telecom challenges in industries.
- Facilitate the creation of proof-of-concepts or prototypes based on market needs.

Final Year Project Instructions:

- Projects must integrate the acquired telecom knowledge
- Project must be Align with current industry trends.
- Use modern advancements in telecommunication technologies, IoT, and network automation.
- Ensure projects address real-world telecom issues and industry demands.

Suggested Fields:

1. Wireless Communication
2. Optical Fiber Communication
3. Internet of Things (IoT) in Telecom
4. Satellite Communication & VSAT Systems
5. Telecom Infrastructure & Smart Grid Communication
6. Network Security & Cyber security in Telecom
7. RF Planning & Optimization
8. Cloud Computing & Virtualization in Telecom
9. AI & Machine Learning Applications in Telecom
10. VoIP & Next-Gen Communication Systems
11. Emergency Communication Systems
12. Smart Cities & Telecommunication Integration
13. Arduino Based Project

PROJECT GUIDELINES:

1. **Project Selection & Approval:**

    1. Projects may be based on telecom and electronic field.
    2. Project maybe selected from above suggested fields.
    3. The project must be approved by the HOD and Project In charge.

2. **Project Development & Implementation:**

    1. Project should be made in college during lab period.
    2. Hands-on implementation and physical model of project is encouraged.
    3. Continuous improvement of past projects is recommended.

3. **Project Report Requirements:**

    1. Report should be submitted with all details of project including Introduction, List of Contents, Objective of Project and Circuit/Block Diagrams with detailed explanation, Conclusion etc.
    2. Budget breakdown may include with future enhancement possibilities.

PROJECT EVALUATION CRITERIA:

1. Sessional:

• Attendance	(10 Marks)
• Project Proposal	(10 Marks)
• Comprehensive Project Report	(25 Marks)
• Presentation (Soft + Hard)	(15 Marks)
Total:	**60 Marks**

2. **Practical**:

• Brief description of project	(05 Marks)
• Viva	(10 Marks)
• Operational & Functional Working	(25 Marks)
Total:	**40 Marks**
Grand Total:	**100 Marks**

(Sessional (60) marks will be awarded by the instructor, and Practical (40) marks will be awarded by an external examiner from PBTE.)

DAE TELECOMMUNICATION TECHNOLOGY

(As per Curriculum Revised, 2025)

(List of the Equipment for 50 Students)

1. ELECTRONICS LAB:

Sr. #.	Name of Item with Specifications	Qty
1.	**Oscilloscope Digital LCD type 100MHz:** 100 MHz 2 Channel Storage Oscilloscope Sample rate: 1GSa/s, 40K USB port With standard accessories Instruction Manual in English.	10
2.	**RF Signal Generator:** Signal Frequency range: 100KHz to 150MHz in 6 selectors, 3 harmonics up to 450MHz Output wave forms: Sine and amplitude modulation wave RF/AM output max, intensity≥10Vp-p External modulation signal can be set between 50Hz to 20kHz Output Impedance: 600 ohm Radio Frequency output: over 100 mvrms Accessories: Power cord, Instruction manual.	10
3.	**Digital Triple output DC Power Supply:** Choice of outputs: Double output: 0 to 30VDC, 0 to 5A Single output: 0 to 60VDC, 0 to 5A Single output: 0 to 30VDC, 0 to 10A Fixed output: 5V/3A With short circuit protection With standard accessories and Operational /Instruction Manual in English	15
4.	**Analog Multimeter** Measuring range: DC Current 0-0.06mA-3mA-30mA-0.3A-12A DC Voltage 0-0.3V-3V-12V-30V-120V-300V-1200V AC Voltage 0-12V-60V-300V-1200V Resistance 2K, 200k, 2M, 20M ohm	20
5.	**Digital Multi meter** • 4000 counts measurement • Diode test/Buzzer • Temperature test • Frequency/Duty Cycle	20

Sr. #.	Name of Item with Specifications	Qty
	• Relative measurement • Data Hold • Auto Power Off • Auto/Manual Ranging • Double Molded • Mechanical / Electronic Protection System • Conform to IEC1010 CAT II 1000V • Convenient Fuse/Battery Change Design • Battery life up to 500 hours Specifications DC Voltage range : 0.1mV-1000V DC Current range : 0.1µA-10A AC Voltage range : 0.1mV-1000V AC Current range : 0.1µA-10A Resistance range : 0.1Ω-40MΩ Capacitance range : 0.01nF-100µF Frequency/Duty Cycle : 10Hz-100kHz Temperature range: -55°C-1000°C	
6.	**Megger Portable (500V, 500MΩ) Hand operated**	05
7.	**Electricity & Magnetism Trainer** DC Power Supply with Short-Circuit protection Fixed voltage: +5V , +12V and -12V Dual variable voltage: 0 – ±25V **AC Power Supply** Center tab: 2-0-2, 15-0-15, 18-0-18V **Function Generator** Output: Sine, Triangle, Square wave, TTL Output impedance : 50ohm Frequency: Maximum 100KHz, adjustable Output amplitude: 0-15Vp-p, adjustable Which can perform the following listed experiments: 1. Study of Multimeter 2. Colour coding of resister 3. Verification of Ohm's law 4. Verification of KVL 5. Verification of KCL 6. Verification of Superposition Theorem 7. Study of transformer 8. Study of Junction diode 9. Half-wave rectification 10. Full-wave rectification 11. Reading and understand the transformer's ratings	10

Sr. #.	Name of Item with Specifications	Qty
	12. Familiarization &use of lab equipments & components. (power supply, Breadboard, Multi-meter & Finding the resistance value by colour coding) 13. Experimental determination of the transformer's polarity 14. Conventional determination of the transformer's voltage drop 15. Measuring the winding resistance 16. Observing charging and discharging pattern in an RC circuit. 17. Study of mutual inductance. 18. Step up transformer (by hardware). 19. Step down transformer (by hardware). 20. Step up transformer. 21. Step down transformer. 22. Find out the Theremin's equivalents of the given circuit and verify the load current. 23. Measurement of voltage ratio in voltage divider on no load condition. 24. Determine Load current for different values of RL. 25. Faraday's Law of Electromagnetic induction. 26. LDR, Photodiode, LEDs. 27. Self Inductance and Induced Induction.	
8.	**Earth Tester Digital** Earth Resistance Range: 0 ohm to 4K ohm Earth AC Voltage Range: 0 to 20V Digital display with analog bar graph 2 pole and 3 pole mode MAX/MIN/AVG/REL measurement functions Low battery display Display backlit With standard accessories and Operational Manual in English	05
9.	**Portable Wattmeter Analog Single Phase** Portable type Range: (1/5A, 240V, 1Φ) Mirror Scale : 120 - 130mm approx With operational Manual in English.	05
10.	**Electric Wiring Boards / Training board** for 1 Φ, 3 Φ **Protection class** I (with protective conductor) **Table fixation** by means of the board support	05
11.	**Solder Iron 40 watt, branded.**	25
12.	**Sucker hand operated.**	25

Sr. #.	Name of Item with Specifications	Qty
13.	**Basic Electronics/ Electrical Tool Kit**	10
14.	**Project Board trainer with built-in power supply.**	10
15.	**Spectrum Analyzer** • Handheld, battery operated, weighs 7.5 lbs • Frequency range: 9 kHz to 20 GHz • Built-in pre-amplifier (standard) up to 4 GHz • Large daylight-viewable transflective color display • Displayed average noise level < -159 dBm • Resolution bandwidths: 1 Hz to 3 MHz • Video bandwidths: 1 Hz to 3 MHz • Antennas are available • Trace averaging - more than 65000 traces can be averaged • Save up to 1000 measurement traces internally • RJ-45 Interface, USB 2.0 Interface, and Software included • AM, FM and SSB demodulation with speaker and headset jack • With All accessories • Operational Manual in English.	05
16.	**Digital Logic Trainer with given accessories** DC Power Supply with short-circuit protection Fixed voltage: +5V, +15V and -15V With power indicators and protection fuse. 8 LEDs used to indicate the state of a logical output. 8 Logic Switches with complementary logic states. Two 7 segment decoder/driver and displays with BCD logic input. Logic Probe with LEDs for determining the logic states Two push switches for generating negative - going pulse. TTL Clock with adjustable frequency. Two potentiometers. **Trainer should consist of various modules to perform following experiments**. 1. To examine the behavior of 2- inputs AND, OR, Inverter, NAND, and NOR gates. 2. To build a 3-inputs AND and OR gate using 2-inputs AND and OR gate. 3. To build a 3-inputs NAND and NOR gate using 2-inputs	05

Sr. #.	Name of Item with Specifications	Qty
	NAND and NOR gate. 4. To examine the behavior of 2- inputs XOR gate. 5. To build a circuit having 2 and 3 inputs XOR gate using a two input XOR gale. 6. To prove De-Morgan's law. 7. Implementation of half adder, half sub tractor, full adder and full sub tractor using gates. 8. To make Karnaugh map of your roll no. 9. TTL-CMOS interfacing 10. CMOS-TTL interfacing. 11. Input multiplexer. 12. Flip - flops. 13. Data shift registers. 14. Binary counter. 15. l to 4 decoder. 16. BCD -to- decimal decoder. 17. Priority encoder. 18. Seven segment LEDs and decoder driver, 19. Monostable7412l. 20. TTL-CMOS Interfacing. 21. Crystal oscillator. 22. Decoder &. Encoders. 23. Operation of an 8421 BCD decoder using open - collector l.C. 24. Operation of an 8-input encoder and significance of priority. 25. Design & implementation of shift register using flip-flops & demonstration of shift right & shift left functions of MSI universal register,	

17.	**Semiconductor / Basic Electronics Trainer in Modular Form** examples of performing the following experiments : 1. Identify the various diodes, transistors & IC package, number system and terminals. 2. Draw the forward & reverse characteristics of a P.N. junction diode. 3. Assemble a full wave diode rectifier circuit with a PI filter & calculate the ripple factor of output wave. 4. Assemble a double side biased diode limiter circuit. 5. Familiarize with a voltage quadrupler circuit. 6. Demonstrate diode as a switch with LED as a load. 7. Troubleshoot a faulty diode rectifier circuit. 8. Use a Zener diode as voltage regulator with diode rectifier. 9. Assemble a double side Zener diode limiter. 10. Demonstrate the performance of power supply using IC regulator. 11. Use varactor diode in a resonant circuit. 12. Assemble a tunnel diode oscillator. 13. Plot the input & output characteristics of a transistor in common base configuration. 14. Plot the input & output characteristics of a transistor in common emitter configuration. 15. Plot the input and output characteristic of transistor in common collector configuration. 16. Plot the transfer characteristics curve of transistor in CE configuration. 17. Consult data sheet for a transistor to study its parameters and ratings. 18. Study the class A, B and C Amplifiers. 19. Assemble a transistor voltage amplifier and find its voltage gain. 20. Demonstrate the characteristics of CB, CE & CC amplifier using curve tracer. 21. Study the gain of an amplifier with an without negative feedback. 22. Plot the characteristics curves for a common source FET amplifier. 23. Demonstrate MOSFET as a switch and study the performance. 24. Plot the characteristics curves for SCR & UJT. 25. Assemble a light dimmer using a Diac & a Triac. 26. Troubleshoot an operational amplifier. 27. Assemble a differential amplifier using transistor. 28. Demonstrate the working of an operational	05

	amplifier. 29. Use of op-amp as an inverting & non-inverting amplifier and a voltage follower. 30. Draw the frequency response of an op-amp. 31. Troubleshoot an operational amplifier. 32. Demonstrate the use of digital logic probe & logic pulser. 33. Recognize an open & a short TTL NAND gate in an IC using logic probe & pulser. 34. Troubleshoot a combinational logic circuit using logic probe & pulser. 35. Troubleshoot a frequency counter using oscilloscope. 36. Study the working of Hartley oscillator 37. Construct a voltage controlled oscillator using 555 timer.	
18.	**Digital Frequency Counter 3GHz:** DC to 3GHz frequency range Frequency, period, pulse width, ratio and event counter modes Rechargeable batteries USB interface included **FM MODULATION** Peak Deviation: 0·5kHz to 100kHz. Setting Resolution: 0·5kHz by direct keyboard entry, rotary control or increment–decrement keys. Modulation Frequency: Internal 1kHz; External 300Hz to 50kHz Deviation Accuracy: <±10%of setting ±0.5kHz, excluding residual FM, for 1kHz modulation, internal or 1Vrms external. External Modulation Frequency Response: ± 1dB from300Hz to 50kHz relative to 1kHz. Distortion: <2%total harmonic distortion at 1kHz modulating frequency, 100kHz deviation and 500MHz carrier. Input Impedance: 100kW Input Connector: BNC	05
19.	**Logic Probe.**	05
20.	**Logic Pulser**	05
21.	**Desoldering Station with ESD**	20
22	**Digital IC Tester:** **Features** Support low voltage components. Provide +/- 5%, +/- 10% Vcc checking function. ● Provide fast programming FLASH/EPROM function. It only takes 20 seconds to process a 16M bits FLASH	05

	memory. (C+P+V) ● Graphic operation software: All programming procedures are simplified into few automatic processes. ● Provide auto-programming function. ● System self-test function. ● Device processing interface: 48-pin ZIF socket and directly support DIP package device under 600mil . **Device Supported** ● EPROMs, EEPROMs, FLASH, Serial EEPROM, NV-RAMs, Microcontrollers, DSP, PLD	
23	**Digital clamp on meter** AC current: 400Amp Frequency: 50Hz AC Voltage: 600V Resistance: 40MΩ	05
24	**LCR Meter (Bridge) Bench type:** l 0.1% measurement accuracy l Test frequencies up to 10kHz l Automatic component recognition l Built-in 4 terminal component fixture l Dual 5 digit high brightness displays l Limits comparator, multiple pass and fail bins l RS-232 interface for PC connectivity **MEASUREMENT FUNCTIONS** Parameters Measured: R, L, C, D, & Q. Parameter Selection: Manual or automatic selection of R, L or C. Measurement Modes: Series or parallel equivalent circuit. Range Hold: Prevents autoranging when changing components. Zero Function: Nulls out up to 100pF at test fixture. Measurement Freq.: Selectable as 100Hz/120Hz, 1kHz, 10kHz. Displayed Functions: R+Q, L+Q, C+D, C+R. **MEASURING RANGES** Resistance: 0.1m□□to 990M□ Inductance: 0.001H to 9900H Capacitance: 0.001pF to 99000µF D: 0.001 to 999 Q: 0.001 to 999 **Accuracy Limits:** 100Hz 1kHz 10kHz **R** 0.1% ± 1 digit 2□-1M□□2□-500k□□2□-50k□ 0.5% ± 1 digit 0.4□-5M□□0.4□-2M□□0.4□-200k□ 2%□□1 digit 0.1□-20M□□0.1□-10M□□0.1□-500k□ **L** 0.1% ± 1 digit 4mH-500H 0.4mH-50H 40µH-5H 0.5% ± 1 digit 0.8mH-2500H 80µH-250H 8µH-25H 2%± 1 digit 0.2mH-9900H 20µH-1000H 2µH-100H **C** 0.1% ± 1 digit 10nF-1000µF 1nF-100µF 100pF-10µF	05

	0.5% ± 1 digit 2nF-5000µF 200pF-500µF 20pF-50µF 2%± 1 digit 500pF-20000µF 50pF-2000µF 5pF-200µF (R accuracies apply for Q<0.1. L accuracies apply for Q>10. C accuracies apply for D<0.1 and after Null). **LIMITS COMPARATOR** Limits Set-up: Multiple Upper and Lower limits can be set from keyboard or from RS-232 interface Binning: Up to 8 Pass bins can be defined plus Fail on minor parameter and general Fail. **COMPONENT CONNECTION** Component Connection: 4-terminal connection via internal fixture for both radial and axial components. External 4-terminal connection via adaptor. Internal Fixture: Sprung jaws for vertical lead insertion. Plug-in sliding pillars for horizontal lead insertion. Bias Voltage: Switchable 2V polarising voltage. External bias up to 50V. **DISPLAY** Display Type: Dual 5-digit 0.56" LEDs. Annunciators: LED annunciators for all functions and measurement units. Displayed Functions: R+Q, L+Q, C+D, C+R, PASS/FAIL, Bin No. **DIGITAL INTERFACE** Interface Type: RS-232 via 9 pin D connector, 9600 baud. Interface Function: Full command and readback. **GENERAL** Keyboard: Full numeric keyboard. Non-volatile memory: Up to 9 complete set-ups. Input Voltage: 230V or 115V ±14%, 50/60Hz, internally adjustable, 25VA max. Installation Category ll. Temperature Range: +5oC to 40oC operating 20 - 80% RH, -40oC to 70oC storage. Safety: Complies with EN61010-1. EMC: Complies with EN61326. Size: 360 x 240 x 95 mm including feet. Weight: 2.9kg approx.	
25	**AF Generator 1 MHz:** Range: 10Hz to 1MHz in five steps Waveform output: Sine & Square Intensity of output singnal: 10Vp-p 60dB accurate attenuate with 6 steps Output impedance: 600 ohm	05
26	**Digital Sound Level Meter:** • 35 ~ 130dB Range • 0.1dB Resolution • +/- 1.5 dB Accuracy	05

	• A/C weighting • Fast/Slow Response • Max Hold Function • AC/DC output • Reset Function • Calibration 94dB Level Range: A LO (Low) - Weighting: 35- 90dB A HI (High) - Weighting: 75-130dB C LO (Low) - Weighting: 35- 90dB C HI (High) - Weighting: 75-130dB Resolution: 0.1dB Frequency Range: 31.5Hz to 8KHz	
27.	**Microcontroller Trainer** PIC Development Board-Trainer Kit	10
28.	**Microcontroller Trainer** 8051 Development Board- Trainer Kit	10
29	**MPPT Charge controller** • Compatible for PV systems in 12v, 24v or 48v • Maximum charging current up to 60a • MPPT Range Operating Voltage: 60 ~115VDC • Maximum PV Array Open Circuit Voltage: 145VDC • Maximum PV Array Power: 3200W • Maximum Input Current: 50A • Nominal Battery Voltage: 12/24/48VDC • Maximum Charge Current: 60A Experiment Include 1. Install a Tall tubular battery with MPPT charge controller. 2. Demonstrate the Power Distribution System at a Telecom Installation. 3. Demonstrate on Solar Installation at work site.	05
30	**Function Generator**	10
31	**Solar Panel** 585 watt N-Type Monofacial	02
32	**Solar Panel** 585 watt N-Type Bifacial	02
33	IR Thermometer	05
34	**Servomotor Voltage regulator** 1000VA, Single Phase	01
35	**Hybrid Solar Inverter.** 3KW, 24V, IP21	01
36	**Tubular Battery** 100Ah	02
37	**Circuit Breakers**	05

	Single Phase, Three Phase, DC	each
38	Sound Level Meter 30-130db, Digital	05
39	**Operational Amplifier Trainers** DC Power Supply with short-circuit protection Fixed voltage: +5V , +12V and -12V Dual variable voltage: 0 – ±25V AC Power Supply Center tab: 2-0-2, 15-0-15, 18-0-18V Function Generator Output: Sine, Triangle, Square wave, TTL Output impedance : 50ohm Frequency: Maximum 100KHz, adjustable Output amplitude: 0-15Vp-p, adjustable LCD Type DC Voltmeter with ranges 200mV, 2V, 20V, 200V LCD Type Ampere Meter DC with ranges 200mA and 2A. Trainer should consist of various modules. All the necessary components required to perform the experiment be installed on the module. This trainer should be able to perform the following experiments: 1. To observe the characteristics of differential amplifier. 2. Op-amp characteristics. 3. Inverting amplifier. 4. Non inverting amplifier. 5. Inverting AC amplifier. 6. Comparator with op-amp. 7. Schmitt triggers using an op- amp. 8. Wein bridge oscillator. 9. Class A amplifier. 10. Class AB amplifier. 11. Class C amplifier. 12. Series regulator.	10

	13. Phase locked loop. 14. Sine/Cosine oscillator. 15. Combined square and triangular wave generator, 16. Active filters. 17. Integrator using op-amp. 18. Differentiator using op-amp	
40	**Solar MPPT Meter** • Battery capacities from 30Ah to 200Ah. • USB Supported and built-in printer for report generation. • 12V cranking lead acid battery test • 12/24V charging or cranking system test • Display battery capacity, voltage, resistance and life • Four-termina Kelvin test • 10 types of battery standards	02

2. Advance Telecommunication Lab:

Sr. No.	Name of Item with Specifications	Qty
1..	**ANTENNA TRAINER** The components of the trainer: • Generator Panel • Mast and Base • Detector • Halfwave Dipole Antenna • Halfwave Folded Dipole Antenna • Yagi-Uda Antenna • Horizontal End-Fed Antenna • Ground Plane (Marconi) Antenna • Slot Antenna • Loop Antenna • Lambda ¼ antenna • Lambda ½ antenna • Combined Collinear antenna • Helix antenna • Antenna current sensor • Parabolic antenna **Study topics:** • Setup of a typical antenna test bed • Review of theory basics • Basic set-up • Generator adjustments • The matching stub • SWR measurements • Radiation polar diagrams • Half-Wavelength dipole and folded dipole • YAGI-UDA antenna • Horizontal End-fed antenna • Ground plane • Slot antenna • Loop antenna	02
2.	**FIBER OPTIC COMMUNICATION TEACHING SET** **Topic areas:** • Amplitude modulation of a light source. • Transmission of signals over a fiber optic cable. • Recovery of original signal at the receiver. • Advantages of modulating a light source with a digital signal. • Analog signal transmission by frequency modulation of a digital subcarrier. • Analog signal transmission by PWM of a digital sub-carrier. • Digital communication via fiber optic cable. • Computer to computer communication using two modules.	02

	• Troubleshooting of faults in fiber optic transmitter and receiver circuits. **Fiber optic polishing kit:** A complete package of hardware, designed for use in conjunction with the Fiber Optic Transmitter/Receiver to enable students to carry out a comprehensive range of experiments that cover the polishing and preparation of fiber optic cable terminations. The Fiber optic polishing kit should comprise the following items: Microscope, microscope adaptor, polishing block, polishing surface, polishing fluid bottle, carrying case and user manual. **Polishing kit accessory pack.** To be used with the Fiber Optic Polishing Kit providing all the consumable items required to perform the experimentation comprising the following items: 10 lengths of polymer fiber optic cable (0.5m long), 20 fiber optic cable connectors, 1 pack of lint free tissue, 10 sheets of 600 grit abrasive paper, 10 sheets of 30 micron lapping film, 10 sheets of 3 micron lapping film, storage case. **Physics of fiber optics system.** To study the physics of fiber optics. Used in conjunction with a Fiber Optic Transmitter/Receiver, the system enables students to investigate the following areas: • Relationship between cable attenuation & cable length. • Coupling losses in fiber optic transmission. The Physics of Fiber Optics System comprises the following items: Optic fiber alignment module, a range of optic fiber cables of varying lengths, two in-line coupling connectors and a user manual. Complete with set of 36 x 4mm leads, Power supply, Computer Aided Instructions, Curriculum text and student workbook	
3.	**TRANSMISSION LINE TRAINER** **Topic areas include:** • Attenuation. • Delay Using a Pulse • Matching Using a Pulse Input. • Reactive Termination. • Noise in Communications • AC Coupling of Pulse Inputs. • Matching and Frequency Response. • Standing Waves. • Transformer Matching. • Low Pass Filter Effect	02

	• The 50 ohm line as an oscillator. • Time Domain Reflectometry. **Activities include:** • Predict the attenuation along a practical transmission line in decibels and Nepers. • Measure a delayed pulse using the simulated 50 ohm line. • Measure reflections using the simulated 50 ohm line. • Observe the effect of a reactive termination using the simulated 50 ohm line. • Observe noise added to a pulse signal using the simulated 50 ohm line. • Observe the effect of AC coupling on pulse signals. • Plot the frequency response of a mismatched simulated 50 ohm line. • Observe standing waves using the Standing Wave Display circuit. • Use the Transmission Line Trainer to demonstrate the low pass filter effect. • Identify the principles of TDR. • Use the principles of TDR to find faults on the Transmission Line Trainer. The teaching set comprises: • Transmission line trainer (includes laboratory manual) • Set of 36 x 4mm leads. • Power supply • Instructor's solutions book	
4.	**MICROWAVE KIT / MICROWAVE TRAINING SYSTEM** **Standard Kit contents:** • Solid state Oscillator • 2K25 Klystron • Klystron Tube Mount • Transitions • Frequency Meter • Slotted Line • Variable Flap Attenuators • Termination • Thermistor Mount • Power Supply (thermistor Bridge & Amplifier) • H-Plane tee • Directional Coupler • Fixed Attenuator • Fixed Attenuator • Cable RG-9”N” to “N” Male	01

	• Cable RG-58 BNC to BNC Male • E-Plane tee • Tuning Probe • Detector Mount • E-H Plane • Waveguide Stands • Horn Antennas • Shorting Plate • Bag: 8/32 screw and nuts • Training Manual **List of Experiments / lessons the trainer covers:** • Transmission Line theory • Measurement of Power • Standing Wave Ratio • Frequency and wavelength • Measurement of Impedance • Attenuator • Microwave tuner • Directional Coupler • Series Tees and Shunt Tees • Detectors and Mixers • Reflection Loss • Propagations of Microwaves • Microwave Antennas • Slid State Characteristics • Instructor can use their own configuration or develop their own experiments. **IMPORTANT NOTE:** The **Power Meter** and **VSWR Meter** are built into the Power Supply unit	
5.	**DIGITAL SATELLITE COMMUNICATION TRAINER** A complete system for reception of TV signals from all satellites of the Mediterranean, Middle East and Asia regions: ASTRA, EUTELSAT, (HOT BIRD) and others. The system is organized to be used as a training instrument and consist of the followings:- - Parabolic antenna, 60cm diameter, offset type, with LNB - Antenna mounting and cabling accessories - Receiver with following major features:- o 22kHz tone to control external antennas	02

	○ 199 pre-selectable channels ○ 2 GHz tuner (920 – 2050 MHz) ○ Compatible also with ASTRA I D Satellite ○ UHF output modulator (CH 30 – 45) ○ Remote controller The system is supplied with all accessories and facilities to make installation and use simple and efficient.	
7.	**GSM Test Set** Voltage ranges: 85 to 130 V and 180 to 264 V AC Frequency range: 45 to 66 Hz Power consumption: 170 VA maximum Functional Tests Call Set-up - MO & MT Call Termination - MO, MT & Call lost Synchronized Handover Transmitter Tests Tx Test - Power, Phase & Frequency Error, Power Profile, Modulation Spectrum, Burst Timing Power Levels/Steps Timing Advance Receiver Tests Rx Test - CII & CIb BER, FER, RXQUAL, RXLEV, GPRS BLER,Sensitivity (Absolute) Speech & Data Tests Voice Loopback Send speech Receive speech SMS point to point MO & MT With all accessories and Operational Manual in English.	05
9	**E-PABX** **8+24 along with console and receiver**	02
10.	**4G/5G Smart Phone Trainer Kit (Mobile Trainer Board)** Network : GSM / HSPA / LTE - 2G bands : GSM 850 / 900 / 1800 / 1900 - SIM 1 & SIM 2 - 3G bands : HSDPA 850 / 900 / 1900 / 2100 - 4G bands : LTE band 1(2100), 3(1800), 5(850), 8(900), 20(800), 40(2300) • CPU - Exynos 3475 - 1.3GHz Cortex-A7 quad-core - Mali-T720 • Operating system : Android • RAM : 1 GB	05

	• Internal Storage : 8 GB • External Storage : Up to 256 GB • Display - Type : Super AMOLED capacitive touch screen, 16M colors - Size : 4.7 inches, 60.9 cm2 (~64.7% screen-to-body ratio) - Resolution : 540 x 960 pixels, 16:9 ratio (~234 ppi density) • Camera - Selfie Camera : 2 MP, f/2.2 - Rear Camera : 5 MP • Communication - WLAN : Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot - Bluetooth : 4.1, A2DP - GPS : Yes, with A-GPS, GLONASS GPS - Radio : FM radio, RDS, recording • Sensors : Accelerometer, proximity • Battery : Li-Ion 2000 mAh battery • Connectivity : USB 2.1Version, 3.5mm Stereo Ear jack, Bluetooth Version v4.1 • On-board Blocks - Dual SIM block : Two no of DUAL SIM Slots is provided. - Li-ion battery block : Battery Block is provided - Display block : 4.7 inch TFT Display is provided - Power & Volume block : Keypad block with Power and Volume control Key is provided - MIC block : MIC for Audio Input is provided. - Hand free MIC block : Hand free MIC block is provided - Speaker block : Speaker block is provided - Ear phone block : Ear Phone block is provided to connect, Ear phone for Audio output - Vibrator motor block : Vibrator motor block is provided - USB block : USB block is provided for data Transfer with Computer - Power supply block : Power supply block for charging the battery. • 43 Test points are provided to analyze signals at various points. • 11 no's of Fault Switches with 34 faults are Provided • All ICS are mounted on IC Sockets. • Bare board Tested Glass Epoxy SMOBC PCB with Block Diagram. • AC Input : 230V ± 10%, 50 Hz • Attractive ABS Enclosure With all accessories and Operational Manual in English.	

11.	**Power beam dishes for wireless internet connection (point to point internet)** With all accessories included to establish a point to point internet connection	02
12	**OTDR** Wavelength : 1528 - 1567 nm Interface: USB, RJ-45, LAN Internal Data Storage: upto 2GB Display: 7 inch Fiber type: single mode/ multi-mode Distance range: 0.1 - 100 Km Power Range :-50 to 27 dBm Power Supply: 100 to 240 VAC, 50 to 60 Hz With all accessories and Operational Manual in English.	02
13	**Optical Power Meter** 1-5KM Visual Fault Locator with FC-LC Adapter Fiber Optic Cable Tester Checker Test Tool for CATV	02
14	**FIBER OPTICS SPLICING MACHINE** • Fiber type: single mode / multimode • Display: LCD monitor with touch screen • Fiber alignment method : Active core alignment • Interface: PC, USB, Bluetooth • Input: AC100 to 240V, 50/60Hz, Max. 1.5A • Output: DC14.4V, 6380mAh • Capacity :300 splice and heat cycles • Temperature: 0-40 C • Protection and heat performance sleeve • Illumination : V-grooves LED lamp • Splice mode : 100 splice modes • Heat mode : 30 heat modes • Splice result: 20000 splices • Splice image : 100 images • Splice time: SM FAST mode : Avg. 7 to 12sec. • Splice time: AUTO mode : Avg. 14 to 20sec • Fiber holder • DC Adapter • DC power cord • J-Plate • Automatic fusion control • Splicing machine box • Optical Fiber Tool kit • With all accessories and Operational Manual in English.	03

15	**GPS Device**	02
16	**Optical Line Terminal (OLT)**	05
17	**Optical Network Unit (ONU)**	05
18	**Optical fiber Stripper**	05
19	**Optical fiber Cleaver**	05
20	**Optical Fiber Tool Kit** Tools: Fiber Cable slitter Round cutter Alfa cutter Side cutter Plier Nose plier Sheath cutter Loose tube cutter Screw drivers	05
21	PON meter	05
22	Cable locator	05
23	**Optical Fiber Identifier** 0.25/0.9/2.0/3.0 mm Optic Dominant Traffic Detector Multi in one Chucks with 800-1700nm Cable Tester Indicate the signal presence or absence(Live or dark fiber) Power Source: Battery power	05

3. Basic Telecommunication Lab:

Sr. No.	Name of Item with Specifications	Qty
1.	**Analogue & Digital Communications Training System,** Covering: Basic Analog Communications: AM, FM, DSB, SSB, PM, PAM, TDM, PWM, Superheterodyne, Speech in Comms, PLL, QAM, SNR Concepts and more Digital Communications: PCM, PCM-TDM, ASK, BPSK, FSK, GFSK, Eye Patterns, DPSK, QPSK, Spread Spectrum, Line Coding, Noise Generation, SNR Concepts and more	10
2	Screwdriver Set (Precision)	10
3	Rework Station	10
4	PCB Holder/Clamp	
5	Magnifying Lamp with LED Light	10
6	Wire Stripper and Cutter	10
7	Suction Pen	10
8	Brush Set	10
9	Desoldering Pump	10

10	Hot Glue Gun	10
11	**Mobile Repair Tool Kit** ESD mat with wrist strap Air gun hot plate USB Tester Repair insulation pad cleaning agent screw driver set 100-in-1 interchangeable precise manual tool set. With all accessories and Operational Manual in English.	10
12	Ultrasonic Cleaner	10
13	Battery Analyzer and Tester	02
14	Microscope with Camera	02
15	UV Lamp	02
16	Heat Gun	02
17	Mobile Phone Flashing Box/Tool Kit	02
18	LCD Tester (Universal)	02
19	BGA Rework Station	02
20	Replacement Screens and Batteries	05
21	**Multiplexer Trainer** Perform FDM,TDM CDM	05
22	**Lab View Simulator**	01
23	**Mobile Training Kit** Dual band 900 / 1800 MHz GSM / GPRS Modem. Data, SMS, Voice. Onboard RS-232 & USB connector for PC Communication. 20 Membrane keys with multifunctional operation. GLCD 128x64 for display. On board RTC with independent battery backup. Onboard Mic and Speaker interface. SMA antenna connector with antenna. Sliding / fixed landing SIM holder (3.3V/5V SIM interf.) Remote control by AT commands (according to GSM 07.07 and GSM 07.05) Maximum output power 2W for GSM 900: 1W for GSM 1800. Bare board Tested Glass Epoxy SMOBC PCB is used. In-Built SMPS of 12V/2A. With all accessories and Operational Manual in English.	10
24	AutoCAD	1
25	MS Visio	1
26	Proteus	1
27	CST	1
28	Electronic workbench	1

29	Packet tracer simulator	1
30	DSL Modem	05
31	DSL/IP TV modem	05
32	Routers	05
33	Network cards	10
34	Biometric machines	02
35	Fingerprint recognition system	02
36	RFID System	02
37	QR code scanner	02
38	Bar code scanner	02
39	PABX Equipment	02
40	Complaint management System Robocall software	01
41	Cordless phones	05
42	Walkie-Talkie sets/handset	05
43	Video surveillance Equipment	05
44	Wi-Fi routers	05
45	Satellite Dish Antenna with all accessories	02
46	Telephone set	10
50	Guided medium demonstration kits	05
51	Telephone Cable and Drop Wire Construction Kit	05
52	Wi-Fi System installation kit Crimping tool for RJ11, RJ12, RJ45 RJ45 Punch down tool	05
59	Fault injection/detection equipment	05
60	PABX fault repair equipment	02
61	Underground cable fault repair tools (TDR)	05
62	Cisco Network assistant tool	02
63	Camera Analog	02
64	Camera IP (4MP)	02
65	Camera PTZ (4MP)	02
66	Camera Dome (4MP)	02
67	Camera Bullet (4MP)	02
68	DVR/NVR 8 channel with all accessories	02
69	**Mobile phone Screen Splitter(separator)** Compatable for cellphonne screen size: 14 inch Temperature: 300-400 C Power: 600w; Input: 110V-250V 50 / 60HZ; Hot plate Built-in vaccum pump temperature controller With all accessories and Operational Manual in English.	10
70	**Hot air station** Power consumption:Wind gun 480W Welding table 90W Screen split 600W Temperature range:Wind gun 100-480 °C Welding table 200-480 °C	10

	Screen split 50-150°C Type of airflow:Brushless fan, gentle wind. Air flow:120 litres per cent(max.) With all accessories and Operational Manual in English.	
71	**Universal Battery Checker Tester with Leads LCD Display Compatibility** a. 1.2V Ni-MH Cylindrical Batteries: AAAA, AAA, AA, A, C, SC, D b. 1.4V Zinc air battery: A10, A13, A312, A675 c. 1.5V alkaline cylindrical batteries: AAA, AA, C, SC, D d. 1.5V alkaline button cell e. 3.0V lithium manganese button cell f. 3.0V lithium manganese column battery: CR123A, CR2 g. 6.0V lithium manganese battery pack: 2CR5, CR-P2 h. 3.2V lithium iron phosphate battery i. 3.7V lithium-ion battery j. 9.0V alkaline battery k. 12.0V alkaline batteries: 23A, 27A With all accessories and Operational Manual in English.	10
72	Cable Testers	05
73	Desktop computers As per MIS TEVTA	25

MINIMUM QUALIFICATION FOR TEACHER/INSTRUCTOR/JR. INSTRUCTOR

Post	Qualification	Experience
Jr. Instructor	DAE Fields: 1. Telecommunication 2. Electronics 3. Electrical	4 Years
Instructor	BSc. Engineering/BE/ BSc.Tech Fields: 1. Telecommunication 2. Electronics 3. Electrical	2 Years
Instructor	MSc. Engineering/MS/M.Tech Fields: 1. Telecommunication 2. Electronics 3. Electrical	NIL

i) A degree in English/ Islamiat / Pst. with 2 years of teaching experience

ii) M.Sc. degree in IT / Computer Sciences or BE in Computer Engineering/ Sciences with 2-years of teaching experience

iii) M.Sc. degree in Mathematics with 2-years of teaching experience

iv) M.Sc. degree in Physics / Chemistry with 2-years of teaching experience

v) MBA/ MBEcon./ BBA (Hons.) degree with 2-years of teaching experience

vi) DAE Mechanical technology/ BSc Mechanical engineering with relevant 4-years' experience for the subject of workshop practice and drawing subjects

Employability & Vertical mobility of Occupations / designations

PTCL/ Semi Govt. org:-

Supervisor→ Associate Engineer→ Tech. Manager

Assistant Business Manager (ABM)→ Project Manager

Engg. Supervisor → Asstt. Manager→ Dy. Manager

Armed Forces (Signal Core): -

Technical Officer →Commissioned officer-→ Senior commissioned officer

POF, WAh:-

Chargeman,→ Asstt. Foreman → Foreman

Various Pvt. Organizations" (like Nokia, Huawei,etc.) -

Technician → Supervisor → Associate Engineer.

Other Jobs at PTCL are "Splicer", Cable Jointer etc

Curriculum Revision Committee

Dr. Raees Muhammad Asif Assistant professor Tainjin University Lahore	**Convener**
Dr. Shahid Iqbal Assistant Professor, National University of Technology Islamabad.	**Member**
Kanwal Farooq Manager, NESCOM Pakistan	**Member**
Zulaikha Bukhari Assistant Manager PTCL Lahore.	**Member**
Syed Hammad Gillani Instructor Telecom, GCT Bhawalpur	**Member**
Hafez Muhammad Waqas Hassan Instructor Telecom, GCT Taxila	**Member**
Zahid Ali Instructor Telecom, GCT Pindi Bhattian	**Member**