GOVERNMENT OF THE PUNJAB
PUNJAB BOARD OF TECHNICAL EDUCATION
21-A Kashmir Block, Allama Iqbal Town, Lahore.

04299260273

PBTE/RES/Res/O/260810/0015

Dated the 10th August, 2026

N O T I F I C A T I O N

In pursuance of the NAVTTC Notification No. (D.G) (SS&C)/2021-QD-1- (Pt-II) dated 13.04.2026, it is notified that the newly developed curriculum of the **DAE in Drone Application Technology** has been approved by National Vocational & Technical Training Commission (NAVTTC) for its implementation in all institutes affiliated with PBTE.

2. The implementation of said technology shall apply on the students who shall be registered for academic session 2026-27 and onward. Punjab Board of Technical Education shall conduct the examination of the said technology w.e.f. 1st Annual Examination 2027.Soft copy of the curriculum of the said technology may be downloaded from the website of PBTE i.e. **https://www.pbte.edu.pk/ptextbooks.aspx**

PBTE
Senior Clerk-II (Research) (Senior Clerk)
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(MUHAMMAD HAFEEZ)
SECRETARY
PUNJAB BOARD OF TECHNICAL EDUCATION

C.C.

A copy is forwarded for information and necessary action to the:-

1) ***PS to Chairperson, PBTE. Lahore***
2) ***PS to Director General (PSDA), Punjab, Lahore***
3) ***PS to Director General (Academics), TEVTA, Lahore.***
4) ***PS to Director General (Ops-I), TEVTA Lahore.***
5) ***PS to Director General (Ops-II), TEVTA Lahore.***
6) ***PA to Secretary, PBTE, Lahore***
7) ***PA to COE, PBTE, Lahore***
8) ***All Principals, affiliated institutes for DAE program.***
9) ***System Analyst, PBTE, Lahore.***
10) ***Database Administrator, PBTE Lahore.***
11) ***Data Processing Officer, PBTE, Lahore.***
12) ***Computer Programmer, PBTE Lahore.***
13) ***AS (Recognition) Section, PBTE, Lahore***
14) ***AS (Registration) Section, PBTE, Lahore.***

15) ***ACE (P&P-I) Section, PBTE, Lahore.***
16) ***ACE (P&P-II) Section, PBTE, Lahore.***
17) ***ACE (C&V) Section, PBTE, Lahore.***
18) ***ACE NSU, PBTE, Lahore.***
19) ***AS (Certificate) Section, PBTE, Lahore.***
20) ***Web Administrator PBTE, to upload at Board's website.***

PBTE
Senior Clerk-II (Research) (Senior Clerk)
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CURRICULUM
For
THREE YEARS' DIPLOMA OF ASSOCIATE ENGINEER
IN
DRONE APPLICATION TECHNOLOGY

Entry Level: -	Matriculation (Science) or Equivalent
Duration of Course: -	Three Years
Credit Hours: -	**71** (Annual System)
Methodology:-	Theory 44%
	Practical 56%
Examination System:-	Annual System (the same as other DAEs programs)

National University of Technology

NUTECH, Islamabad

DAE in DRONE TECHNOLOGY
SCHEME OF STUDIES

FIRST YEAR

Course code		Course Name	T	P	C
Gen	111	Islamiat & Pakistan Studies	1	0	1
TTQ/CIVICS	111	Tarjuma Tul Quran/CIVICS	1	0	1
CIT	101	Occupational Health Safety & Environment	1	0	1
Eng	112	English	2	0	2
GenC	112	Chinese Language-1	2	0	2
Math	123	Applied Mathematics-I	3	0	3
Phy.	132	Applied Physics	1	3	2
Ch.	132	Applied Chemistry	1	3	2
ELTR	124	Electrical Circuits	3	3	4
DAT	112	Introduction to Electronics Technology	1	3	2
DAT	113	Mechanical Engineering Drawing & CAD	1	6	3
DAT	123	Introduction to Unmanned Aerial Vehicle (UAV) Technology	2	3	3
Total			**19**	**21**	**26**

SECOND YEAR

Course code		Course Name	T	P	C
Gen	201	Islamiat & Pak Studies	1	0	1
TTQ/CIVICS	211	Tarjuma Tul Quran/CIVICS	1	0	1
Math	233	Applied Mathematics-II	3	0	3
CIVIL	271	Entrepreneurship	1	0	1
GenC	212	Chinese Language-2	2	0	2
MgmC	212	Understanding China	2	0	2
BDT	212	Python Programming Basics	1	3	2
DAT	212	Micro-Controllers and Embedded System	1	3	2
DAT	213	Introduction to Unmanned Aerial Vehicle (UAV) Aerodynamics	2	3	3
DAT	223	Introduction to Unmanned Aerial Vehicle (UAV) Autopilot system	2	3	3
DAT	233	Introduction to Unmanned Aerial Vehicle (UAV) Motors and Batteries	2	3	3
Total			**18**	**15**	**23**

THIRD YEAR

Course Code		Course Name	T	P	C
Gen	301	Islamiat & Pak Studies	1	0	1
DAT	311	Metalworking Technology (Fitter Training)（金工实习，刘硕）	0	3	1
DAT	312	UAV Assembly and Debugging（张钦彦）	1	3	2
DAT	313	Drone Formation Flight（无人机编队飞行，刘硕）	2	3	3
DAT	314	UAV Ground Station System（刘硕）	3	3	4
DAT	322	Drone Aerial Photography Application（张钦彦）	1	3	2
DAT	323	UAV surveying and mapping application（无人机测绘应用，李勤超）	2	3	3
DAT	333	UAV Intelligent Perception and Information Processing（无人机智能感知与信息处理，李勤超）	2	3	3
DAT	343	The Operation of UAV flight（无人机飞行操控，马江华）	1	6	3
Total			**13**	**27**	**22**

1ST YEAR

اسلامیات/مطالعہ پاکستان

		ٹی	پی	سی
حصہ اول اسلامیات	GEN III			
حصہ دوم مطالعہ پاکستان		1	0	1
موضوعات حصہ اول اسلامیات	سال اول	کل وقت: 20 گھنٹے		

کتاب و سنت

(ا) قرآن مجید

-1 تعارف قرآن مجید 2- نزول قرآن 3- مکی و مدنی سورتوں کی خصوصیات 4- وحی کی اقسام 5- پندرہ منتخب آیات مع ترجمہ

1.1 تنالو البر حتی تنفقوا مما تحبون
1.2 واعتصموا بحبل اللّٰہ جمیعا" ولا تفرقو
1.3 ولا یجرمنکم شنان قوم علی ان لا تعدلوا
1.4 ان اللّٰہ یامرکم ان تودوا الامانات الی اھلھا
1.5 ان اللّٰہ یامر بالعدل والاحسان
1.6 ان الصلوتہ تنھی عن الفحشاء والمنکر
1.7 لقد کان لکم فی رسول اللّٰہ سوۃ حسنتہ
1.8 ان اکرمکم عند اللّٰہ اتقاکم
1.9 وما آتاکم الرسول فخرزووما نھی عنھوا انتھوا
1.10 ولوفو بالعھد
1.11 وماشروھن بالمعروف
1.12 یمحق اللّٰہ الربوویر بی الصمدقات
1.13 واصبر علی ما اصابک
1.14 وقولو قولا سدیدا
1.15 ان الدین عند اللّٰہ السلام

(ب) سنت

-1 سنت کی اہمیت
-2 دس منتخب احادیث مع ترجمہ و تشریح

حصہ اول

حصہ اسلامیات

تدریسی مقاصد

1- 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
- ☆ قرآن مجید کی مکی و مدنی سورتوں کی پہچان کر سکے
- ☆ منتخب آیات کا ترجمہ و تشریح کر سکے

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

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

2- سنت

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

خصوصی مقصد:

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

3- منتخب احادیث نبویہ

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

خصوصی مقصد: احادیث کا ترجمہ و تشریح کر سکے

رسول اللہ ﷺ کے اسوۂ حسنہ کی پیروی کا جذبہ پیدا ہو سکے

دین اسلام

عمومی مقاصد: دین اسلام کے بنیادی مقاصد اور عبادات کے بارے میں جان سکے اور بیان کر سکے

خصوصی مقاصد

لفظ دین اسلام کے لغوی اور اصطلاحی معنی بیان کر سکے

اسلام کے بنیادی مقاصد کی اہمیت بیان کر سکے

اسلام کے بنیادی مقاصد سے انسان کی انفرادی و اجتماعی زندگی پر پڑنے والے اثرات بیان کر سکے

عبادت کے لغوی و اصطلاحی معنی بیان کر سکے

عقیدے اور عبادت کا فرق بیان کر سکے

عبادات (نماز، روزہ، حج، زکوٰۃ) کے فوری اشکلات اور انسانی زندگی پر ان کی اثرات بیان کر سکے

اسلامی مقاصد و عبادات کے مطابق اپنی زندگی ڈھال کر ایک اچھا مسلمان بن سکے

(غیر مسلم طلباء کے لئے)

ڈی	بی	سی
1	0	1

نصاب اخلاقیات سال اول — GEN III

حصہ دوم مطالعہ پاکستان

کل وقت - 20 گھنٹے

موضوعات

اخلاقیات کی تعریف اور اہمیت

اخلاقیات کا معیار (قانون، عقل، الہامی کتب)

مندرجہ ذیل اخلاق کی وضاحت

- ☆ دیانت داری
- ☆ وفاداری
- ☆ نظم و ضبط
- ☆ راست گوئی
- ☆ صبر و استقلال
- ☆ حوصلہ مندی
- ☆ وقت کی پابندی
- ☆ صفائی
- ☆ ایثار
- ☆ باہمی احترام
- ☆ مصلحت

نصاب اخلاقیات (سال اول)

تدریسی مقاصد

عمومی مقاصد: اعلیٰ اخلاق کی وجہ سے ملکی ترقی میں مثبت قدر اضافہ کر سکے

خصوصی مقاصد: طالب اس علم سے اس قابل ہو گا کہ

- ☆ موضوعات کا مطلب بیان کر سکے
- ☆ عملی زندگی سے مثالوں کی نشاندہی کر سکے
- ☆ اپنی شخصیت اور معاشرے پر موضوعات کے مثبت اثرات پیدا کرنے کے طریقے بیان کر سکے
- ☆ دیانت داری کی اہمیت بیان کر سکے
- ☆ وفاداری کی اہمیت بیان کر سکے
- ☆ نظم و ضبط کی افادیت بیان کر سکے
- ☆ صدق بیان کی ضرورت بیان کر سکے
- ☆ حوصلہ مندی کے فوائد بیان کر سکے
- ☆ وقت کی پابندی کے فوائد بیان کر سکے
- ☆ صفائی اور باہمی اتفاق سے حسن کارکردگی کو بیان کر سکے
- ☆ مصلحت کے فوائد بیان کر سکے

نصاب (سال اول) (Part III)

حصہ دوئم — مطالعہ پاکستان — کل وقت 12 گھنٹے

موضوعات

- ☆ تحریک فکر: مسلمان قوم میں آزادی فکر کی تاریخ، مسلمانوں میں سیاسی آزادی کی اہمیت اور ضرورت - ذاتی، جماعتی غلامی کے تصورات
- ☆ نظریہ پاکستان

قیام پاکستان کی اساس (دین اسلام) قیام پاکستان کی غرض و غایت، نظریہ پاکستان کی وضاحت، نظریہ پاکستان اور علامہ اقبال اور قائداعظم کے ارشادات کی روشنی میں

- ☆ نظریہ پاکستان کا تاریخی پس منظر

محمد بن قاسم کی آمد، مجدد الف ثانی اور شاہ ولی اللہ کی تبلیغی خدمات، سید احمد شہید کی تحریک مجاہدین

- ☆ تعلیمی تحریکیں

علی گڑھ - ندوۃ العلماء (لکھنؤ) - مدرسۃ الاسلام - (کراچی) اسلامیہ کالج (پشاور) انجمن حمایت اسلام (لاہور)

مطالعہ پاکستان (حصہ دوئم)

تدریسی مقاصد

حریت فکر:

عمومی مقصد

طالب علم یہ جان لے کہ اسلام میں اور مسلمان قوم میں آزادی فکر کی کیا اہمیت ہے

خصوصی مقاصد

☆ حریت فکر کا معنی و مفہوم بیان کر سکے

☆ آزادی فکر کی اہمیت بیان کر سکے

☆ خصوصاً اسلام میں آزادی اظہار رائے کی اہمیت بیان کر سکے

☆ ذہنی غلامی کے قومی سطح پر نقصانات کے بیان کر سکے

☆ جسمانی غلامی قومی سطح پر نقصانات بیان کر سکے

نظریہ پاکستان

عمومی مقصد:

نظریہ پاکستان (دین اسلام) سے پوری طرح واقفیت ہو جائے

خصوصی مقاصد:

☆ نظریہ کی تعریف بیان کر سکے اور اس کی وضاحت کر سکے

☆ نظریہ پاکستان کی تعریف کر سکے اور اس کا مفہوم بیان کر سکے

☆ علامہ اقبال اور قائداعظم کے فرمودات کی روشنی میں نظریہ پاکستان بیان کر سکے

نظریہ پاکستان کا تاریخی پہلو

عمومی مقصد

☆ نظریہ پاکستان کے تاریخی پس منظر سے واقفیت حاصل کر سکے

خصوصی مقاصد:

☆ محمد بن قاسم کے بارے میں بیان کر سکے

- محمد بن قاسم کے ہندوستان پر حملہ کی وجہ بیان کر سکے
- محمد بن قاسم کے ہندوستان پر حملہ کے اثرات بیان کر سکے
- 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 کے جو تبلیغ دین اور مسلمانوں میں سیاسی شعور پیدا کیا اسے بیان کر سکے

علمی تحریکیں

عمومی مقصد

- برصغیر کی علمی تحریکوں سے آگاہی حاصل ہو سکے

خصوصی مقاصد:

- علی گڑھ - دیوبند - ندوت العلماء مدرسۃ السلام ، 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

TARJUMA TUL QURAN/CIVICS

Course Code: TTQ/CIVICS - 111
Total Contact Hours : 32

		T	P	C
Theory :	**32**	**1**	**0**	**1**
Practical:	**0**			

As per Syllabus of BISE from PCTB Book

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Version of PCTB Textbook

ہدایات برائے اساتذۂ کرام

1. ترجمہ قرآنِ مجید کی تدریس اس طرح کیجیے کہ طلبہ کی کردار سازی ہو سکے۔ وہ علم و عمل میں ترقی کر سکیں اور قرآنِ مجید سے ان کے تعلق اور محبّت میں اِضافہ ہو۔ تدریسِ قرآنِ مجید کا بنیادی مقصد تربیت، اصلاح اور کردار سازی ہے۔
2. عربی متن کے ساتھ ترجمہ پڑھایا جائے۔ ترجمہ پر خاص توجہ دیتے ہوئے اسے بار بار دہرایا جائے، تاکہ طلبہ کو اس سے زیادہ سے زیادہ آگاہی حاصل ہو اور وہ اُس کو سمجھ سکیں۔
3. عربی متن کی تلاوت کے دوران یہ خیال رکھا جائے کہ الفاظ کو ادا کرنے کا طریقہ بالکل درست ہو۔
4. کلاس میں ایسے طلبا و طالبات سے تلاوت کرائی جائے جن کی تجوید درست ہو۔
5. جہاں تک ممکن ہو سکے اساتذہ خود بھی باوضو ہوں اور طلبہ کو بھی اس کا پابند بنائیں، تاکہ پاکیزگی اور طہارت کے ساتھ اس عمل کو انجام دیا جائے اور روحانی برکات کا بھی حصول ہو۔
6. طلبہ میں قرآنِ مجید کی تلاوت کے آداب کا مذاکرہ کرائیے۔
7. قرآنی نصوص/متن سے متعلّق سوال و جواب کے ذریعے سے طلبہ کی استعداد میں اضافہ کیجیے۔
8. سابقہ اَسباق کے اِعادے کا اصول اپنائیے۔
9. کوئز پروگرام، آن لائن اَیپ اور دستاویزی فلم سے اِستفادہ کرتے ہوئے تدریس کی کوشش کیجیے۔
10. متعلقہ جماعت کے لیے مقرّرہ حصّۂ قرآنِ مجید کی تمام سورتوں کا تعارف اور مرکزی مضامین پر مشتمل تفصیلی، مختصر اور کثیر الانتخابی سوالات کے ذریعے سے امتحان لیں۔
11. گیارھویں جماعت کے لیے مختص ذخیرۂ قرآنی الفاظ میں سے ہی ماڈل پیپر کی طرز پر امتحان لیا جائے۔
(گیارھویں جماعت کے منتخب ذخیرۂ الفاظِ قرآنی اور ماڈل پیپر اس کتاب کا حصّہ ہیں۔)
12. نمبروں کی تقسیم سے متعلّق ہدایات کے لیے ماڈل پیپر سے اِستفادہ کریں۔

Web Version of PCTB Textbook

OCCUPATIONAL HEALTH SAFETY & ENVIRONMENT

Course Code: CIT-101
Total Contact Hours: 32

		T	P	C
Theory:	**32**	**1**	**0**	**1**
Practical:	**0**			

AIMS

This introductory course on computer-related health and safety in the IT industry aims to instill a strong safety mindset in students. It covers the various causes of safety hazards in IT workplaces, helping students identify and understand these risks. The course emphasizes the importance of maintaining a safe work environment and teaches theoretical principles of health and safety specific to the IT industry.

Learning Outcomes:
The students will be able to

1. Recognize Health and Safety Issues in IT: Learn about health and safety problems in IT workplaces and with computers and smart devices.
2. Apply Environmental Protection Concepts: Understand and use ideas to protect the environment while working with computers.
3. Practice Safety Measures: Follow safety steps to protect physical, mental health of individuals and groups in computer labs and workplaces.
4. Incorporate Health and Safety in Daily Life: Develop habits for maintaining mental and physical health and safety every day, while using computers or working in an information technology environment.

COURSE CONTENTS

1. Understanding General OHS Concepts **04 Hours**

1.1 What is OHS?

1.1.1. Introduction to Occupational Health and Safety (OHS)
1.1.2. OHS regulations and legislation
1.1.3. Identifying potential workplace hazards and risks
1.1.4. Roles and responsibilities of employers, employees, and supervisors in maintaining a safe workplace

2. Physical, Mental, and Social Health Issues **12 Hours**

2.1 Eyesight Issues

2.1.1. Digital eyestrain, dryness, blurred vision, headaches
2.1.2. Solutions: 20-20-20 rule, monitor adjustment, avoiding glare, maximizing screen size, screen lighting and setting adjustment, document holder use, artificial tears, washing face with water
2.2. Wrist, Elbow & Hand, Arm, Shoulder Issues
2.2.1. Repetitive strain injury, carpal tunnel syndrome, symptoms of overuse injuries
2.2.2. Occupational overuse syndrome, work-related upper limb disorder (WRULD)

2.3. Backbone & Neck Issues

2.3.1. Lower back pain or neck pain due to poor workstation design, bad chair, poor posture, sitting for long periods

2.4. Legs and Feet Issues

2.4.1. Increased risk of blood clots from sitting without stretching legs

2.5. Hearing Issues

2.5.1. Hearing loss from high volume headphone use

2.6. Mental Health Issues

2.6.1. Nervous breakdowns, photosensitive epileptic seizures, sleep disorders from late-night device use

2.7. Social Health Issues

2.7.1. Stress disorders, behavioral problems, loneliness, depression, anxiety, aggression, low social relationships, obsessive-compulsive disorder (OCD)

2.8. Lifestyle Diseases

2.8.1. Obesity, constipation, digestion issues, diabetes, hypertension, cardiovascular issues from long sittings and sedentary lifestyle

2.8.2. Solutions: reduce junk and processed diet, soda, caffeine, use green and leafy vegetables, fruits, dairy and protein, eating and sleeping time according to circadian rhythm, daily exercise and social interaction, meditation and prayers

3. Introduction to OHS in Information Technology — 04 Hours

3.1. OHS in IT

3.1.1. Understanding OHS regulations and legislation in the IT industry

3.1.2. Identifying potential workplace hazards and risks in IT environments

3.2. Ergonomics and Workplace Design

3.2.1. Ergonomic principles and best practices in IT workstations

3.2.2. Assessing and mitigating ergonomic risks in IT work environments

3.2.3. Designing and maintaining a safe and comfortable IT workplace

3.3. Electrical Safety and IT Equipment

3.3.1. Electrical hazards in IT environments

3.3.2. Safe use and maintenance of IT equipment and tools

3.3.3. Proper handling and storage of batteries and other power sources

3.4. Emergencies and IT Incidents

3.4.1. Preparing for and responding to emergencies in IT workplaces

3.4.2. IT incident response and management

3.4.3. IT security and data protection during emergencies

4. OHS Considerations While Working Online — 06 Hours

4.1. Introduction to OHS for Remote Workers

4.1.1. Understanding OHS for remote workers

4.1.2. Regulations and legislation for remote work

4.1.3. Identifying potential workplace hazards and risks while working online

4.2. Ergonomics and Workstation Setup for Remote Work

4.2.1. Ergonomic principles and best practices for remote workstations

4.2.2. Assessing and mitigating ergonomic risks in remote work environments

4.2.3. Designing and maintaining a safe and comfortable remote work environment

4.3. Cyber Security and Information Security for Remote Work

4.3.1. Understanding cyber security risks and threats for remote workers

4.3.2. Strategies for protecting sensitive personal and organizational information

4.3.3. Best practices for secure remote access and online communication

4.3.4. Reporting individual cyber security issues to local and online organizations

4.4. Work-Life Balance and Mental Health in Remote Work

4.4.1. Maintaining a healthy work-life balance while working remotely

4.4.2. Strategies for preventing burnout and promoting mental health and well-being

4.4.3. Communicating effectively with colleagues and supervisors while working remotely

4.5. Emergency Preparedness

4.5.1. Incident management for remote work

4.5.2. Preparing for and responding to emergencies in remote work environments

4.5.3. Incident response and management in remote work environments

4.5.4. Cyber security and data protection during emergencies while working online

5. Workstation/Workshop Designing **06 Hours**

5.1. Setting Up a Computer Lab

5.1.1. Considerations for sunlight, artificial lighting, fresh air, ventilation, social interaction, gender-based harassment, noise, heat, radiation

5.2. Workshop Layout Preparation

5.2.1. Designing a suitable workshop layout based on lab space and equipment ratio

5.3. Workstation Setup

5.3.1. Minimum working space for individuals and teams

5.4. Routine Cleaning and Maintenance

5.4.1. Designing and following SOPs and checklists for cleaning and maintenance

5.5. Precaution Measures

5.5.1. Noise, heat, electrostatic discharge precautions, reporting, and correction procedures

5.6. Working Posture and Sitting Position

5.6.1. Correct posture and sitting positions concerning table, chair, keyboard, and display

REFERENCE 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
3. "Ergonomics for Beginners: A Quick Reference Guide" by Jan Dul and Bernard Weerdmeester, 2019, CRC Press, ISBN: 9780367350138
4. "Digital Minimalism: Choosing a Focused Life in a Noisy World" by Cal Newport, 2019, Publisher: Portfolio, ISBN: 9780525536512

INSTRUCTIONAL OBJECTIVES

1. Understanding General OHS Concepts

1.1. Define Occupational Health and Safety (OHS) and its importance.

1.2. Describe OHS regulations and legislation.

1.3. Identify potential workplace hazards and risks.

1.4. Explain the roles and responsibilities of employers, employees, and supervisors in maintaining a safe workplace.

2. Physical, Mental, and Social Health Issues

2.1. Eyesight Issues

2.1.1. Explain digital eyestrain, dryness, blurred vision, and headaches.

2.1.2. Apply solutions such as the 20-20-20 rule, monitor adjustment, avoiding glare, maximizing screen size, screen lighting and setting adjustment, document holder use, artificial tears, and washing the face with water.

2.2. Wrist, Elbow & Hand, Arm, Shoulder Issues

2.2.1. Describe repetitive strain injury, carpal tunnel syndrome, and symptoms of overuse injuries.

2.2.2. Identify occupational overuse syndrome and work-related upper limb disorder (WRULD).

2.3. Backbone & Neck Issues

2.3.1. Explain lower back pain or neck pain caused by poor workstation design, bad chair, poor posture, and sitting for long periods.

2.4. Legs and Feet Issues

2.4.1. Describe the increased risk of blood clots from sitting without stretching legs.

2.5. Hearing Issues

2.5.1. Explain hearing loss from high volume headphone use.

2.6. Mental Health Issues

2.6.1. Describe nervous breakdowns, photosensitive epileptic seizures, and sleep disorders from late-night device use.

2.7. Social Health Issues

2.7.1. Explain stress disorders, behavioral problems, loneliness, depression, anxiety, aggression, low social relationships, and obsessive-compulsive disorder (OCD).

2.8. Lifestyle Diseases

2.8.1. Describe obesity, constipation, digestion issues, diabetes, hypertension, and cardiovascular issues from long sittings and sedentary lifestyle.

2.8.2. Apply solutions such as reducing junk and processed diet, soda, caffeine, using green and leafy vegetables, fruits, dairy and protein, eating and sleeping time according to circadian rhythm, daily exercise and social interaction, meditation, and prayers.

3. Introduction to OHS in Information Technology

3.1. OHS in IT

3.1.1. Understand OHS regulations and legislation in the IT industry.

3.1.2. Identify potential workplace hazards and risks in IT environments.

3.2. Ergonomics and Workplace Design

3.2.1. Explain ergonomic principles and best practices in IT workstations.

3.2.2. Assess and mitigate ergonomic risks in IT work environments.

3.2.3. Design and maintain a safe and comfortable IT workplace.

3.3. Electrical Safety and IT Equipment

3.3.1. Identify electrical hazards in IT environments.

3.3.2. Practice safe use and maintenance of IT equipment and tools.

3.3.3. Properly handle and store batteries and other power sources.

3.4. Emergencies and IT Incidents

3.4.1. Prepare for and respond to emergencies in IT workplaces.

3.4.2. Implement IT incident response and management.

3.4.3. Ensure IT security and data protection during emergencies.

4. OHS Considerations While Working Online

4.1. Introduction to OHS for Remote Workers

4.1.1. Understand OHS for remote workers.

4.1.2. Explain regulations and legislation for remote work.

4.1.3. Identify potential workplace hazards and risks while working online.

4.2. Ergonomics and Workstation Setup for Remote Work

4.2.1. Apply ergonomic principles and best practices for remote workstations.

4.2.2. Assess and mitigate ergonomic risks in remote work environments.

4.2.3. Design and maintain a safe and comfortable remote work environment.

4.3. Cyber Security and Information Security for Remote Work

4.3.1. Understand cyber security risks and threats for remote workers.

4.3.2. Implement strategies for protecting sensitive personal and organizational information.

4.3.3. Apply best practices for secure remote access and online communication.

4.3.4. Report individual cyber security issues to local and online organizations.

4.4. Work-Life Balance and Mental Health in Remote Work

4.4.1. Maintain a healthy work-life balance while working remotely.

4.4.2. Implement strategies for preventing burnout and promoting mental health and well-being.

4.4.3. Communicate effectively with colleagues and supervisors while working remotely.

4.5. Emergency Preparedness

4.5.1. Manage incidents for remote work.

4.5.2. Prepare for and respond to emergencies in remote work environments.

4.5.3. Implement incident response and management in remote work environments.

4.5.4. Ensure cyber security and data protection during emergencies while working online.

5. Workstation/Workshop Designing

5.1. Setting Up a Computer Lab

5.1.1. Consider sunlight, artificial lighting, fresh air, ventilation, social interaction, gender-based harassment, noise, heat, and radiation.

5.2. Workshop Layout Preparation

5.2.1. Design a suitable workshop layout based on lab space and equipment ratio.

5.3. Workstation Setup

5.3.1. Determine minimum working space for individuals and teams.

5.4. Routine Cleaning and Maintenance

5.4.1. Design and follow SOPs and checklists for cleaning and maintenance.

5.5. Precaution Measures

5.5.1. Implement noise, heat, electrostatic discharge precautions, reporting, and correction procedures.

5.6. Working Posture and Sitting Position

5.6.1. Practice correct posture and sitting positions concerning table, chair, keyboard, and display.

ENGLISH

Course Code: Eng-112
Total Contact Hours: 64

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

AIMS

At the end of the course, the students will be equipped with cognitive skill to enable them to present facts in a systematic and logical manner to meet the language demands of dynamic field of commerce and industry for functional day-to-day use and will inculcate skills of reading, writing and comprehension.

COURSE CONTENTS

ENGLISH PAPER "A"

1 PROSE/TEXT **16 Hours**

1.1 First eight essays of Intermediate English Book-II

2 CLOZE TEST **4 Hours**

2.1 A passage comprising 50-100 words will be selected from the text. Every 11th word or any word for that matter will be omitted. The number of missing words will range between 5-10. The chosen word may or may not be the one used in the text, but it should be an appropriate word.

ENGLISH PAPER "B"

3 GRAMMAR **26 Hours**

3.1 Sentence Structure.
3.2 Tenses.
3.3 Parts of speech.
3.4 Punctuation.
3.5 Change of Narration.
3.6 One word for several
3.7 Words often confused

4. COMPOSITION **8 Hours**

4.1 Letters/Messages
4.2 Job application letter
4.3 For character certificate/for grant of scholarship
4.4 Telegrams, Cablegrams and Radiograms, Telexes, Facsimiles
4.5 Essay writing
4.6 Technical Education, Science and Our life, Computers, Environmental Pollution, Duties of a Student.

5. TRANSLATION **10 Hours**

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

REFERENCE BOOKS

1. Intermediate English Book-II.
2. An English Grammar and Composition of Intermediate Level.

3. A Hand Book of English Students Bzy Gatherer.

INSTRUCTIONAL OBJECTIVES

PAPER-A

1. DEMONSTRATE BETTER READING, COMPREHENSION AND VOCABULARY

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

2. UNDERSTAND FACTS OF THE TEXT

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

PAPER-B

3. APPLY THE RULES OF GRAMMAR IN WRITING AND SPEAKING

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

4. APPLY THE CONCEPTS OF COMPOSITION WRITING TO PRACTICAL SITUATIONS

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

5. APPLY RULES OF TRANSLATION

5.1 Describe confusion.
5.2 Describe rules of translation.
5.3 Use rules of translation from Urdu to English in simple paragraphs and sentences.

CHINESE LANGUAGE

Course Code: GenC-112
Total Contact Hours: 64

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

PART ONE

AIMS

This course consists of 32 classes (including mid-term test and final test). After completing this part, students can master the primary Chinese language knowledge taught in the content of the course, and be able to achieve and exceed the **HSK level One**.

INSTRUCTION OBJECTIVE

The course is mainly for zero-based learners. Through the study of this course, learners can lay a solid language foundation and have a preliminary understanding of Chinese language structure, including Pinyin, Chinese characters, words, grammar and other knowledge. After completing this course, learners can understand and use some basic words and sentences, and complete the most basic communication, such as greeting, asking, introducing, shopping and so on.

COURSE CONTENTS

PART ONE

1. **LESSON 1 HELLO VS NǏHǍO** **1 Hour**
   This lesson briefly introduces pinyin and spelling methods.
2. **HELLO!** **1 Hour**
   This lesson briefly introduces the sentence patterns used in greeting, such as dialogue, greeting farewell, and introducing one's own name.
3. **LESSON 3 I AM THAI** **1 Hour**
   Teach students to understand basic classroom language, learn to use "national + person" for simple communication dialogue, and introduce which country they come from.
4. **LESSON 4 WHAT'S THE DATE TODAY** **1 Hour**
   This lesson introduces the expression of numbers, years, months, etc., and teaches students to ask about a date and answer it.
5. **LESSON 5 THIS IS MY BROTHER** **1 Hour**
   By introducing family members, students can understand the simple words when asking about family status and introduce them briefly.
6. **LESSON 6 I'M NINETEEN YEARS OLD** **2 Hours**
   This lesson expands quantifiers and animal names, and introduces the expression of age, so that students can ask and answer each other's age correctly.
7. **LESSON 7 WHAT TIME IS IT** **2 Hours**
   This lesson introduces the usage of hours, minutes and seconds, so that students can describe their lives with time points.
8. **LESSON 8 WHAT DO YOU LIKE TO DO ON WEEKENDS** **2 Hours**
   This lesson introduces the expressions of hobbies, interests, activities and other related nouns, so as to help students communicate with each other by using simple linking sentences.
9. **SEMI-MID-TERM REVIEW** **2 Hours**
   Mid-term review is a summary of the knowledge learned in the past. The test paper uses the knowledge points learned in the past to design listening questions, answering questions by looking at pictures, connecting questions, filling in blanks, etc., which are illustrated with

pictures and interesting, and can test students' learning effect.

10. LESSON 9 INTRODUCE YOURSELF 2 Hours

Explain the related expressions related to self-introduction, and students can correctly introduce their names, families, ages, hobbies, school majors, etc.

11. LESSON 10 MY FATHER IS IN BEIJING 2 Hours

This lesson introduces the names of major cities in China, Britain and Europe, and introduces the use of "person + place" in sentences.

12. LESSON 11 I CAME TO BEIJING BY PLANE 2 Hours

This lesson introduces the means of transportation and how to express long sentences in combination with the time and place learned before.

13. LESSON 12 I EAT AT THE COMPANY 2 Hours

This lesson introduces the polite expressions used in eating.

14. LESSON 13 THE WEATHER IS FINE ON MONDAY 2 Hours

It shows the conversations and topics that may appear when you want to date.

15. LESSON 14 HOW MUCH IS IT ALTOGETHER 2 Hours

This lesson introduces the vocabulary and sentences commonly used in shopping, and how to use Chinese for daily shopping.

16. LESSON 15 WHAT WOULD YOU LIKE TO HAVE 2 Hours

This lesson introduces the classic Chinese and Thai cuisine, the terms of treating guests, and the communicative terms of how to order food in restaurants.

17. LESSON 16 THE BATHROOM IS NEXT TO THE PANTRY 2 Hours

This lesson introduces location and location words, and how to use location words to introduce the location of a place.

18. SEMI- FINAL REVIEW 2 Hours

Similar to the mid-term test questions, it is a test of important knowledge points of the course to test students' learning effect. This lesson briefly introduces pinyin and spelling methods.

PART TWO

AIMS

After completing this part, students can master the basic Chinese language knowledge taught in the content of the course, and be able to reach and exceed **HSK Level TWO.**

INSTRUCTION OBJECTIVE

Learners can master the language knowledge and use some basic grammar and sentence patterns in communication, learn to express personal feelings and attitudes in Chinese, and can complete communicative functions such as gratitude, apology, introduction and farewell, and begin to understand Chinese cultural knowledge and cultivate interest in learning.

COURSE CONTENTS

1. LESSON 1 I WAS STILL SLEEPING AT 7 O'CLOCK 1 Hour

This lesson introduces the grammatical points of "still", so that students can correctly understand the meaning of sentences related to "still" and use this sentence pattern correctly for communication.

2. LESSON 2 IT WILL BE CLOUDY TOMORROW 1 Hour

By introducing the weather in several Chinese cities, explain how to use temperature to answer weather questions.

3. LESSON 3 THAT ONE IS FIVE HUNDRED DOLLARS CHEAPER THAN THIS ONE

1 Hour

This lesson explains comparative sentences, and compares them in terms of price, height and temperature, so that students can understand comparative sentences thoroughly.

4. LESSON 4 THIS IS A FAMILY PHOTO **1 Hour**

This lesson introduces family members in detail through appearance, clothing and occupation, so that students can master more detailed description methods.

5. LESSON 5 IT IS FORBIDDEN TO TAKE PICTURES HERE **2 Hours**

This lesson leads students to understand the relevant knowledge points of expressing commands, such as forbidden and forbidden, so that students can correctly understand the meaning of words in daily life.

6. LESSON 6 I CAN'T FIND SOMETHING **2 Hours**

This lesson introduces the use of language points in "V + should + result complement", so that students can correctly use relevant sentence patterns in communication.

7. LESSON 7 I HAVE BEEN TO SICHUAN AND SEEN PANDAS **2 Hours**

This lesson introduces Chinese culture through "V + have been to", such as the Great Wall, the Forbidden City, national treasures, etc., so that students can use this sentence pattern correctly in communication.

8. LESSON 8 I HOPE YOU CAN COME TO MY WEDDING **2 Hours**

By introducing Chinese weddings, this lesson enables students to master the verbal usage of banquet invitation, holiday blessing, emotional expression and euphemistic refusal.

SEMI-MID-TERM REVIEW **2 Hours**

This section leads students to review the knowledge points they have learned in the past and conduct mid-term tests through reading pictures, listening questions and connecting questions to test students' learning effect.

9. LESSON 9 BE ILL, TAKE MORE REST **2 Hours**

This lesson introduces the vocabulary related to illness and the doctor's medication advice, so that students can correctly describe and understand the doctor's meaning in the process of seeing a doctor.

10. LESSON 10 THE STATION IS JUST ACROSS THE ROAD **2 Hours**

This lesson introduces the way of asking places and answers by asking directions, which helps students to use relevant sentence patterns for practical communication questions and answers.

11. LESSON 11 SHE SINGS VERY WELL **2 Hours**

This lesson focuses on hobbies and introduces the correct use of related words in sentences.

12. LESSON 12 DID YOU DO WELL IN THE EXAM **2 Hours**

By describing the examination process and the situation of answering questions, students can correctly understand the instructions of the examination room, the distribution of questions and the analysis of test paper problems

13. LESSON 13 BUY TWO AND GET ONE FREE **2 Hours**

This lesson introduces the commodity names of supermarkets, as well as common terms such as promotional activities, discounts and price reductions.

14. LESSON 14 WE'RE A NEW RESTAURANT 2 Hours

This lesson helps students understand how to understand the waiter's recommendation and put forward the food requirements for ordering.

15. LESSON 15 THE GIRL IS DRESSED IN WHITE CLOTHES 2 Hours

This lesson introduces others' clothes and how to use grammar points to describe the state of something through "V + be dressed in".

16. LESSON 16 YOU CAN BE DISCHARGED FROM HOSPITAL NEXT WEEK 2 Hours

This lesson introduces a variety of expressions, such as hospitalization, visiting patients and discharge, so that students can understand the language of hospital scenes and strengthen their multi-scene communication ability.

17. SEMI- FINAL REVIEW 2 Hours

This section is similar to the mid-term review, which leads students to review the knowledge points they have learned in the past and conduct final tests by looking at pictures, listening questions, connecting questions, etc., to test students' learning effect.

REFERENCE BOOKS:

Tang Chinese Course 1 for Part Two
Tang Chinese Course 2 for Part Two

APPLIED MATHEMATICS-I

Course Code: Math-123
Total Contact Hours: 96

		T	P	C
Theory	**96**			
Practical	**0**	**3**	**0**	**3**

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

AIMS

After completing the course the students will be able to

1. Solve problems of Algebra, Trigonometry, vectors, Mensuration, Matrices and Determinants.
2. Develop skill, mathematical attitudes and logical perception in the use of mathematical
3. instruments as required in the technological fields.
4. 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 & 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 & circular system
- 4.5 Relation between Length of a Circular Arc & 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 & 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 & 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 products of sums
10.3 Binary, decimals and octal, presentation of decimal numbers in BCD
10.4 Interconversion of numbers
10.5 OR Gates and AND Gates
10.6 Logical Expressions and their simplifications
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 Ration 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 equations
- 13.2 General Form of Equation
- 13.3 Radius and Coordinates of Center
- 13.4 Problems

REFERENCE BOOKS:

1. Ghulam Yasin Minhas, Technical Mathematics Vol I, Ilmi Kitab Khana, Lahore
2. Riaz Ali Khan, Polytechnic Mathematics Series Vol- I and Vol -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

INSTRUCTIONAL OBJECTIVES

1. 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. UNDERSTAND 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. UNDERSTAND 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. UNDERSTAND 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 vectors.
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 problems 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 complementation 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. UNDERSTAND 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 the equation of a straight line.
12.2 Derive slope intercept and intercept forms of equations of a straight line.
12.3 Write a general form of equations of a straight line.
12.4 Derive an expression for the 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 the 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.

APPLIED PHYSICS

Course Code: Phy-132
Total Contact Hours: 128

		T	P	C
Theory:	**32**			
Practical:	**96**	**1**	**3**	**2**

AIMS

The students will be able to understand the fundamental principles and concepts of Physics, use these to solve problems in practical situations/technological courses and understand concepts to learn advanced Physics/technical courses.

COURSE CONTENTS

1. MEASUREMENTS **03 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 **03 Hours**

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

3. MOTION **04 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 **04 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 **04 Hours**

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 **04 Hours**

6.1. Review laws of reflection and refraction
6.2. Image formation by mirrors and lenses

6.3. Optical instruments
6.4. Waves 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 **02 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 **03 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 principles
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 **03 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 **02 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

REFERENCE BOOKS:

1. Tahir Hussain, Fundamentals of Physics Vol. – I and II
2. FaridKhawaja, Fundamental of Physics Vol. – I and II
3. Wells and Slusher, Schaum's Series Physics
4. Nelkon and Oyborn, Advanced Level Practical Physics
5. MehboobIllahi Malik and Inam-ulHaq, Practical physics
6. Wilson, Lasers – Principles and Applications
7. M. Aslam Khan and M. AkramSandhu, Experimental Physics Note Book

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 the law of conservation of momentum to practical/technological problems.
   - 3.2 Explain relation between liner 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. **UNDERSTAND CONCEPTS OF SOUND**
   - 5.1 Describe longitudinal waves 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's 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 formulas to solve problems.
   - 6.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g., microscope, telescopes, camera and sextant.

7. **UNDERSTAND 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. **UNDERSTAND THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER**
   - 8.1 Explain the structure of the optical fiber.
   - 8.2 Explain its principles of working.
   - 8.3 Describe use of optical fiber in industry and medicine.

9. UNDERSTAND 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's contents.

10. UNDERSTAND 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 the spectrum of electromagnetic waves.

11. UNDERSTAND 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.

LIST OF PRACTICALS

Lab 1: Draw graphs representing the functions:
- 1.1. $Y=mx$ for $m=0, 0.5, 1,2$
- 1.2. $Y=x^2$
- 1.3. $Y=1/x$

Lab 2: Find the volume of a given solid cylinder using Vernier calipers.
Lab 3: Find the area of cross-section of the given wire using a micrometer screw gauge.
Lab 4: Proven that force is directly proportional to (a) mass, (b) acceleration, using Fletcher's trolley.
Lab 5: Verify law of parallelogram of forces using Grave-sands apparatus.
Lab 6: Verify law of triangle of forces and Lami's theorem.
Lab 7: Determine the weight of a given body using:
- 7.1. Law of parallelogram of forces.
- 7.2. Law of triangle of forces.
- 7.3. Lami's theorem.

Lab 8: Verify law op polygon of forces using grave-sands apparatus.
Lab 9: Locate the position and magnitude of resultant of like parallel forces.
Lab 10: Determine the resultant of two unlike parallel forces.
Lab 11: Find the weight of a given body using the principle of moments.
Lab 12: Locate the centre of gravity of regular and irregular shaped bodies.
Lab 13: Find Young's Modules of Elasticity of a metallic wire.
Lab 14: Verify Hooke's Law using helical springs.
Lab 15: Study of frequency of stretched string with length.
Lab 16: Study of variation of frequency of stretched string with tension.
Lab 17: Study the resonance of the air column in the resonance tube and find velocity of sound.
Lab 18: Find the frequency of the given tuning fork using a resonance tube.
Lab 19: Find velocity of sound in rod by Kundt's tube.
Lab 20: Verify rectilinear propagation of light and study shadow formation.
Lab 21: Study the effect of rotation of plane mirrors on reflection.
Lab 22: Compare the refractive indices of given glass slabs.

Lab 23: Find focal length of concave mirror by locating centre of curvature.
Lab 24: Find focal length of concave mirror by object and image method.
Lab 25: Find focal length of concave mirror with converging lens.
Lab 26: Find refractive index of glass by apparent depth.
Lab 27: Find refractive index of glass by spectrometer.
Lab 28: Find focal length of converging lens by plan mirror.
Lab 29: Find focal length of converging lens by displacement method.
Lab 30: Find focal length of diverging lenses using converging lenses.
Lab 31: Find focal length of diverging lens using concave mirror.
Lab 32: Find angular magnification of an astronomical telescope.
Lab 33: Find angular magnification of a simple microscope (magnifying glass).
Lab 34: Find angular magnification of a compound microscope.
Lab 35: Study working and structure of cameras.
Lab 36: Study working and structure of sextant.
Lab 37: Compare the different scales of temperature and verify the conversion formula.
Lab 38: Determine the specific heat of lead shots.
Lab 39: Find the coefficient of linear expansion of a metallic rod.
Lab 40: Find the heat of fusion of ice.
Lab 41: Find the heat of vaporization.
Lab 42: Determine relative humidity using a hygrometer.

APPLIED CHEMISTRY

Course Code: Ch-132
Total Contact Hours: 128

	T	P	C
Theory: 32			
Practical : 96	**1**	**3**	**2**

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

AIMS

After studying this course a student will be able to:

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

COURSE CONTENTS

1. INTRODUCTION **2 Hours**

1.1 The scope and significance of the subject.
1.2 Orientation with reference to Technology.
1.3 Terms used & units of measurements in the study of chemistry.

2. FUNDAMENTAL CONCEPTS OF CHEMISTRY **2 Hours**

2.1 Symbols, Valency, Radicals, formulas.
2.2 Chemical Reactions & their types.
2.3 Balancing of equations by ionic method.

3. ATOMIC STRUCTURE **2 Hours**

3.1 Sub-atomic particles.
3.2 Bohr's Atomic Model.
3.3 The periodic classification of elements and periodic law
3.4 General characteristics of a period and group.

4. CHEMICAL BOND **2 Hours**

4.1 Nature of chemical Bond.
4.2 Electrovalent bond with examples.
4.3 Covalent Bond (Polar and Non-polar, sigma & Pi Bonds with examples.
4.4 Co-ordinate Bond with examples.

5. SOLIDS AND LIQUIDS **3 Hours**

5.1 The liquid and Solid's state.
The liquids and their general properties (Density, viscosity, surface tension capillary action
e tc).
5.3 Solids and their general properties.
5.4 Crystal structure of solids
5.5 Crystals of Si and Ge.

6. WATER **3 Hours**

6.1 Chemical nature and properties.
6.2 Impurities.
6.3 Hardness of water (types, causes & removal)
6.4 Scales of measuring hardness (Degress Clark, French, PPM, Mgm per litre).
6.5 Boiler feed water, scales and treatment.
6.6 Sea-water desalination, sewage treatment.

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

7.1 Definitions with examples.
7.2 Properties, their strength, basicity & Acidity.
7.3 Salts and their classification with examples.
7.4 pH-value and scale.

8. OXIDATION & REDUCTION **2 Hours**

8.1 The process with examples.
8.2 Oxidizing and Reducing agents.
8.3 Oxides and their classifications.

9. NUCLEAR CHEMISTRY **2 Hours**

9.1 Introduction.
9.2 Radioactivity (Alpha, beta and gamma rays).
9.3 Half-life process.
9.4 Nuclear reaction & transformation of elements.
9.5 Isotopes and their uses.

10. ALLOYS **2 Hours**

10.1 Introduction with need.
10.2 Preparation and properties.
10.3 Some important alloys and their composition.

11. CORROSION **2 Hours**

11.1 Introduction with causes.
11.2 Types of corrosion.
11.3 Rusting of Iron
11.4 Protective measures against corrosion.

12. ELECTRO CHEMISTRY **2 Hours**

12.1 Ionization and Arrhenius theory of Ionization.
12.2 Electrolytes and Electrolysis.
12.3 Faraday's Laws and numericals related to them.
12.4 Application of Electrolysis (Electron, lathing etc).
12.5 Electro Chemical cells.

13. ELECTRICAL INSULATING MATERIALS. **2 Hours**

13.1 Introduction.
13.2 Solid insulators with chemical nature.
13.3 Liquid insulators with chemical nature.
13.4 Gaseous insulators with chemical nature.
13.5 Uses and their classification.

14. SEMI CONDUCTORS. **2 Hours**

14.1 Introduction

14.2 Atomic structure of silicon and germanium.
14.3 Bonding & Conductivity.
14.4 Energy bands in a semiconductor.

15. ETCHING PROCESS. **2 Hours**

15.1 The process and its aims.
15.2 Etching reagents.
15.3 Applications of processors.

REFERENCE BOOKS

1. Intermediate Text-Books of chemistry I & II
2. ILMI Applied Science by SH. Ata Mohammed
3. Materials science by J.C.Anderson & Leaver.
4. Polytechnic Chemistry by G.N.Ready (ELBS & Nelson, Hong Kong).
5. Chemistry for engineers by Eric Gyngell.

INSTRUCTIONAL OBJECTIVES

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

1.1 Define chemistry and its terms.
1.2 Define the units of measurements in the study of chemistry.
1.3 Explain the importance of chemistry in various fields of specialization.
1.4 Explain the role of chemistry in this technology.

2. UNDERSTAND LANGUAGE OF CHEMISTRY AND CHEMICAL REACTIONS.

2.1 Define symbol, valency, radical, formula with examples of each.
2.2 Write a chemical formula of common compounds.
2.3 Define chemical reaction and equations.
2.4 Describe types of chemical reactions with examples.
2.5 Explain the method of balancing the equation by ionic method.

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

3.1 Define atoms.
3.2 Describe the fundamental sub atomic particles
3.3 Distinguish between atomic no. mass no. and between isotope and isobars.
3.4 Explain the arrangements of electrons in different shells and sub energy levels and understand Bohr's atomic model.
3.5 Explain the grouping and placing of elements in the periodic table, especially Si & germanium.
3.6 State the periodic law of elements.
3.7 Explain the trend of properties of elements based on their position in the periodic table.
3.8 Explain general characteristics of a period and a group.

4. UNDERSTAND THE NATURE OF CHEMICAL BONDS.

4.1 Define chemical Bond.
4.2 State the nature of chemical bonds.
4.3 Differentiate between electrovalent and covalent bonding.
4.4 Explain the formation of polar and non-polar, sigma and pi-bond with examples.
4.5 Describe the nature of coordinate bonds with examples.

5. UNDERSTAND THE STATES OF MATTER AND DISTINGUISHES SOLIDS FROM GASES.

5.1 Describe the liquid and solid states of matter.
5.2 State the general properties of liquid.
5.3 State the general properties of solid.
5.4 Explain the formation of crystals and their types.
5.5 Describe the crystal structure of Si and Ge.

6. UNDERSTAND THE CHEMICAL NATURE OF WATER.

6.1 Describe the chemical nature of water with its formula.
6.2 Describe the general impurities present in water.
6.3 Explain the causes and methods to remove hardness of water.
6.4 Express hardness in different units like mg/litre. p.p.m, degrees Clark and degrees French.
6.5 Describe the formation and nature of scales in boiler feed water.
6.6 Explain the method for the treatment of scales.
6.7 Explain the sewage treatment and desalination of sea water.

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

7.1 Define acids, bases and salts with examples.
7.2 State general properties of acids and bases.
7.3 Differentiate between acidity and basicity.
7.4 Define salts, give their classification with examples.
7.5 Explain pH value of solution and pH scale.

8. UNDERSTAND THE PROCESS OF OXIDATION AND REDUCTION.

8.1 Define oxidation.
8.2 Illustrate the oxidation process with examples.
8.3 Define reduction.
8.4 Explain the reduction process with examples.
8.5 Define oxidizing and reducing agents and give at least six examples of each.
8.6 Define oxides.
8.7 Classify the oxides and give examples.

9. UNDERSTAND THE FUNDAMENTALS OF NUCLEAR CHEMISTRY.

9.1 Define nuclear chemistry and radio activity.
9.2 Differentiate between alpha, beta and gamma particles.
9.3 Explain the half-life process.
9.4 Explain at least six nuclear reactions resulting in the transformation of some elements.
9.5 State the uses of isotopes.

10. UNDERSTAND THE NATURE OF ALLOYS USED IN THE RESPECTIVE TECHNOLOGY.

10.1 Define alloy.
10.2 Explain different methods for the preparation of alloys.
10.3 Explain important properties of alloys.
10.4 Explain the composition, properties and uses of alloys.

11. UNDERSTAND THE PROCESS OF CORROSION.

11.1 Define corrosion.
11.2 Describe different types of corrosion.
11.3 State the causes of corrosion.
11.4 Explain the process of rusting of iron.
11.5 Describe methods to prevent/control corrosion.

12. UNDERSTAND THE APPLICATION OF ELECTROCHEMISTRY IN DIFFERENT FIELDS OF INDUSTRIES.

12.1 Define ionization, electrolyte and electrolysis.
12.2 Describe Arrhenius theory of ionization.
12.3 State Faraday's laws of electrolysis.
12.4 Apply Faraday's laws of different fields of industry.
12.5 Solves numerical problems on Faraday's Laws.
12.6 Explain the construction and working of Daniel cell and lead accumulator.

13. KNOW THE USE OF INSULATING MATERIALS.

13.1 Define insulator, conductor.
13.2 Classify solid, liquid and gaseous insulators with their chemical nature.
13.3 Describe their uses.

14. UNDERSTAND THE NATURE AND CHEMISTRY OF SEMI CONDUCTORS.

14.1 Define semi -conductors.
14.2 Draw the atomic structure of silicon and germanium.
14.3 Describe the process of bonding and conductivity in conductors and semi-conductors.
14.4 Explain energy bands in semi- conductors.

15. USE ETCHING PROCESS IN DIFFERENT FIELDS OF TECHNOLOGY.

15.1 Define the etching process and its aims.
15.2 Enlist the chemicals/reagents used in the process.
15.3 Explain the use of the process in the technology.

LIST OF PRACTICALS

Lab 1: To introduce the common apparatus, glassware and chemical reagents used in the chemistry lab.
Lab 2: To purify a chemical substance by crystallization.
Lab 3: To separate a mixture of sand and salt.
Lab 4: To find the melting point of substance.
Lab 5: To find the pH of a solution with pH paper.
Lab 6: To separate a mixture of inks by chromatography.
Lab 7: To determine the co-efficient of viscosity of benzene with the help of Ostwald vasomotor.
Lab 8: To find the surface tension of a liquid with a stalagmometer.
Lab 9: To perform electrolysis of water to produce Hydrogen and Oxygen.
Lab 10: To determine the chemical equivalent of copper by electrolysis of Cu SO.
Lab 11: To get introduced with the scheme of analysis of salts for basic radicals.
Lab 12: To analyse 1st group radicals (Ag^{+} - Pb^{++} - Hg^{+}).
Lab 13: To make practice for detection 1st group radicals.
Lab 14: To get introduction with the scheme of II group radicals.
Lab 15: To detect and confirm II-A radicals (hg^{++}, Pb^{++++}, Cu^{+}, Cd^{++}, Bi^{+++}).
Lab 16: To detect and confirm II-B radicals Sn^{+++}, Sb^{+++}, As^{+++}).
Lab 17: To get introduction with the scheme of III group radicals (Fe^{+++} - Al^{+++}, Cr^{+++})
Lab 18: To detect and confirm Fe^{+++}, Al^{+++} and Cr^{+++}.
Lab 19: To get introduction with the scheme of IV group radicals.
Lab 20: To detect and confirm An^{++} and Mn^{++} radicals of IV group.
Lab 21: To detect and conform Co^{++} and Ni^{++} radicals of IV group.

Lab 22: To get introduced with the Acid Radical Scheme.
Lab 23: To detect dilute acid groups.
Lab 24: To detect and confirm CO''_3 and HCO'_3 radicals.
Lab 25: To get introduced with the methods/apparatus of conducting volumetric estimations.
Lab 26: To prepare a standard solution of a substance.
Lab 27: To find the strength of a given alkali solution.
Lab 28: To estimate HCO'_3 contents in water.
Lab 29: To find out the %age composition of a mixture solution of KNO_3 and KOH volumetrically.
Lab 30: To find the amount of chloride ions (Cl') in water volumetrically.

ELECTRICAL CIRCUITS

Course Code: ELTR-124
Total Contact Hours: 192

	T	P	C
Theory: 96			
Practical : 96	**3**	**3**	**4**

AIMS

This course is designed so that the student will be able to learn basic knowledge of electricity and electronics.

Learning outcomes:

After this course the student will be able to:

- Demonstrate an understanding of the principles of operation, applications, ratings, tolerances, coding, and troubleshooting of electrical and electronic components/devices in electrical circuits.
- Apply circuit laws and network theorems to calculate current, voltage, power, and power factor in electrical circuits.
- Explain the fundamentals of DC and AC circuits, as well as the concepts of electrostatics, magnetism, electromagnetism, and resonance.
- Utilize filters and coupling techniques in electronic circuits effectively.

COURSE CONTENTS

(PAPER -A)

1. BASIC PRINCIPLES OF ELECTRICITY — 5 Hours

1.1. Electron theory
- 1.1.1. Structure of atom, K, L, and M shells Energy levels and valence electrons
- 1.1.2. Energy bands with reference to conductors, insulators, and semiconductors

1.2. Electrical quantities
- 1.2.1. potential, current, and resistance
- 1.2.2. Units of electrical quantities
- 1.2.3. Conventional current and electron current

2. DC FUNDAMENTALS — 16 Hours

2.1. Ohm's Law:
- 2.1.1. Definition of Ohm's Law
- 2.1.2. Numerical Problems on Ohm's Law

2.2. Laws of resistance
- 2.2.1. Specific resistance, conductance, and conductivity
- 2.2.2. Effect of temperature on resistance and temp. Coefficient of resistance
- 2.2.3. Problems on $\boldsymbol{R = \rho * L/A}$ and $\boldsymbol{R_t = R_0(1 + \alpha t)}$
- 2.2.4. Resistance in series, parallel, and series-parallel
- 2.2.5. Calculations on combination of resistance and cells in series, parallel and series-parallel combinations.
- 2.2.6. Power and Energy their units and calculations.
- 2.2.7. Power dissipation in resistors.

2.3. Kirchhoff's Laws
- 2.3.1. Introduction of Kirchhoff's Laws.
- 2.3.2. Calculation using KVL and KCL by loop and node methods.

2.4. Resistors
- 2.4.1. Resistor construction and types.

2.4.2. Application of resistors.
2.4.3. Resistors, Power rating.
2.4.4. Resistor, troubles.

2.5. Batteries

2.5.1. Types of DC sources
2.5.2. Types of cells, Primary and secondary cells and their applications
2.5.3. Chemical Energy sources: Lead-acid batteries, mercury, silver oxide etc.
2.5.4. Introduction to tubular batteries, lithium-ion batteries, and safety measures
2.5.5. Solar Energy; Solar Cell
2.5.6. Internal resistance of a cell
2.5.7. Application of cell as constant voltage and constant current source.

3. NETWORK THEOREMS **10 Hours**

3.1. Superposition theorem for complex circuits.
3.2. Numerical calculation based on the superposition theorem
3.3. Thevenin's Theorem circuits simplification
3.4. Numerical calculation base on the Thevenin's theorem
3.5. Norton theorem and current source concept
3.6. Numerical calculation based on the Norton's Theorem
3.7. Star and Delta transformation
3.8. Numerical calculation based on Star and Delta transformation
3.9. Maximum power transfer theorem and its applications

4. ELECTROSTATICS **12 Hours**

4.1. Principle of electrostatic, positive and negative charges
4.2. Laws of electrostatic
4.3. Electrostatic induction and field strength
4.4. Properties of electric lines of force and comparison with magnetic lines
4.5. Dielectric, dielectric strength and its importance permittivity and break down voltage
4.6. Capacitance and capacitors. Capacitance of parallel plate capacitor
4.7. Types and uses of capacitors
4.8. Equivalent capacitance for series, parallel and series parallel combination of capacitors
4.9. Energy stored in capacitors
4.10. Color code, tolerance and rating of capacitors
4.11. Troubles in capacitors

5. MAGNETISM AND ELECTROMAGNETISM **12 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. Electromagnetism, M.M.F. (AT) field intensity (H =AT/L) ampere turns/meter.
5.2.2. B-H curve and magnetic Hystersis.
5.2.3. Electromagnetic induction.
5.2.4. Magnetic field around a current carrying conductor and solenoids cork screw and left hand rules.
5.2.5. Force between two magnetic fields and motor action.
5.2.6. Faraday's Law of Electromagnetic induction ($\boldsymbol{R = Nd\Phi/dt.}$)
5.2.7. Lenz's Law.

(PAPER-B)

6. AC FUNDAMENTALS — 16 Hours

6.1. The simple AC generator.
- 6.1.1. Sine wave, cycle, wavelength, period, frequency and units.
- 6.1.2. AC sine wave form and its characteristics. (Instantaneous, peak, average, rms or effective values and their inter relation).
- 6.1.3. Audio and Radio frequencies, wavelengths and periods frequency spectrum.
- 6.1.4. Types of alternating wave forms(sinusoidal and non-sinusoidal waves). Fundamental wave and harmonics.

6.2. Ohm's Law in AC Circuits
- 6.2.1. AC through pure resistance, Phaser quantities.
- 6.2.2. Phase angle, in-phase, out of phase waves and phase lag & lead and power factor.
- 6.2.3. Calculation of V,I and W for resistive circuits through inductance.
- 6.2.4. Self inductance, and self induced voltage.
- 6.2.5. Inductive reactance ($\boldsymbol{X_L = 2\pi fL}$) Phase relation between V & I.
- 6.2.6. Phaser diagram and power for pure inductor.
- 6.2.7. AC through R-L series circuit.
- 6.2.8. Phaser diagram and power in a R-L series circuit.
- 6.2.9. Time constant ,$\boldsymbol{\tau = L/R}$, and its effect.
- 6.2.10. Impedance, Impedance triangle.
- 6.2.11. AC through R-L parallel circuit.
- 6.2.12. Inductive reactance in series, parallel and series-parallel combination.
- 6.2.13. Q of coil and its effects on selectivity.
- 6.2.14. Skin effect, AF and RF chokes.
- 6.2.15. Troubles in chokes.
- 6.2.16. AC through pure capacitor. Phase relation between V&I and power.
- 6.2.17. Capacitive reactance
- 6.2.18. AC through R-C series circuit.
- 6.2.19. Time constant RC and its effect.
- 6.2.20. Impedance, Impedance triangle.
- 6.2.21. AC through R-C parallel circuit.
- 6.2.22. Capacitive reactance in series, parallel, and series parallel combination.
- 6.2.23. AC through RLC series circuit, phase relation and power calculation.
- 6.2.24. AC through RLC parallel circuit phase relation and power calculation.
- 6.2.25. Simple calculations for RLC circuits.
- 6.2.26. Concepts of real Power ($\boldsymbol{VI\ Cos\Phi}$) and apparent power (VA), power factor. simple calculations.

7. TRANSFORMERS — 8 Hours

7.1. Principle of transformer, mutual inductance, coefficient of mutual inductance.
7.2. Turn ratio and e.m.f. equation
7.3. Construction, types of transformers, core materials.
7.4. Application of transformers in electronics.
7.5. Auto-transformers, principle, advantages, disadvantages and applications.
7.6. Poly phase transformers, star and delta connection.
7.7. Phase and line voltage and current their, inter-relation.
7.8. Transformer losses.
- 7.8.1. Core loss.
- 7.8.2. Hysteressis loss.

8. RESONANCE — 8 Hours

8.1. Condition of resonance and resonant circuit.
8.2. Relation between f, L and C at resonance.
8.3. Series resonant circuit. Impedance of series resonant circuit.

8.4. Current, voltage and impedance characteristic of series resonant circuit.
8.5. Parallel resonant circuit and its impedance
8.6. Characteristics of impedance, current and voltage of a parallel resonant circuit
8.7. Series and parallel resonance curve comparison and Bandwidth.
8.8. Q of circuit, Effect of Q on the slope and width of the resonance curves.
8.9. Relation between the slope of the resonance curve on selectivity.
8.10. Effect of the L.C. ratio on selectivity.
8.11. Use of resonance circuit in radio and TV receivers.

9. FILTERS AND COUPLING CIRCUITS **9 Hours**

9.1. Purpose and action of a filter circuit.
9.2. Principle of filter action.
9.3. Types of filter circuit LPF, HPF, K filter and m drive filter.
9.4. Band Pass filter (BPF) Band Stop filter (BSF)
9.5. Power supply filter.
9.6. Purpose and action of coupling circuit.
9.7. Coefficient of coupling and coupled impedance.
9.8. Type of coupling, RC, Impedance transformer coupling.
9.9. Delay action circuits, R-L and R-C circuits.
9.10. Time constant of R-L & R-C circuits and its importance in rise and fall of circuit current and voltage.

REFERENCE BOOKS

1. Bird J O — Electrical and Electronic Principles and Technology, Second Edition (Newnes, 2004) ISBN 0750665505
2. Bird J O — Electrical Circuit Theory and Technology (Newnes, 2004) ISBN 0750657847
3. Grob, Bernard, Basic Electronics, Eight Edition.

INSTRUCTIONAL OBJECTIVES

(PAPER-A)

1. BASIC PRINCIPLE OF ELECTRICITY.

1.1. Understand electron theory.
1.1.1. Describe the structure of atom.
1.1.2. Describe the K, L, and M shells.
1.1.3. Describe energy level.
1.1.4. Describe valence electron.
1.1.5. Explain energy bands with reference to conductors, insulators & semiconductors.
1.2. Understand Electrical Quantities
1.2.1. Describe potential, current & resistance
1.2.2. Describe units of potential, current & resistance
1.2.3. Differentiate between conventional current and electron current.

2. DC FUNDAMENTALS.

2.1. Understand Ohm's Law.
2.1.1. Define ohm's law
2.1.2. Solve problems on Ohm's law
2.2. Understand Laws of Resistance
2.2.1. Define specific resistance
2.2.2. Define conductor

2.2.3. Define conductivity
2.2.4. Explain the effect of temperature on resistance
2.2.5. Explain coefficient of resistance
2.2.6. Solve problems on $\boldsymbol{R = \rho\, x\, L/A}$ and $\boldsymbol{R_t = Ro\,(1 + xt)}$.
2.2.7. Describe the resistance in series
2.2.8. Describe the resistance in parallel
2.2.9. Describe the resistance in series-parallel
2.2.10. Calculate the combination of resistances and cells, $\boldsymbol{Rt}$, I & V
2.2.11. Define power and energy
2.2.12. Describe units of power and energy
2.2.13. Explain the power dissipation in resistor

2.3. Understand Kirchhoffs' Laws
2.3.1. Define Kirchhoff's laws
2.3.2. Solve problems using Kirchhoff voltage law
2.3.3. Solve problems using kirchhoff current law

2.4. Understand Resistors
2.4.1. Define resistance and resistor
2.4.2. List types of resistors
2.4.3. Enlist use of resistors
2.4.4. Describe resistor colour codes
2.4.5. Describe power rating of resistor

2.5. Understand Batteries
2.5.1. Name types of D.C source
2.5.2. Describe types of cells (Mercury, Silver oxide, Nickel cadmium)
2.5.3. Describe lead acid battery
2.5.4. Describe solar cells
2.5.5. Explain the internal resistance of cell
2.5.6. Use cells in series and parallel of voltage and constant source of current

3. NETWORK THEOREMS.

3.1. Understand Superposition, Thevenin & Norton theorems
3.1.1. Explain Superposition theorem
3.1.2. Solve problems based on superposition theorem
3.1.3. Explain Thevenin's theorem
3.1.4. Solve problems based on Thevenin's theorem
3.1.5. Explain Norton's theorem
3.1.6. Solve problems based on Norton's theorem
3.1.7. Explain transformation of star to delta and delta to star networks
3.1.8. Solve problems based on star, delta transformation

4. ELECTROSTATICS.

4.1. Understanding Electrostatics
4.1.1. Describe principle of electrostatic charges
4.1.2. Explain the effect of negative & positive charges
4.1.3. Describe the laws of electrostatics
4.1.4. Describe electrostatic induction & field strength E
4.1.5. Explain properties of electric lines of force
4.1.6. Compare between electric lines of force and magnetic lines of force
4.1.7. Describe dielectric & dielectric strength/dielectric constant
4.1.8. Describe the importance of dielectric & dielectric strength
4.1.9. Describe capacitor and capacitance
4.1.10. Describe breakdown voltage
4.1.11. Describe the capacitance of parallel plate capacitor
4.1.12. Describe types of capacitors

4.1.13. Describe the use of capacitors
4.1.14. Calculate the total capacitance in series in parallel and series-parallel combination
4.1.15. Explain the energy stored in capacitor
4.1.16. Describe the colour coding, tolerance and voltage rating of capacitors
4.1.17. Describe the troubles in capacitors

5. MAGNETISM & ELECTROMAGNETISM

5.1. Understand magnetism
5.1.1. Describe lines of force, flux, flux density, permeability, reactance & their units
5.1.2. Explain properties of magnetic lines of force
5.1.3. Describe types of magnets
5.1.4. Explain magnetic properties of materials
5.1.5. Define and list ferromagnetic, paramagnetic and diamagnetic materials.
5.1.6. Describe magnetic induction.

5.2. To understand electromagnetism
5.2.1. Describe electromagnetism
5.2.2. Describe magneto-motive force
5.2.3. Describe field intensity (H=AT/L)
5.2.4. Draw B-H Curve 4.2.5 Explain B-H curve
5.2.5. Describe magnetic hystersis
5.2.6. Explain electromagnetic induction
5.2.7. Explain magnetic field around a current carrying conductor
5.2.8. Define inductor
5.2.9. Write formula for inductance base on physical parameters of an inductor [$L = Ur\ x * (N) * 2 * A / L$]
5.2.10. Solve problem using the above formula for inductor
5.2.11. Describe solenoids
5.2.12. Describe cork screw rule and left hand rule
5.2.13. Explain force between two magnetic fields and motor action
5.2.14. Define Faraday's law of electromagnetic induction ($e = Nd\Phi/dt$)
5.2.15. Define Lenz's Law

(PAPER-B)

6. **AC FUNDAMENTALS**.

6.1. Understand A.C Waveform
6.1.1. Describe sine wave (cycle, wave length, period, frequency and their units)
6.1.2. Draw AC sine waveform (sinusoidal, square, saw tooth)
6.1.3. Describe Instantaneous value, peak value, average value, r.m.s. value, effective value and their inter-relation
6.1.4. Describe Audio & Radio frequencies and their wavelengths
6.1.5. Draw the electromagnetic wave spectrum
6.1.6. Define harmonic and fundamental wave.

6.2. Understand AC circuits
6.2.1. Describe Ohm's Law in AC circuits
6.2.2. Describe AC through resistors
6.2.3. Describe phase angle, in phase & out of phase waves
6.2.4. Describe phase lag, lead & power factor
6.2.5. Calculate voltage, current & power(v,i,w) for resistive circuit
6.2.6. Describe AC through inductance using waveforms and phasor diagram
6.2.7. Define self inductance & self induced voltage
6.2.8. Explain inductive reactance ($X_L = 2\pi fL$), phase relation between voltage & current
6.2.9. Draw its phaser diagram
6.2.10. Calculate power for pure inductor
6.2.11. Explain AC through R-L series circuit

6.2.12. Draw phaser diagram for R-L series circuit
6.2.13. Calculate power factor for R-L series circuit
6.2.14. Calculate time constant for L/R
6.2.15. Define impedance
6.2.16. Draw impedance triangle
6.2.17. Explain AC through R-L parallel circuit
6.2.18. Calculate inductive reactance for series, parallel and series-parallel inductor
6.2.19. Describe skin effect
6.2.20. Describe audio frequency chokes
6.2.21. Describe radio frequency chokes
6.2.22. Explain ac through pure capacitor
6.2.23. Explain phase relation between voltage, current & power for AC through capacitors
6.2.24. Calculate capacitive reactance (½ π f C)
6.2.25. Explain AC through R-C series circuit
6.2.26. Explain time constant for R-C series circuit
6.2.27. Explain AC through R-C parallel circuit
6.2.28. Calculate capacitive reactance for capacitor in series, in parallel and series parallel combination
6.2.29. Explain AC through RLC series circuit
6.2.30. Explain phase relation
6.2.31. Calculate power for RLC series circuit
6.2.32. Explain real power ($VI\ Cos\ \Phi$), apparent power (VI)
6.2.33. Calculate power factor

7. TRANSFORMER.

7.1. Understand the transformers
7.1.1. Explain the principle of transformer
7.1.2. Define mutual induction
7.1.3. Define coefficient of mutual induction
7.1.4. Describe turn ratio of transformer
7.1.5. Describe construction of transformer
7.1.6. Enlist the types of transformer
7.1.7. Enlist core material of transformer
7.1.8. Describe auto transformer
7.1.9. Explain star, delta connections of three phase transformer
7.1.10. Explain phase & line voltage for star and delta connection
7.1.11. Explain phase & line current for star and delta connection of three phase system
7.1.12. List the applications of transformer in electronics:
i) step down transformer,
ii) impedance matching
iii) coupling
7.1.13. Explain transformer losses.
7.1.14. Explain hysteresis loss and core loss.

8. UNDERSTAND RESONANCE

8.1. Explain resonance
8.2. Explain the relation between frequency, inductance & capacitance at resonant
8.3. Draw the series resonant circuit
8.4. Explain series resonant circuit
8.5. Draw the characteristics of series resonant circuit
8.6. Calculate current, voltage and impedance of series resonant circuit
8.7. Draw the diagram of parallel resonant circuit
8.8. Explain the parallel resonant circuit
8.9. Draw the characteristics of parallel resonant circuit

8.10. Compare series and parallel resonant circuit
8.11. Describe the band width of a resonant circuit
8.12. Describe Q of a circuit
8.13. Explain the effect of the L.C ratio on selectivity
8.14. Enlist the use of resonant circuit in radio and TV receivers

9. UNDERSTAND FILTERS & COUPLING CIRCUITS

9.1. Explain purpose & action of a filter circuit
9.2. Enlist the types of filter circuits
9.3. Explain low pass filter
9.4. Explain high pass filter
9.5. Explain K-filter & m-derived filters
9.6. Explain band pass filter & band stop filter
9.7. Explain action & purpose of a coupling circuit
9.8. Define coefficient of coupling
9.9. Enlist types of coupling
9.10. Explain RC, impedance, and transformer coupling
9.11. Define time constant of R-L & R-C Circuits
9.12. Explain importance of rise and fall of circuit current and voltage in reactive circuit.

LIST OF PRACTICALS

Lab 1: Study of Ammeter, Voltmeter and Multimeter.
Lab 2: a) Measurement of current, voltage and resistance.
b) Verification of Ohm's Law by:
Keeping the voltage constant.
Keeping the resistance constant.
Lab 3: Verify the laws of series and parallel combination of resistances by
i) Ohmmeter method.
ii) Voltmeter-Ammeter method.
Lab 4: Determine temperature coefficient of resistance.
Lab 5: Verify Kirchhoffs' laws.
Lab 6: a) Measurement of power by:
i) Voltmeter/Ammeter method.
ii) Wattmeter.
b) Measurement of Energy by:
i) Wattmeter and clock method.
ii) Energy meter.
Lab 7: a) Practice of resistor colour coding.
b) Use of potentiometer and Rheostat as voltage divider and current limiter.
Lab 8: Combine cells in series and parallel and verify the net voltage.
Lab 9: a) Study of lead acid battery, practice and use of hydrometer and electrolyte preparation.
b) Practice charging of a lead acid battery.
Lab 10: a) Determine the internal resistance of a cell.
b) Study of E.M.F. of cell and measurement of their voltages.
Lab 11: Plot magnetic line of forces of bar magnets in different positions.
Lab 12: Study of the magnetic effect of a current carrying:
i) Conductor.
ii) coil.
Lab 13: Study the change in the Magnetic power of an Electromagnet by the introduction of various cores in the coil.
Lab 14: Study of the effect on a current carrying conductor when placed in

a) magnetic field.

Lab 15: Verify Faraday's Laws of Electromagnetic induction.

Lab 16: Study of various types of capacitors and their colour coding.

Lab 17: Verify laws of combination of capacitors.

Lab 18: Observe capacitor charging and discharging.

Lab 19: Practice plotting sine wave for a given equation e=Em sine Q.

Lab 20: Study of sine wave on an oscilloscope and determine its peak, peak to peak, r.m.s. and average values of current and voltage.

Lab 21: Determine of wave length, time period and frequency of a given AC signal by oscilloscope.

Lab 22: Determine the power factor of a given AC circuit using a power factor meter.

Lab 23: Study the principles of self and mutual induction in coils.

Lab 24: a) Determine the inductance of a choke coil.
b) Determine the capacitance of a capacitor by using digital LCR meter.

Lab 25: Determine phase relationship between voltage and current in inductive circuit by showing phase difference between VR and VL using an oscilloscope.

Lab 26: Study the behavior of inductance and capacitance with AC and DC supplies.

Lab 27: a) Determine active and reactive power in an AC circuit.
b) Calculate power factor for the above circuit.

Lab 28: a) Study of the frequency response of R.L.C. series circuit and resonance effect.
b) Study of the frequency response of R.L.C. parallel circuit and resonance effect.

Lab 29: a) Study of various type of transformers used in electronics field.
b) Study of single-phase transformer and determine its transformation ratio.

Lab 30: Practice of core assembly and winding of the core type transformers.

Lab 31: a) Study of various type of incandescent and vapour lamps.
b) Connect a fluorescent tube light.

Lab 32: Verify the line and phase values of current and voltage in star and delta connections.

INTRODUCTION TO ELECTRONICS TECHNOLOGY

Course Code: DAT - 112
Total Contact Hours: 128

	T	P	C
Theory: 32			
Practical : 96	**1**	**3**	**2**

AIMS

This course aims to introduce UAV (drone) technology students to the fundamental principles of electronics used in unmanned aerial systems. Students will develop an understanding of basic electronic components, circuit concepts, and their roles in drone subsystems such as power distribution, control, sensing, and communication. The course builds a foundational electronics knowledge required for advanced drone hardware, avionics, and control systems.

COURSE CONTENTS

1. Introduction to Electronic Systems **06 Hours**

1.1. **Scope and Structure of Electronic Systems**

1.1.1. Definition and classification of electronic systems
1.1.2. Difference between electrical power systems and electronic systems
1.1.3. Functional block diagrams of electronic systems
1.1.4. Role of electronics in modern technological applications

1.2. System-Level Electronics Concepts

1.2.1. Signal flow and system interconnections
1.2.2. Control, processing, and interface elements
1.2.3. Constraints in electronic system design (power, heat, size, reliability)

2. Electronic Components and Devices **09 Hours**

2.1. **Passive Electronic Component**

2.1.1. Resistors: types, ratings, and applications
2.1.2. Capacitors: characteristics, filtering, and decoupling
2.1.3. Inductors and chokes: basic operation and uses
2.1.4. Selection of passive components for reliability and stability

2.2. **Semiconductor Devices**

2.2.1. Diodes: rectification, protection, and switching
2.2.2. Bipolar junction transistors (BJTs): operation and applications
2.2.3. MOSFETs: structure, switching behavior, and applications
2.2.4. Thermal effects and heat dissipation in semiconductor devices

2.3. **Integrated Circuits**

2.3.1. Linear and switching voltage regulators
2.3.2. Power management integrated circuits
2.3.3. Signal conditioning and interface ICs
2.3.4. Introduction to microcontroller-based electronic systems

3. Electrical and Electronic Circuit Analysis **07 Hours**

3.1. **Circuit Laws and Network Analysis**

3.1.1. Application of Ohm’s Law in practical circuits
3.1.2. Kirchhoff’s Voltage and Current Laws
3.1.3. Analysis of series, parallel, and mixed circuits
3.1.4. Power dissipation and efficiency in electronic circuits

3.2. **Signal Types and Characteristics**

3.2.1. DC and AC signals in electronic systems
3.2.2. Analog and digital signal concepts
3.2.3. Pulse and PWM signals

3.2.4. Noise, interference, and grounding fundamentals

3.3. **Basic Fault Analysis**

3.3.1. Open circuits, short circuits, and overload conditions

3.3.2. Effects of component failure on circuit performance

3.3.3. Logical approach to circuit troubleshooting

4. Power Electronics and Energy Management **06 Hours**

4.1. **Power Sources and Storage**

4.1.1. Characteristics of common electronic power sources

4.1.2. Rechargeable battery types and performance parameters

4.1.3. Charging, discharging, and protection concepts

4.2. **Power Distribution and Regulation**

4.2.1. Power distribution in electronic systems

4.2.2. Voltage regulation and current control techniques

4.2.3. Efficiency, losses, and thermal considerations

4.2.4. Over-voltage, over-current, and short-circuit protection

5. Electronic Schematics, Interfacing, and Safety **04 Hours**

5.1. **Electronic Symbols and Schematics**

5.1.1. Standard electronic symbols and notation

5.1.2. Reading and interpreting circuit diagrams

5.1.3. Block diagrams and wiring diagrams

5.1.4. Connectors, pin configurations, and interfacing basics

5.2. **Safety, Reliability, and Good Practice**

5.2.1. Electrical and electronic safety principles

5.2.2. Electrostatic discharge (ESD) awareness and protection

5.2.3. Safe handling of components and power sources

5.2.4. Reliability, maintenance, and fault prevention practices

REFERENCE BOOKS

1. Electronics-I Punjab Board of Technical Education (PBTE), Lahore.
   (Official PBTE / TEVTA prescribed textbook for DAE Electronics-related programs)
2. Electronics Technology (DAE Curriculum Textbook) National Institute of Science and Technical Education (NISTE), Islamabad. *(Recommended reference for diploma-level electronics courses in Pakistan)*
3. Electronic Fundamentals Thomas L. Floyd, Pearson Education.
   (Recommended in PBTE / TEVTA electronics curricula as a standard reference book)
4. Principles of Electronics V.K. Mehta and Rohit Mehta, S. Chand Publishing.
   (Widely used and accepted reference book for DAE Electronics Technology)

INSTRUCTIONAL OBJECTIVES

1. UNDERSTANDING BASIC ELECTRONICS AND ELECTRONIC SYSTEMS

1.1. **Understand the term of Electronics.**

1.2. **Understand basic structure of an electronic system.**

1.2.1. Draw block diagram of a basic electronic system.

1.2.2. Discuss function of each block.

1.2.3. Discuss signal flow in electronic systems.

1.3. **Understand electrical and electronic quantities.**

1.3.1. Describe voltage, current, resistance, and power.
1.3.2. Explain Ohm's Law.
1.3.3. Explain Kirchhoff's Laws.

1.4. **Understand electronic circuits.**
1.4.1. Describe series circuits.
1.4.2. Describe parallel circuits.
1.4.3. Describe series-parallel circuits.

1.5. **Understand types of signals used in electronics.**
1.5.1. Describe DC and AC signals.
1.5.2. Describe analog and digital signals.
1.5.3. Describe pulse and PWM signals.

2. UNDERSTANDING ELECTRONIC COMPONENTS

2.1. **Understand passive electronic components.**
2.1.1. Describe resistors and their types.
2.1.2. Describe capacitors and their applications.
2.1.3. Describe inductors and their applications.

2.2. **Understand semiconductor devices.**
2.2.1. Describe PN junction diode and its operation.
2.2.2. Describe rectifier circuits.
2.2.3. Describe Zener diode and its applications.

2.3. **Understand transistor devices.**
2.3.1. Describe construction and working of BJT.
2.3.2. Describe BJT as a switch.
2.3.3. Describe MOSFET and its basic operation.

2.4. **Understand integrated circuits.**
2.4.1. Describe types of integrated circuits.
2.4.2. Describe applications of ICs in electronic systems.

3. UNDERSTANDING POWER SUPPLIES AND SAFETY

3.1. **Understand power supplies used in electronics.**
3.1.1. Describe DC power supply block diagram.
3.1.2. Describe regulated power supply.

3.2. **Understand electronic protection and safety.**
3.2.1. Describe over-current and over-voltage protection
3.2.2. Describe basic electrical and electronic safety rules.
3.2.3. Describe ESD protection and safe handling of components.

LIST OF PRACTICALS

Lab 1: Introduction to Electronics Laboratory and Safety Rules.

Lab 2: Identification of Passive and Active Electronic Components.

Lab 3: Use of Digital Multimeter for Measurement of Voltage, Current, and Resistance.

Lab 4: Verification of Ohm's Law using resistive circuit.

Lab 5: Construction and testing of series and parallel resistor circuits.

Lab 6: Study and testing of PN junction diode characteristics.

Lab 7: Construction and testing of half-wave and full-wave rectifier circuits.

Lab 8: Study of transistor operation as a switch.

MECHANICAL ENGINEERING DRAWING & CAD

Course Code: DAT-113
Total Contact Hours: 224

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

AIMS

At the end of this course the students will be able to understand the Fundamentals of mechanical Engineering Drawing used in the various fields of industry. The students will be familiar with the use of conventional drawing equipment as well as the modern techniques used for this subject. Also, he / she will be familiarized with AutoCAD/SOLIDWORKS and will achieve ability to draw geometrical figures

COURSE CONTENT

1. Manual Drawing — 24 Hours

1.1. Application of Technical Drawing

1.1.1. Importance of Technical Drawing
1.1.2. Language of Engineering Terminology
1.1.3. Type of Drawing
1.1.4. Application of Technical drawing

1.2. Drafting Equipment Uses, and Care

1.2.1. Introduction and importance of drafting equipment
1.2.2. List of drawing equipment
1.2.3. Drawing equipment usage and care
1.2.4. Drafting board, Table and machine
1.2.5. Tee, Triangles and protractors
1.2.6. Instruments Box and its accessories
1.2.7. Drawing Pencil, their grading, sharpening and using techniques
1.2.8. Scale and its types

1.3. Types of Lines in Engineering

1.3.1. Basic lines
1.3.2. Importance of lines
1.3.3. Common Types of lines
1.3.4. Uses and correct line weightage
1.3.5. Use of pencils for different lines
1.3.6. Application of lines
1.3.7. Objectives in drafting

1.4. Lettering

1.4.1. Importance of a lettering
1.4.2. General Proportion of lettering
1.4.3. Composition of letters
1.4.4. Lettering Guidelines
1.4.5. Classification of lettering
1.4.6. Style of letters
1.4.7. Lettering devices

1.5. Drafting Geometry

1.5.1. Introduction to plane and solid type of geometry

1.5.2. Definition of terms
1.5.3. Different conventional shapes, surfaces and objects
1.5.4. Basic geometrical construction

1.6. Introduction to multi-view drawings and projection

1.6.1. Introduction to the plane and its types
1.6.2. Dihedral and Trihedral angles
1.6.3. Projection of point, lines, plane and solids
1.6.4. Concept of multi-view drawings
1.6.5. Perceptual views of plane of projections
1.6.6. Orthographic projections
1.6.7. 1st angle and 3rd angle projection
1.6.8. Principle views and layout
1.6.9. Multi-view drawings and missing lines

1.7. Basic Dimensioning

1.7.1. Definition of dimensioning
1.7.2. Types of dimensioning
1.7.3. Elements of dimensioning
1.7.4. Measuring System
1.7.5. Dimensioning of multi view drawing
1.7.6. Dimensioning pictorial views
1.7.7. Dimensioning rules and practices

2. SOFTWARE (AUTOCAD/SOLIDWORKS) 8 Hours

2.1. Introduction of Auto CAD / Solidworks

2.1.1. User Interface
2.1.2. Templates
2.1.3. Layers and Object
2.1.4. Mechanical Structure

2.2. Drawing and Editing Tools

2.2.1. Object Snap
2.2.2. Drawing Command
2.2.3. Edit Command
2.2.4. Object Command

2.3. Understanding of Layers

2.4. Dimensioning and Symbols

2.4.1. Creating Dimension
2.4.2. Editing Dimension
2.4.3. Use of Block and Symbols

2.5. Drawing Layout

2.5.1. Creating layout
2.5.2. Drawing frame and title block
2.5.3. Preparing drawing Template

REFERENCE BOOK

1. Mechanical Drawing (12th Addition) by French. Svensen, Helsel and Urbanick

LIST OF PRACTICALS

Lab 1: Install and configure AutoCAD and SolidWorks in the computer system
Lab 2: Adjust the software interface for mechanical drawing and 3D modeling
Lab 3: Use Zoom, Pan, Orbit command to adjust drawing in center
Lab 4: Use Line and Poly line Command to draw a rectangle, pentagon, hexagon.
Lab 5: Create object using absolute coordinate system, polar coordinate system and relative coordinate system
Lab 6: Use drawing aids for accurate drafting: (Object Snap, Grid, Orthogonal)
Lab 7: Organize drawings using layers and object properties.
Lab 8: Use construction Line and Center Line for referencing
Lab 9: Practice of printing on A3 and A4 sheet by using print setup in AutoCAD/SolidWorks
Lab 10: Create object on offset distance using offset command
Lab 11: Draw Circles and Arcs of different radii and Ellipse in gear drawing using commands like ttr.
Lab 12: Create Rectangle and Polygon using polygon command
Lab 13: Adjust Dimension size, color, tick using dimension style and implement in drawing
Lab 14: Use standard hatching pattern with respect to desire material of casting
Lab 15: Create custom text style and implement in drawing
Lab 16: Create object reflection and duplicate using Copy and Mirror command respectively
Lab 17: Create multiple objects by using different types of array command
Lab 18: Modify object position and size using Move, Rotate and Scale Command
Lab 19: Modify object boundaries using Trim and Extend Command
Lab 20: Modify object connectivity by using join and Break Command
Lab 21: Create smooth or beveled corners using Fillet and Chamfer Command
Lab 22: Break complex objects into individual elements Explode Command
Lab 23: Create 3d model Using Extrude, Revolve, Sweep, and Loft command
Lab 24: Create 3d model using union, subtract and intersection command

INTRODUCTION TO UNMANNED AERIAL VEHICLE (UAV) TECHNOLOGY

Course Code: DAT - 123
Total Contact Hours: 160

	T	P	C
Theory: 64			
Practical : 96	**2**	**3**	**3**

AIMS

The objective of this course is to provide students with a comprehensive understanding of Unmanned Aerial Vehicle (UAV) technology, including its history, classification, and various practical applications. The course also aims to enable students to identify and explain the functions of major UAV components and subsystems such as propulsion systems, flight controllers, sensors, and communication modules. In addition, students will develop an understanding of the fundamental principles of flight and aerodynamics applicable to both multi-rotor and fixed-wing UAVs, along with the skills required to configure, calibrate, and operate flight controllers. Furthermore, the course introduces sensor systems used in UAVs, including GPS, IMU, and cameras, while emphasizing the importance of adhering to UAV regulations and safety protocols established in Pakistan as well as relevant international standards.

1. INTRODUCTION TO UAV TECHNOLOGY — 6 Hours

1.1. Definition and Terminology

- 1.1.1. UAV, UAS, Drone, RPAS - definitions and differences
- 1.1.2. Remote Pilot, Observer, Visual Line of Sight (VLOS)
- 1.1.3. Beyond Visual Line of Sight (BVLOS)
- 1.1.4. Autonomous vs remotely piloted operations

1.2. History of UAV Development

- 1.2.1. Early unmanned aircraft (1900s-1960s)
- 1.2.2. Military UAV evolution
- 1.2.3. Commercial and civilian UAV emergence
- 1.2.4. Current state of UAV technology

1.3. UAV Applications

- 1.3.1. Agriculture: Crop monitoring, spraying, mapping
- 1.3.2. Surveying and mapping
- 1.3.3. Infrastructure inspection
- 1.3.4. Photography and cinematography
- 1.3.5. Search and rescue
- 1.3.6. Delivery and logistics
- 1.3.7. Security and surveillance

2. UAV CLASSIFICATION AND TYPES — 6 Hours

2.1. Classification by Configuration

- 2.1.1. Fixed-wing aircraft
- 2.1.2. Rotary-wing (helicopter)
- 2.1.3. Multi-rotor (quadcopter, hex copter, octocopter)
- 2.1.4. Hybrid VTOL
- 2.1.5. Lighter-than-air (airships, balloons

2.2. Classification by Size and Weight

- 2.2.1. Nano UAV (< 250g)
- 2.2.2. Micro UAV (250g - 2kg)
- 2.2.3. Small UAV (2kg - 25kg)
- 2.2.4. Medium UAV (25kg - 150kg)
- 2.2.5. Large UAV (> 150kg)

2.3. Classification by Range and Endurance

- 2.3.1. Close range (< 10km, < 1 hour)
- 2.3.2. Short range (10-50km, 1-3 hours)
- 2.3.3. Medium range (50-200km, 3-6 hours)

2.3.4. Long endurance (> 200km, > 6 hours)

2.4. Multi-rotor Configuration

2.4.1. Tricopter (3 motors, Y configuration)
2.4.2. Quadcopter (4 motors: X, +, H configurations)
2.4.3. Hexacopter (6 motors: flat, Y6)
2.4.4. Octocopter (8 motors: flat, X8)
2.4.5. Coaxial configurations
2.4.6. Motor rotation patterns (CW/CCW)

3. PRINCIPLES OF FLIGHT **6 Hours**

3.1. Basic Aerodynamics

3.1.1. Lift, drag, thrust, weight forces
3.1.2. Airfoil theory and lift generation
3.1.3. Angle of attack
3.1.4. Stall conditions
3.1.5. Reynolds number considerations

3.2. Fixed-wing Flight Principles

3.2.1. Control surfaces: Aileron, elevator, rudder
3.2.2. Roll, pitch, yaw movements
3.2.3. Stability: longitudinal, lateral, directional
3.2.4. Wing types and configurations

3.3. Multi-rotor Flight Principles

3.3.1. Thrust vectoring through differential motor speed
3.3.2. Pitch, roll, yaw control in multi-rotors
3.3.3. Hover mechanics
3.3.4. Stability and control theory
3.3.5. Center of gravity and its importance

3.4. Flight Dynamics

3.4.1. Angular velocity and acceleration
3.4.2. Momentum and inertia
3.4.3. PID control basics for flight
3.4.4. Rate and attitude stabilization

4. UAV FRAME AND STRUCTURE **6 Hours**

4.1. Frame Types and Materials

4.1.1. Carbon fiber frames
4.1.2. Aluminum frames
4.1.3. Plastic/polymer frames
4.1.4. Hybrid material frames
4.1.5. 3D printed frames

4.2. Structural Components

4.2.1. Main frame/center plate
4.2.2. Arms and motor mounts
4.2.3. Landing gear designs
4.2.4. Canopy and covers
4.2.5. Vibration dampening systems

4.3. Frame Design Considerations

4.3.1. Weight vs strength tradeoffs
4.3.2. Arm length and motor spacing
4.3.3. Payload mounting options
4.3.4. Accessibility for maintenance
4.3.5. Crash resistance

5. FLIGHT CONTROLLERS **8 Hours**

5.1. Flight Controller (FC) Fundamentals

5.1.1. Role of flight controller in UAV
5.1.2. Hardware architecture (MCU, sensors, I/O)

5.1.3. Popular FC platforms (Pixhawk, Betaflight, DJI)
5.1.4. Processor types: STM32, F4, F7, H7

5.2. Flight Controller Components

5.2.1. Microcontroller unit (MCU)
5.2.2. Inertial Measurement Unit (IMU)
5.2.3. Barometer
5.2.4. Magnetometer (digital compass)
5.2.5. Power management
5.2.6. Communication interfaces

5.3. Flight Controller Configuration

5.3.1. Firmware installation and updates
5.3.2. Frame type selection
5.3.3. Motor output mapping
5.3.4. Receiver protocol configuration
5.3.5. Failsafe settings

5.4. PID Tuning

5.4.1. PID control theory basics
5.4.2. P, I, D gains explained
5.4.3. Rate vs Attitude/Angle PID
5.4.4. Basic PID tuning methodology
5.4.5. Blackbox logging and analysis

5.5. Flight Modes

5.5.1. Manual/Acro mode
5.5.2. Angle/Stabilize mode
5.5.3. Altitude hold mode
5.5.4. Position hold (GPS required) mode
5.5.5. Return to Home (RTH)
5.5.6. Waypoint navigation
5.5.7. Follow me mode

6. SENSORS AND NAVIGATION SYSTEMS **10 Hours**

6.1. Inertial Measurement Unit (IMU)

6.1.1. Accelerometer: principle and specifications
6.1.2. Gyroscope: principle and specifications
6.1.3. Sensor fusion techniques
6.1.4. IMU calibration procedures
6.1.5. Noise and drift compensation

6.2. Barometric Altitude Sensor

6.2.1. Operating principle
6.2.2. Accuracy and limitations
6.2.3. Temperature compensation
6.2.4. Altitude hold implementation

6.3. Magnetometer (Compass)

6.3.1. Operating principle
6.3.2. Magnetic interference sources
6.3.3. Calibration procedures
6.3.4. External compass mounting

6.4. Global Navigation Satellite Systems (GNSS)

6.4.1. GPS, GLONASS, BeiDou, Galileo overview
6.4.2. GPS receiver types (single, dual, RTK)
6.4.3. Position accuracy factors
6.4.4. HDOP, VDOP, satellite count
6.4.5. RTK and PPK for precision applications

6.5. Proximity and Obstacle Sensors

6.5.1. Ultrasonic sensors

- 6.5.2. Infrared sensors
- 6.5.3. LiDAR sensors
- 6.5.4. Optical flow sensors
- 6.5.5. Vision-based obstacle detection

7. COMMUNICATION AND TELEMETRY **8 Hours**

7.1. Radio Control Systems

- 7.1.1. Transmitter types and features
- 7.1.2. Receiver protocols (PWM, PPM, SBUS, CRSF)
- 7.1.3. Frequency bands (2.4GHz, 900MHz)
- 7.1.4. Binding and pairing procedures
- 7.1.5. Range and reliability factors

7.2. Telemetry Systems

- 7.2.1. Purpose of telemetry
- 7.2.2. Telemetry protocols (MAVLink, FrSky)
- 7.2.3. Telemetry data parameters
- 7.2.4. Ground station software
- 7.2.5. On-Screen display (OSD)

7.3. Video Transmission (FPV)

- 7.3.1. Analog video systems
- 7.3.2. Digital video systems (DJI, Walksnail, HDZero)
- 7.3.3. Video transmitters and receivers
- 7.3.4. Camera types and specifications
- 7.3.5. Latency consideration mechanisms

7.4. Data Links

- 7.4.1. Control link requirements
- 7.4.2. Redundancy and failsafe
- 7.4.3. Encryption and security
- 7.4.4. Interference management

8. PAYLOAD SYSTEMS **8 Hours**

8.1. Camera Systems

- 8.1.1. Action cameras (GoPro, etc.)
- 8.1.2. Aerial mapping cameras
- 8.1.3. Multispectral cameras
- 8.1.4. Thermal/infrared cameras
- 8.1.5. Camera specifications (sensor size, resolution)

8.2. Gimbal Systems

- 8.2.1. 2-axis vs 3-axis gimbals
- 8.2.2. Gimbal motors and control
- 8.2.3. Stabilization algorithms
- 8.2.4. Gimbal calibration

8.3. Other Payload Types

- 8.3.1. LiDAR scanners
- 8.3.2. Spraying systems
- 8.3.3. Delivery mechanisms
- 8.3.4. Sensors (gas, radiation, etc.)

8.4. Payload Integration

- 8.4.1. Weight and balance considerations
- 8.4.2. Power requirements
- 8.4.3. Data transmission
- 8.4.4. Mounting solutions

9. UAV REGULATIONS AND SAFETY **6 Hours**

9.1. International Regulations

- 9.1.1. ICAO guidelines for UAS
- 9.1.2. FAA regulations (USA reference)

9.1.3. EASA regulations (Europe reference)
9.1.4. Common regulatory elements

9.2. Pakistan CAA Regulations

9.2.1. PCAA UAV/Drone regulations overview
9.2.2. Drone Registration requirements
9.2.3. Pilot licensing requirements
9.2.4. Operating permissions and NOC
9.2.5. Restricted and prohibited zones
9.2.6. Insurance requirements

9.3. Safety Principles

9.3.1. Pre-flight safety checks
9.3.2. Risk assessment procedures
9.3.3. Emergency procedures
9.3.4. Weather considerations
9.3.5. Bystander safety

9.4. Operational Safety

9.4.1. VLOS requirements
9.4.2. Altitude restrictions
9.4.3. Distance from airports and heliports
9.4.4. Night operation
9.4.5. Operations over population

REFERENCE BOOKS

1. "Build Your Own Drone Manual" - Haynes Publishin”
2. "Drone Technology in Architecture, Engineering and Construction" -Daniel Tal, Jon Altschuld
3. "Small Unmanned Aircraft: Theory and Practice" - Randal W. Beard,Timothy W. McLain
4. "Make: Drones" - David McGriffy, O'Reilly Media
5. "The Complete Guide to Drones" - Adam Juniper
6. Pakistan Civil Aviation Authority (PCAA) Drone Regulations
7. ArduPilot Documentation: ardupilot.org
8. Betaflight Wiki: betaflight.com/docs
9. Oscar Liang Blog: oscarliang.com

DJI Academy Training Materials

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION TO UAV TECHNOLOGY

1.1. Define UAV, UAS, Drone, and RPAS with clear distinctions
1.2. Describe the historical development of UAV technology
1.3. Identify and explain at least 8 commercial applications of UAVs
1.4. Discuss current trends and future directions in UAV technology

2. UAV CLASSIFICATION AND TYPES

2.1. Classify UAVs by configuration, size, and range
2.2. Identify different multi-rotor configurations and their advantages
2.3. Compare fixed-wing and multi-rotor UAVs for specific applications
2.4. Select appropriate UAV type for given mission requirement

3. PRINCIPLES OF FLIGHT

3.1. Explain the four forces of flight
3.2. Describe how multi-rotors achieve controlled flight
3.3. Explain roll, pitch, and yaw movements in multi-rotors

3.4. Calculate thrust-to-weight ratios for flight capability
3.5. factors affecting flight stability

4. UAV FRAME AND STRUCTURE

4.1. Compare different frame materials and their properties
4.2. Identify structural components of typical UAV frames
4.3. Evaluate frame designs for specific applications
4.4. Select appropriate frames based on mission requirement

5. FLIGHT CONTROLLERS

5.1. Explain the role and architecture of flight controllers
5.2. Identify popular flight controller platforms and their features
5.3. Configure flight controller firmware and settings
5.4. Perform basic PID tuning for stable flight
5.5. Configure and use different flight modes appropriately

6. SENSORS AND NAVIGATION SYSTEMS

6.1. Explain the operation of IMU components
6.2. Perform sensor calibration procedures
6.3. Describe GNSS principles and accuracy factors
6.4. Configure GPS-based navigation features
6.5. Identify and configure proximity sensors

7. COMMUNICATION AND TELEMETRY

7.1. Explain radio control system operation
7.2. Configure receiver protocols and failsafe
7.3. Set up telemetry systems and interpret data
7.4. Configure FPV video systems
7.5. Troubleshoot communication issues

8. PAYLOAD SYSTEMS

8.1. Identify different payload types and their applications
8.2. Select appropriate cameras for specific missions
8.3. Configure and calibrate gimbal systems
8.4. Calculate payload capacity and impact on flight time

9. UAV REGULATIONS AND SAFETY

9.1. Explain key elements of UAV regulations
9.2. Describe Pakistan CAA requirements for UAV operations
9.3. Perform pre-flight risk assessments
9.4. Apply safety procedures for UAV operations
9.5. Respond appropriately to emergency situations

LIST OF PRACTICALS

Lab1: Identify different UAV types from samples/images
Lab2: Classify UAVs by configuration, size, weight category
Lab3: Identify all major components of a multi-rotor UAV
Lab4: Identify all major components of a fixed-wing UAV
Lab5: Assemble quadcopter frame from kit
Lab6: Mount motors with correct orientation
Lab7: Install battery connector and test voltage outputs
Lab8: Mount flight controller with correct orientation
Lab9: Connect ESC, receiver, GPS and compass with the flight controller
Lab10: Connect telemetry module
Lab11: Install flight controller software
Lab12: Connect flight controller to computer
Lab13: Configure receiver protocol (PPM)

Lab14: Calibrate accelerometer
Lab15: Calibrate gyroscope
Lab16: Calibrate magnetometer/compass
Lab17: Calibrate barometer
Lab18: Verify all sensor readings
Lab19: Configure failsafe setting
Lab20: Bind receiver to transmitter
Lab21: Calibrate radio (transmitter) in flight controller

2ND YEAR

اسلامیات/مطالعہ پاکستان

نصاب سال دوئم

GEN201

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حصہ اول اسلامیات

حصہ دوئم مطالعہ پاکستان

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 و الظن 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(اسباب ونتائج)

4۔ حضور ﷺ بحیثیت

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

() معلم کامل۔سربراہ خاندان

5۔ اسلامی معاشرہ

نظام تعلیم اور اس 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/معلومات 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

() حضور ﷺ کی بطور سربراہ بیان کر سکے

حضور ﷺ 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 ومفہوم کر سکے

() اسلامی معاشرہ کی امتیازی خصوصیات بیان کر سکے

() اسلامی معاشرہ میں عدل واحسان کی اہمیت بیان کر سکے

() تبلیغ کے لغوی معنی بیان کر سکے

() تبلیغ کی اہمیت اور ضرورت بیان کر سکے

() جہاد کے لفظی واصطلاحی 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

سال دوئم

حصہ دوم

ٹی	پی	سی
1	0	1

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 ہو سکے 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 خودشناسی 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

TARJUMA TUL QURAN/CIVICS

Course Code: TTQ/CIVICS - 211
Total Contact Hrs. 32

	T	P	C
Theory: 32			
Practical: 0	**1**	**0**	**1**

As per Syllabus of BISE from PCTB Book

نمبر شمار	عنوانات	صفحہ نمبر
1	تلاوتِ قرآنِ مجید کے آداب	1
2	عمومی ہدایات	2
3	حاصلاتِ تعلم	3
4	سُوْرَةُ النِّسَآءِ	4
5	سُوْرَةُ الْمَآئِدَةِ	38
6	سُوْرَةُ النُّوْرِ	66
7	سُوْرَةُ الْاَحْزَابِ	81
8	سُوْرَةُ مُحَمَّدٍ	97
9	سُوْرَةُ الْفَتْحِ	106
10	سُوْرَةُ الْحُجُرٰتِ	115
11	سُوْرَةُ الْحَدِيْدِ	121
12	سُوْرَةُ الْمُجَادَلَةِ	129
13	سُوْرَةُ الْحَشْرِ	136
14	سُوْرَةُ الْمُمْتَحِنَةِ	144
15	سُوْرَةُ الصَّفِّ	151
16	سُوْرَةُ الْجُمُعَةِ	156
17	سُوْرَةُ الْمُنٰفِقُوْنَ	160
18	سُوْرَةُ التَّغَابُنِ	165
19	سُوْرَةُ الطَّلَاقِ	170
20	سُوْرَةُ التَّحْرِيْمِ	175
21	ماڈل پیپر	180
22	رموزِ اوقاف	183
23	سرٹیفکیٹ	184

عمومی ہدایات برائے اساتذۂ کرام

- تدریسِ قرآنِ مجید کا مقصد طلبہ کی کردار سازی ہونا چاہیے۔
- طلبہ کو قرآنِ مجید عام فہم انداز میں پڑھایا جائے۔
- ترجمۃ القرآن المجید کی تدریس کے دوران میں عربی متن کی درست ادائی کا خیال رکھا جائے۔
- باوضو ہو کر تدریس کا اہتمام کیا جائے۔
- طلبہ کو قرآنِ مجید کے آداب سے آگاہ کیا جائے۔
- ترجمۃ القرآن المجید کے نصاب میں شامل سورتوں کے تعارف اور بنیادی مضامین پر خصوصی توجہ دی جائے۔
- نصاب میں شامل سورتوں میں موجود قرآنی دُعاؤں کی ترجمہ کے ساتھ تدریس کا خصوصی اہتمام کیا جائے۔
- نصاب میں مختص آیات پر خصوصی توجہ دی جائے۔
- کوئز پروگرام، آن لائن ایپ اور سمعی و بصری معاونات سے استفادہ کرتے ہوئے تدریس کا اہتمام کیا جائے۔
- نصاب میں موجود سورتوں میں بنیادی عقائد، اوامر و نواہی اور معاشرتی احکام کو آسان طریقہ سے طلبہ کو سمجھایا جائے۔
- بارھویں جماعت کے لیے مقرّرہ حصّۂ قرآنِ مجید کی تمام سورتوں کا تعارف اور مرکزی مضامین پر مشتمل تفصیلی، مختصر اور کثیر الانتخابی سوالات کے ذریعے سے امتحان لیا جائے۔
- بارھویں جماعت کے لیے مختص ذخیرۂ قرآنی الفاظ میں سے ہی ماڈل پیپرز کی طرز پر امتحان لیا جائے۔

APPLIED MATHEMATICS-II

Course Code: MATH-233
Total Contact Hrs. 96

	T	P	C
Theory: 96			
Practical: 0	**3**	**0**	**3**

AIMS & OBJECTIVES

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

COURSE CONTENTS

1. **FUNCTIONS & LIMITS.** **6 Hours**
   - 1.1. Constants and variables
   - 1.2. Functions & their types
   - 1.3. The concept of limit
   - 1.4. Limit of a function
   - 1.5. Fundamental theorems on limit
   - 1.6. Some important limits
   - 1.7. Continuous function
   - 1.8. Problems
2. **DIFFERENTIATION.** **6 Hours**
   - 2.1. Increments
   - 2.2. Geometrical interpret
   - 2.3. Differentiation ab –initio by first principle.
   - 2.4. Geometrical interpretation of differential coeff.
   - 2.5. Differentiation coefficient of X^n and $(a+b)^n$
   - 2.6. 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 Sinx, Cosx, Tanx from first principle.
   - 4.2. Differential Coefficient of Cosecx, Secx, Cotx.
   - 4.3. Differential Coefficient of Inverse Trigonometric Functions
   - 4.4. Problems
5. **DIFFERENTIATION OF LOGARITHMIC & EXPONENTIAL FUNCTION** **15 Hours**
   - 5.1. Differentiation of lnx
   - 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 Formulae
   7.3. Important Rules
   7.4. Problems
8. **METHODS OF INTEGRATION** **9 Hour**
   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 EQUATION.** **6 Hours**
   10.1. Introduction
   10.2. Order and Degree
   10.3. First Order Differential Equation of 1st Degree
   10.4. Solution of Problems
   10.5. Problems
11. **LAPLACE TRANSFORMATION.** **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** **6 Hours**
   13.1. Concept of mean, median and mode
   13.2. Standard Deviation
   13.3. Laws of probability
   13.4. Problems

REFERENCE 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

ENTREPRENEURSHIP

Course Code: CIVIL 271
Total Contact Hours: 32

	T	P	C
Theory: 32			
Practical: 0	**1**	**0**	**1**

AIMS

The student will be able to understand the procedures governing estimation of earth work and complete estimate of single storey building in order to:

1. Understanding the concept and elements of small business enterprise.
2. Apply the techniques for generating business ideas as well as for identifying and assessing business opportunities.
3. Understand the procedures required for establishing an enterprise.
4. Understand the procedures for assessing market and for selecting location for a small business.
5. Understand the importance of financial record keeping in a small business.
6. Develop business plans and evaluate it in real market situation.
7. Apply the concepts of Chemical / Pharmaceutical Engineering on planning, designing and layout of related technical projects.

COURSE CONTENTS

1. ENTREPRENEURSHIP AND MANAGEMENT — 8 hours

1.1. The concept of entrepreneurship
1.2. Entrepreneurial style Vs Managerial style
1.3. Terminology used in entrepreneurship
1.4. Classification of business; difference between social and commercial business
1.5. Reasons for Entrepreneurship; importance in society, self-employment, benefits & limitation, Importance of relations/links
1.6. Entrepreneurial motivation; setting goals and risk assessment.
1.7. Small enterprises; elements, ideas, motivation, resources, business plan etc

2. ENTREPRENEURSHIP AND INNOVATION — 4 Hours

2.1. Creativity and innovation; creativity potential, techniques for developing creative abilities
2.2. Business ideas; resources of business ideas, collective thinking and creative thinking,
2.3. Risk involved in innovation
2.4. Identifying and assessing business opportunities

3. ENTREPRENEURS — 6 Hours

3.1. Entrepreneurial characteristics
3.2. Assessment of entrepreneurial potential; assessment of individuals
3.3. Entrepreneurial Leadership: abilities for a successful businessman
3.4. Self-discipline; check list for attaining self-discipline
3.5. Decision making skills; steps for decision making rating of decision-making skills
3.6. Principles of negotiation; resolving business issues through negotiation

4. ESTABLISHMENT OF AN ENTERPRISE — 6 Hours

4.1. Market; Five 'W' of market, competitors, assessment of market size & demand
4.2. Business location; importance, selection of site
4.3. Legal forms of business; Proprietorship, Partnership, limited company, Cooperative, advantages & disadvantages
4.4. Costing of product; direct and indirect cost
4.5. Break even analysis: fixed and variable costs, calculating break even indicates &

applications

4.6. Finance & sources of financing; equity financing & loan financing, initial capital & working capital estimation

5. MANAGEMENT OF AN ENTERPRISE 4 Hours

5.1. Hiring and managing people; hiring procedures, term & condition of services and Job description etc.

5.2. Managing sales & supplies; characteristics of successful sales personals, importance of advertising, life cycle of product, selection of supplies, work order, delivery & payment etc.

5.3. Management of capital; operating cycle concept, management of cash & stock etc.

5.4. Accounting and bookkeeping: cash book, balance sheet etc.

5.5. Income tax; income tax returns, computation of business income

5.6. Sales tax; basic scheme of sale tax, assessment of return etc.

6. **BUSINESS PLAN 4 Hours**

6.1. Purpose of business plan

6.2. Components of business plan; outline, process of writing business plan

6.3. Analysis of business plan: feasibility; breakeven point, evaluating problem in starting business

6.4. Standard business plan.

REFERENCE BOOKS

1. Small Business and Entrepreneurship by Paul Burns and Jim Dew Hurst.
2. Innovation and Entrepreneurship By Peter F. Drucker
3. Entrepreneurial Success By John B. Miner
4. Entrepreneurship for economic Growth by P.N Singh
5. Knowing About Business (KAB), ILO..

INSTRUCTIONAL OBJECTIVES

1. **Understand the concept and elements of Entrepreneurship**
   - 1.1. Define entrepreneurship
   - 1.2. Explain the concept of entrepreneurship
   - 1.3. Explain the various types of enterprise that exist in the community
   - 1.4. Identify and interpret the terms and elements involved in the concept of enterprise1.5 Appreciate that the advancement of individual and society in general when entrepreneurship is adopted
   - 1.5. Explain various motivational factors that entrepreneurs possess and utilize.
   - 1.6. Exhibit the skills needed to assess and evaluate a risk
   - 1.7. Describe the outline of small enterprises
2. **Understand the techniques for generating business ideas as well as for identifying and assessing business opportunities**
   - 2.1. Describe creativity and innovation
   - 2.2. Apply the techniques for developing creative abilities
   - 2.3. Explain the resources of business ideas
   - 2.4. Explain the collective and creative thinking
   - 2.5. Explain how to generate a business idea
   - 2.6. Appreciate the importance of, and possess techniques for identifying and assessing business opportunities.
3. **Understand personal characteristics needed to be a successful entrepreneur**
   - 3.1. Identify the various entrepreneurial characteristics
   - 3.2. Access personal potential for becoming future entrepreneurs.
   - 3.3. Identify leadership qualities which are essential to the success of entrepreneurs
   - 3.4. Identify self- management skills and how they are important to be enterprising

3.5. Apply a rational approach to make personal and business decisions
3.6. Explain the steps for decision making and rating of decision making skills
3.7. Apply the rules of negotiation for resolving business issues.

4. Understand the procedures required for establishing an enterprise

4.1. Describe the market & marketing
4.2. Differentiate between sellers and buyers' market
4.3. Describe the five 'w' of market
4.4. Explain the procedure for assessing the market size and demand
4.5. Explain the major factors to be considered when selecting a location for a business
4.6. Describe the basic types of business ownership and the limitation of each
4.7. Explain the computation of initial and working capital needed to start an enterprise
4.8. Identify the advantages and disadvantages of using various sources of capital to start an enterprise
4.9. Explain the component of cost of product
4.10. Explain the break even analysis for a new business
4.11. Calculate the breakeven point for various new business.

5. Understand the various techniques that affect the management of an enterprise

5.1. Describe the hiring method/Procedures
5.2. Describe the term & conditions of services and job description for various employments
5.3. Describe the characteristics of successful sales personals
5.4. Describe the life cycle of product
5.5. Identify the various ways of selecting suppliers,
5.6. Explain the inventory management of stock, raw material and finished goods etc.
5.7. Appreciate the importance of financial record keeping in a small business
5.8. Explain techniques to keep cost as low as possible
5.9. Develop balance sheet for a small enterprise
5.10. Explain the operating cycle concept
5.11. Explain the income tax computation procedure for a small business
5.12. Explain the basic scheme of sales tax
5.13. Explain the assessment procedure for returns and filling of returns.

6. Apply the entrepreneurship knowledge for development of business plan for a small business and evaluate in a real market situation.

6.1. Appreciate the importance of business plan
6.2. Explain the process of writing a business plan
6.3. Develop feasibility for a business idea
6.4. Realize the problem that may be encountered when starting a small business/Enterprise
6.5. Develop a business plan for a small business on the standard format
6.6. Evaluate the business plan in a real market situation

CHINESE LANGUAGE-2

Course Code: GenC 212
Total Contact Hours: 64

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

AIMS

There are 20 lessons (including 4-unit reviews) in this course. It is recommended to complete 8 lessons and the unit reviews in 32 class hours. After completing this course, students can master the advanced-basic Chinese language knowledge in the content of the course, and be able to reach and exceed HSK level THREE.

COURSE CONTENTS

1. LESSON 1 PICKUP INTERNATIONAL STUDENTS AT THE AIRPORT 3 Hours

This lesson introduces grammatical knowledge such as "flexible use of interrogative pronouns" and "basic forms of clutch words", which requires students to use sequential words correctly and understand the contextual meaning of some special words.

2. LESSON 2 WHAT WOULD YOU LIKE TO DRINK 3 Hours

This lesson introduces the rhetorical question form "can…?" and the related words "not only… but also...", and learn to express your needs correctly in communication.

3. LESSON 3 I'M KIDDING YOU 4 Hours

This lesson explains the fixed structures "more and more", "more A, more B", etc., and understands how to praise in Chinese and how to deal with others' praise.

4. LESSON 4 I LIKE WINTER BEST 4 Hours

Through the description of weather, students can learn the usage of adverbs such as "often" and "always", which express frequency, and compare and describe similar phenomena.

UNIT REVIEW 1 (INCLUDING TESTS) 2 hours

Summarize the contents of Lesson 1-4, review key words and grammar knowledge, and help learners really consolidate their mastery. There are tests designed, which can detect what has been learned before, so as to check for leaks and fill gaps.

5. LESSON 5 I CAUGHT A COLD 3 Hours

This lesson learns the basic usage of "active" sentence, understands the expressions related to illness and medical treatment, and learns the language communication in hospital scenes.

6. LESSON 6 YOU ARE REALLY CARELESS 3 Hours

Learn and summarize the usage of simple directional complements "V come" and "V leave", and

master the basic expression of request and evaluation functions in daily communication.

7. LESSON 7 ENGLISH BLACK TEA IS HEALTHY AND DELICIOUS 4 Hours

Understand how to express approximate numbers in Chinese, how to persuade others and how to express their basic attitude.

8. LESSON 8 I'M NOT A SHOPAHOLIC 4 Hours

This lesson is related to online shopping. Learn the expression "A is A, that is" and learn how to express your views from different angles.

UNIT REVIEW 2 (INCLUDING TESTS) 2 Hours

This section leads students to review the knowledge points they have learned in the past, and conduct mid-term tests to test students' learning effect.

9. LESSON 9 WHY DID GRANDPARENTS MOVE 3 Hours

This lesson introduces a life event related to "moving house", the expression of learning conditions and the extended meaning of directional complement through events.

10. LESSON 10 EAT HOT POT FOR THE FIRST TIME 3 Hours

This lesson introduces the way of having dinner in China through "hot pot" and some basic situations of Chinese restaurants, so as to help learners get a preliminary understanding of Chinese dining customs.

11. LESSON 11 TEACHER WANG IS GOING TO CHANGE THE HOUSE 4 Hours

This lesson is related to "housing" in "food, clothing, housing and transportation". While understanding the story, students can learn language knowledge such as hypothetical relationship and overlapping of disyllabic verbs.

12. LESSON 12 SINGLE LI WENCHAO 4 Hours

This lesson introduces emotional problems, learn about young people's concepts of marriage and love, and learn how to compare them in Chinese.

UNIT REVIEW 3 (INCLUDING TESTS) 2 Hours

Review the previous knowledge, students answer questions through the platform, check the learning situation, and help teachers and students analyze their learning situation.

13. LESSON 13 THIS IS HER NEW HOME 3 Hours

This lesson introduces the living conditions of young people at present, and understands how to describe the living environment, learn the Chinese expression of concepts such as location and existence.

14. LESSON 14 ALLEN'S WEEKEND 3 Hours

This lesson introduces school life, understand the sentence structure expressing complete negation, and summarize the usage of three auxiliary words "adjective", "adverb" and "should".

15. LESSON 15 FALL IN LOVE WITH PUBLIC SQUARE DANCING 4 Hours

By introducing the living conditions of the elderly in China, students can learn Chinese comparative structure, enumerating relations and various usages of complements.

16. LESSON 16 TASTE ENGLISH AFTERNOON TEA 4 Hours

This lesson introduces grammatical knowledge such as "passive" sentence and "adjective reduplication". Through the study of this lesson, students can understand the dining habits of restaurant ordering and national dishes.

UNIT REVIEW 4 (INCLUDING TESTS) 2 Hours

This section is a review test class, leading students to review the knowledge points learned in the past for final tests to test students' learning effect.

REFERENCE BOOKS

Tang Chinese Course 3

INSTRUCTION OBJECTIVE

Through this course, learners can systematically learn the language knowledge at this stage and cope with general communication, and can communicate on familiar topics and meet the basic communication needs of daily life and study, and gradually understand and be familiar with Chinese communication etiquette, cultural customs, etc.

UNDERSTANDING CHINA

Course Code: MgmC 212
Total Contact Hours: 64

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

AIMS

A course about understanding Chinese culture and introducing China's national conditions. It aims to enable international students in China to better understand China, learn Chinese language and culture, enhance understanding of different cultures, and learn about China's geographical history, philosophy, religion, political economy, etc. It covers Chinese geography and history, philosophy and religion, politics and economy, literature and art, science and technology education, medicine, and sports, etc.

COURSE OBJECTIVES

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

1. Master the basic overview of China
2. Enhance knowledge of Chinese language
3. Broaden horizon
4. Learn the integration and communication between different cultures

COURSE CONTENTS

1. GEOGRAPHY **2 Hours**

- 1.1. China from the perspective of the world
- 1.2. China's natural environment
- 1.3. China's mountains and rivers (1)
- 1.4. China's mountains and rivers (2)
- 1.5. City Highlight - Beijing
- 1.6. City Highlight - Shanghai
- 1.7. City Highlight - Hongkong
- 1.8. Natural Landscape (1) Five Mountains, Jiuzhaigou Valley and Zhangjiajie
- 1.9. Natural Landscape (2) Xinjiang
- 1.10. Natural Landscape (3) Tibet
- 1.11. Cultural Tour

2. HISTORY **8 Hours**

- 2.1. Chinese Ancestors
- 2.2. Emperor Qin Shihuang
- 2.3. Emperor Wu in Han Dynasty
- 2.4. Silk Road in Western Han Dynasty
- 2.5. Prosperous Period of Tang Dynasty
- 2.6. Riverside Scene at Qingming Festival
- 2.7. Genghis Khan and Kublai Khan
- 2.8. Ming Taizu (the First Emperor of the Ming Dynasty)
- 2.9. The Great Voyages of Zheng He
- 2.10. Prosperous Period of Qing dynasty (from Kangxi to Qianlong)
- 2.11. Opium War
- 2.12. Sun Yat-sen and Kuomintang
- 2.13. The Communist Party of China (CPC)
- 2.14. Mukden Incident (9.18 Incident)

2.15. Mao Zedong and the Founding of the PRC
2.16. Diplomatic Relations of the PRC
2.17. Deng Xiaoping and Reform and Opening-up
2.18. New Era of Socialism with Chinese Characteristics

3. PHILOSOPHY **4 Hours**

3.1. The representative figure of Confucianism - Confucius
3.2. The representative figure of Confucianism - Mencius
3.3. The core concept of Confucianism - ritual
3.4. The core concept of Confucianism - benevolence and benevolent governance
3.5. The core concept of Confucianism - Taoism, reason, and knowledge acquirement by investigation
3.6. Taoism - Lao Tzu's Tao and inaction
3.7. Taoism - Chuang Tzu's equality of things and unfettered
3.8. Other schools of thought - Legalism
3.9. Other schools of thought - Military Strategist

4. RELIGION **4 Hours**

4.1. Folk Beliefs and Ancestor Worship
4.2. Taoism
4.3. Buddhism in China
4.4. Buddhist Doctrine, Zen, and Buddhist scenic spots
4.5. Other Religions and China's Religious Policies

5. NATIONAL GOVERNANCE **4 Hours**

5.1. National Flag, National Anthem, and National Emblem
5.2. Administrative divisions
5.3. National Institutions (1)
5.4. National Institutions (2)
5.5. Political Parties (1)
5.6. Political Parties (2)
5.7. Foreign policy

6. LITERATURE AND ART **4 Hours**

6.1. Stages and Genres of Chinese literature
6.2. Pre-Qin Literature
6.3. Tang Poetry
6.4. Song Ci
6.5. Four Great Classical Novels
6.6. Modern Chinese Contemporary Literature (1)
6.7. Modern Chinese Contemporary Literature (2)
6.8. Chinese Opera (1)
6.9. Chinese Opera (2)
6.10. Chinese Opera (3)
6.11. Concept of Chinese Traditional Music
6.12. Characteristics of Chinese Traditional Music and Music Appreciation
6.13. Diversified Modern Chinese Music

7. LANGUAGE AND LITERATURE **4 Hours**

7.1. Mandarin and Dialect
7.2. Ancient Chinese and Modern Chinese
7.3. Idioms
7.4. Origin and Development of Chinese Characters
7.5. Six Categories of Chinese Characters
7.6. Simplified and Traditional Chinese Characters

8. CALLIGRAPHY AND PAINTING **4 Hours**

8.1. Definition of Calligraphy
8.2. The Evolution of Chinese Calligraphy - Bone inscriptions and bronze inscriptions
8.3. The Evolution of Chinese Calligraphy - Regular script

8.4. The Evolution of Chinese Calligraphy - Cursive script
8.5. The Evolution of Chinese Calligraphy - Running script
8.6. Calligraphy Creation and the Charm of Calligraphy
8.7. Four Treasures of the Study
8.8. Calligraphy and Other Arts
8.9. Basic Knowledge of Chinese Painting
8.10. Artistic Features of Chinese Painting
8.11. Appreciation of Three Major Themes and Representative Works of Chinese Painting

9. ECONOMY **4 Hours**

9.1. Agriculture
9.2. Industry
9.3. Three Major Industries in China
9.4. “Internet plus” - New engine of the Chinese economy
9.5. Digital Economy 2.0
9.6. Belt and Road Initiative

10. SCIENCE AND TECHNOLOGY **4 Hours**

10.1. Four Great Ancient Inventions
10.2. Bronze Ware
10.3. Seismograph
10.4. Ceramics
10.5. Hybrid Rice
10.6. Five-hundred-meter Aperture Spherical Radio Telescope (FAST)
10.7. China High Speed Rail
10.8. Jiaolong Manned Submersible
10.9. Supercomputer Sunway TaihuLight
10.10. Aerospace Science and Technology
10.11. Internet Payment

11. EDUCATION **4 Hours**

11.1. Imperial Examination System
11.2. Chinese Literature
11.3. China’s Examination
11.4. Teaching Chinese to Speakers of Other Languages

12. MEDICAL AND HEALTH **4 Hours**

12.1. Medical and Health Service System in China
12.2. Traditional Chinese Medicine (TCM)
12.3. History of TCM
12.4. Core Concept of TCM
12.5. Acupuncture and Massage
12.6. TCM and Life (1)
12.7. TCM and Life (2)
12.8. Understanding Chinese Medicine
12.9. Mystery of TCM Treatment
12.10. International Communication of TCM

13. SPORTS AND WUSHU (CHINESE MARTIAL ART) **4 Hours**

13.1. Traditional Sports - Kite
13.2. Traditional Sports - Archery
13.3. Chinese Women and the Olympic Games
13.4. Taiji Boxing
13.5. Overview of Wushu Films and Dramas
13.6. Wushu Elements in Wushu Films and Dramas
13.7. Cultural Connotation of Chinese Wushu

14. TRADITIONAL FESTIVALS AND CHINESE CUISINE **4 Hours**

14.1. Chinese Traditional Festivals
14.2. Chinese Traditional Festivals-The Spring Festival&The Lantern Festival

14.3. Chinese Traditional Festivals-The Dragon Boat Festivall &The Mid-Autumn 14.4 Festival
14.4. Chinese Cuisine

15. HISTORICAL AND CULTURAL HERITAGE 4 Hours

15.1. Human Civilization: “Peking Man” Site at Zhoukoudian
15.2. Dunhuang Mogao Grottoes
15.3. Great Engineering: Great Wall and Dujiangyan Irrigation System
15.4. Royal Tombs: Xiaoling Mausoleum and Imperial Tombs of the Ming and Qing Dynasties
15.5. The Largest Bronze Ware: Simuwu Great Tripod
15.6. Warring States Court Musical Instrument: Chime-Bells of Marquis Yi of the Zeng State
15.7. Types of Chinese Ancient Buildings
15.8. Royal Architecture: The Forbidden City
15.9. Ancient Residential Buildings: Quadrangles
15.10. Chinese Gardens

16. INTANGIBLE CULTURAL HERITAGE 4 Hours

16.1. Current Status of Intangible Cultural Heritage
16.2. Gesar
16.3. Guqin
16.4. Rural Music and Dance
16.5. Shadow Play
16.6. Cantonese Opera
16.7. Chinese Seal Cutting
16.8. Nanjing Yunjin Brocade
16.9. Twenty-four Solar Terms
16.10. Crosstalk
16.11. Acrobatics
16.12. Protection of Intangible Cultural Heritage

REFERENCE BOOKS

1. Understanding China (Digital and Paper format), edited by Cheng Aimin, jointly developed by Peking University, Beijing Normal University, Zhejiang University, Tianjin University, Harbin Institute of Technology, Xi’an Jiaotong University, Wuhan University, Chongqing University, Shanghai International Studies University, Dalian Medical University, South China Normal University, Jiangsu Normal University and Tang International Education Group, published by Shanghai Foreign Language Education Press, Recommended by China Association for International Education (CAFSA)

INSTRUCTIONAL OBJECTIVES

1. Understand the basic geography of China and some famous Chinese cities
2. Understand the unique natural and cultural landscape
3. Master basic knowledge of Chinese history and important historical figures
4. Understand the basic context and major issues in the development of Chinese history
5. Understand the main schools of Chinese traditional philosophy and their representatives
6. Understand the relevant core concepts
7. Master the influence of Chinese philosophy on the mindset and lifestyle of Chinese people
8. Understand the development and spread of Taoism, Buddhism, Islamism and Christianity
9. Understand the current status and policies of religious in China

10. Master the basic knowledge in seven videos
11. Describe the main contents of China's political system in Chinese
12. Compare the similarities and differences between China's political system and home country
13. Correct and comprehensive understanding of China's political system
14. Understand knowledge related to Chinese literature
15. Understand the inheritance and absorption of Chinese contemporary music to traditional music culture
16. Experience the characteristics of Chinese language
18. Understand the language and text of China as a whole
19 Understand the evolution of Chinese calligraphy
20. Understand the basic knowledge of Chinese painting and appreciation of representative works
21. Learn knowledge and information in related fields
22. Understand the logic and reasons behind the development of China's economy
23. Understand the ancient and modern Chinese scientific and technological civilization
24. Understand the unique and long-standing Chinese education
25. Master the core concepts of harmony between man and nature, five elements of qi, yin and yang and the basic principles of health preserving in four seasons
26. 5. Familiarize with the efficacy of acupuncture and massage and the nature and function of traditional Chinese medicine
27. Understand the Chinese medical service system; Characteristics of Tibetan medicine, Mongolian medicine, Hui medicine and Zhuang medicine
28. Understand the development history of TCM
29 International communication of traditional Chinese medicine science
30. Learn the development history of Chinese traditional sports
31. Master Chinese traditional sports such as kite and archery and their related cultural connotations
32. Understand the characteristics and advantages of modern competitive sports in China
33. Understand the spiritual connotation of Chinese Wushu
34. Understand the diet of traditional Chinese festivals
35. Understand the basic situation of Chinese historical and cultural heritage
36. Know important ancient sites and cultural relics: Peking Man Site Zhoukoudian, Dunhuang Mogao Grottoes, Great Wall, Dujiangyan Irrigation System, 37. Imperial Tombs of the Ming and Qing Dynasties, Simuwu Great Tripod, Chime-Bells of Marquis Yi of the Zeng State, etc.
38. Understand the historical and cultural value of cultural heritage
39. Master the basic situation, basic characteristics, and main types of Chinese ancient buildings
40. Familiarize with representative ancient buildings, and know important ancient sites and cultural relics: Peking Man Site Zhoukoudian, 41. Dunhuang Mogao Grottoes, Great Wall, Dujiangyan Irrigation System, Imperial Tombs of the Ming and Qing Dynasties, Simuwu Great Tripod, Chime-Bells of Marquis Yi of the Zeng State, etc.
42. Understand the historical and cultural value of ancient buildings
43. Able to distinguish different architectural and garden styles and features
44. Able to read and explain relevant key words
45. Understand the development, current situation, and protection of China's intangible cultural heritage

PYTHON PROGRAMMING BASICS

Course Code: BDT 212
Total Contact Hours: 128

		P	T	C
Theory:	**32**			
Practical:	**96**	**1**	**3**	**2**

AIMS

Enable students to master the basic syntax and core concepts of Python programming language, be able to flexibly apply Python to solve practical problems, and use PyCharm tools for project creation and development.

COURSE CONTENTS

1. **INTRODUCTION TO PYTHON** **2 Hours**
   - 1.1. Basic Knowledge of Python Programming Language
   - 1.2. Writing the Python programming language
   - 1.3. Features of Python programming language
2. **FUNDAMENTALS OF FUNCTIONS** **4 Hours**
   - 2.1. Python immutable data types
   - 2.2. Python Variable Data Types
   - 2.3. Python Functions
   - 2.4. Python Function Parameters
   - 2.5. Python Function Return Value
3. **PYTHON STRING** **4 Hours**
   - 3.1. Definition of String
   - 3.2. Escape character
   - 3.3. String Splicing
   - 3.4. String Copy
   - 3.5. input() Obtain keyboard input
   - 3.6. String Slice Operation
   - 3.7. Split() segmentation
   - 3.8. Case Conversion
4. **SEQUENCES, DICTIONARIES, AND COLLECTIONS** **2 Hours**
   - 4.1. Characteristics of lists
   - 4.2. List operation
   - 4.3. Characteristics of tuples
   - 4.4. Operation of tuples
   - 4.5. Characteristics of dictionaries
   - 4.6. Dictionary operation
5. **CONTROL STATEMENT** **2 Hours**
   - 5.1. Single branch selection structure
   - 5.2. Dual branch selection structure
   - 5.3. Multi branch selection structure
   - 5.4. Cycle structure
   - 5.5. Nested Loop
   - 5.6. Break and continue statements
6. **TURTLE DRAWING** **2 Hours**
   - 6.1. Basic code for sea turtles
   - 6.2. Case analysis of turtle mapping
   - 6.3. Turtle Drawing Operations
7. **VIRTUAL ENVIRONMENT, REGULAR EXPRESSIONS** **2 Hours**
   - 7.1. Creation of Virtual Environment

7.2. Virtual Environment Usage
7.3. Introduction to Regular Expressions
7.4. Operation of Regular Expressions

8. **UNICODE AND ENCODING** **3 Hours**
   8.1. Decimal conversion
   8.2. Unicode
   8.3. Coding
9. **MULTI THREADING** **2 Hours**
   9.1. Multi tasking and multithreading
   9.2. Computer multitasking
   9.3. Python Threads
   9.4. Multi-thread priority queue
10. **DOCUMENT PROCESSING** **2 Hours**
   10.1. Basic knowledge of file processing
   10.2. Method of File Object
   10.3. Operating System Path Module
11. **EXCEPTION HANDLING** **2 Hours**
   11.1. Python Exception Handling
   11.2. Cleaning after final use
   11.3. Exception Hierarchy
12. **COMMAND LINE PARAMETERS, DATE, AND TIME** **2 Hours**
   12.1. Python Time Module
   12.2. Sys.argv
   12.3. sys. path
13. **ADVANCED PYTHON CONCEPTS** **1 Hour**
   13.1. Lambda function
   13.2. Collection module
   13.3. Map() function
   13.4. Filter() function
   13.5. Sort List
   13.6. Packaging
14. **USING DATA AND NUM. PY** **1 Hour**
   14.1. Database management system
   14.2. Operation of SQLite Database
   14.3. sys. Path
15. **CLASSES AND OBJECTS** **1 Hour**
   15.1. Classes in Python
   15.2. Objects in Python

REFERENCE BOOKS

1. Michael Besley, Python Programming from Beginner to Proficient, 2nd Edition

2. Magnus Lie Hetland, Basic Python Tutorial

3. Wesley Chun, Python Core Programming

4. Tarek Ziadé, Python Advanced Programming

5. Luciano Ramalho, Smooth Python

6. Brian Jones, David Beazley, Python Cookbook

7. Python Language and Its Applications by Chen Fengji

8. Fundamentals of Python Data Analysis by W.S. Vincent

9. Python Network Programming by Han Yong and Zeng Yuxin

10. Python Neural Network Programming by Sebastian Raschka

INSTRUCTIONAL OBJECTIVES

1. Introduction to Python
- 1.1. Understand the basic knowledge of Python programming language.
- 1.2. The writing and characteristics of the Python programming language.

2. Master functions
- 2.1. Master the data types of Python.
- 2.2. Master the basics of functions.

3. Python String
- 3.1. Definition of String
- 3.2. Be familiar with escape character, string splicing, string copying, and input() to obtain keyboard input.

4. Editability: sequences, dictionaries, and collections
- 4.1. Characteristics of lists and other operations.
- 4.2. Characteristics of tuples and other operations.
- 4.3. Characteristics of dictionaries and other operations.

5. Control statement
- 5.1. Single branch selection structure, double branch selection structure, and multi branch selection structure.
- 5.2. Cycle structure
- 5.3. Nested loops and break, continue statements

6. Turtle drawing
- 6.1. Basic code for turtles
- 6.2. Case analysis and operation of turtle mapping.

7. Virtual Environment, Regular Expression
- 7.1. and operation of regular expressions.

8. Unicode and Encoding
- 8.1. Decimal conversion
- 8.2. Unicode and Encoding

9. Multi threading
- 9.1. Multi tasking and multithreading
- 9.2. Computer multitasking
- 9.3. Threads and multithreading priority queues in Python.

10. Document processing
- 10.1. Understand the basic knowledge of file processing.
- 10.2. Method of File Object
- 10.3. Operating System Path Module

11. Exception Handling
- 11.1. Exception handling in Python.

11.2. Cleaning after final use
11.3. Exception Hierarchy

12. Command line parameters, date, and time

12.1. Time module in Python.
12.2. Sys.argv
12.3. sys. Path

13. Advanced Python Concepts

13.1. Lambda function in Python.
13.2. Collection module, map() function, filter() function, sorting list.
13.3. Packaging

14. Using Data and Num. py

14.1. Database management system
14.2. Operation of SQLite Database

15. Classes and Objects

15.1. Classes in Python
15.2. Objects in Python

LIST OF PRACTICALS

Lab 1: Use PyCharm tool to develop Python programs.

Lab 2: Using Python functions:

2.1. Write a function to determine whether an integer is a prime number, and write the main program to call the function.
2.2. Write a function to receive a string, count the number of uppercase letters, lowercase letters, numbers, and other characters, and return the result in tuples.

Lab 3: Using Python strings:

3.1. Enter a line of characters and count the number of English letters, spaces, numbers, and other characters.
3.2. Enter an English sentence, convert the lowercase letters to uppercase letters, and output.
3.3. Enter a letter identifier and calculate the sum of the numerical values of each letter in the identifier.

Lab 4: Use sequences, dictionaries, and collections:

4.1. Write a program, input a natural number greater than 2, and then output a list of all prime numbers less than that number.
4.2. Write a program, input set A and set B, and output their intersection, union, and difference respectively
4.3. Enter a string and output the character with the highest number of occurrences and its number of occurrences, using a dictionary.

Lab 5: Use control statements:

5.1. Determine whether a positive integer is a palindrome. If the forward and reverse directions of a number are the same, then the number is called a palindrome number, such as 12321 and 7887 being palindrome numbers.
5.2. Enter the age of the guess until it is correct. Each time a prompt is given indicating whether the guess is too high or too low, the number of guesses will

be output when the guess is successful.

Lab 6: Use Python for turtle drawing.

Lab 7: Using Python regular expressions:

7.1. Write a regular expression to determine whether a string is an IPv4 address.

7.2. Use regular expressions to find the longest numeric string in text.

Lab 8: Use Python for file processing:

8.1. Create a file named num.txt with a total of 100 lines, each containing an integer between 30 and 90.

8.2. Write a program that prompts the user to enter a name. After the user enters the name, it will accumulate it and write it into the file user.txt. At the same time, it will print all the names in the user.txt file. When 'q' or 'Q' is entered, the program will exit.

Lab 9: Use exception handling to guess numbers in a game, input non-integers, and throw exceptions.

Lab 10: Time module in Python:

10.1. Use the Datetime module to obtain the current time and indicate the year, month, day, week number of the current time, as well as the day of the week

Lab 11: Using Python to operate the database

Lab 12: Using Python's Num. py

12.1. Given a matrix 2n × 2n, divide the matrix into four quadrants, and then return a new 2 × 2 matrices, containing the average values of each quadrant.

12.2. Generate a random number array evenly distributed between [0,1), containing 1000 elements and 612 random seeds. Receive user input of a number between 1 and 100. Print all index values in a random array that can be divided by the input integer, and print the sequence number and index value. The serial number starts from 1 and increases by 1 in sequence.

Lab 13: Using Python Classes and Objects

13.1. Given a Dog class with three attributes: foot, weight, and height. Please output the values of these three attributes outside of the class.

13.2. Define a Math class, define a mean method in the class, pass in a list of parameters, and the function of this method is to calculate the average value of all elements in the list.

13.3. Define a Cuboid class with three attributes: length, width, and height. The class also defines a surface area function area and a volume function volume. The length, width, and height are obtained through the input function. Please write code to implement this class.

MICRO-CONTROLLERS AND EMBEDDED SYSTEMS

Course Code: DAT 212
Total Contact Hours: 128

		T	P	C
Theory:	**32**			
Practical:	**96**	**1**	**3**	**2**

AIMS

This course aims to provide students with fundamental knowledge of microcontrollers and embedded systems. Students will learn the basic architecture, hardware components, programming concepts, and interfacing techniques of microcontroller-based systems. The course builds a foundation for understanding embedded system applications used in industrial, control, and automation technologies.

COURSE CONTENTS

1. Introduction to Microcontrollers **06 Hours**

- 1.1. **Scope and Applications of Microcontrollers**
  - 1.1.1. Definition of microcontroller
  - 1.1.2. Difference between microprocessor and microcontroller
  - 1.1.3. Applications of microcontrollers in embedded systems
- 1.2. **Basic Architecture of a Microcontroller**
  - 1.2.1. Block diagram of a microcontroller
  - 1.2.2. Function of CPU, memory, and I/O ports
  - 1.2.3. Role of clock and reset circuits

2. Microcontroller Hardware and Memory Organization **07 Hours**

- 2.1. **Microcontroller Pin Configuration**
  - 2.1.1. I/O port pins and their functions
  - 2.1.2. Power supply and ground pins
  - 2.1.3. Oscillator and reset pins
- 2.2. **Memory Organization**
  - 2.2.1. Program memory
  - 2.2.2. Data memory
  - 2.2.3. Stack and special function registers
- 2.3. **Addressing Modes**
  - 2.3.1. Immediate addressing
  - 2.3.2. Direct addressing
  - 2.3.3. Indirect addressing

3. Microcontroller Programming Concepts **09 Hours**

- 3.1. **Instruction Set Overview**
  - 3.1.1. Data transfer instructions
  - 3.1.2. Arithmetic instructions
  - 3.1.3. Logical instructions
- 3.2. **Program Control Instructions**
  - 3.2.1. Jump instructions
  - 3.2.2. Call and return instructions
  - 3.2.3. Loop and delay instructions
- 3.3. **Development Tools**
  - 3.3.1. Assembler and compiler concepts
  - 3.3.2. Programming environment and debugging tools

4. Embedded System Fundamental **06 Hours**

4.1. **Introduction to Embedded System**

4.1.1. Definition of embedded system

4.1.2. Characteristics of embedded system

4.1.3. Hardware and software components of embedded system

4.2. **Embedded System Applications**

4.2.1. Industrial control systems

4.2.2. Consumer and automation applications

5. Interfacing and Communication **04 Hours**

5.1. **Digital Interfacing**

5.1.1. LED interfacing

5.1.2. Switch and keypad interfacing

5.1.3. Seven-segment display interfacing

5.2. **Communication Basics**

5.2.1. Serial communication concepts

5.2.2. UART communication

REFERENCE BOOKS

1. Microcontroller Technology, Punjab Board of Technical Education (PBTE), Lahore. *(Official PBTE / TEVTA prescribed textbook)*
2. Embedded Systems (DAE Curriculum Textbook), National Institute of Science and Technical Education (NISTE), Islamabad.
3. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson Education.
4. Microcontrollers and Embedded Systems, Raj Kamal, McGraw-Hill Education.

INSTRUCTIONAL OBJECTIVES

1. UNDERSTANDING MICROCONTROLLER FUNDAMENTALS

1.1. Understand the term of microcontroller.

1.2. Differentiate between microprocessor and microcontroller.

1.3. Understand basic architecture of a microcontroller.

1.3.1. Draw block diagram of a microcontroller.

1.3.2. Discuss the function of each block.

2. UNDERSTANDING MICROCONTROLLER HARDWARE

2.1. Understand pin configuration and hardware features.

2.1.1. Describe I/O port pins.

2.1.2. Describe power, clock, and reset pins.

2.2. Understand memory organization.

2.2.1. Describe program memory.

2.2.2. Describe data memory.

3. UNDERSTANDING PROGRAMMING AND EMBEDDED SYSTEMS

3.1.1. Understand instruction set and programming concepts.

3.1.2. Understand embedded system components and applications.

LIST OF PRACTICALS

Lab1: Identify Microcontroller Pins and Hardware Components.

Lab2: Install Microcontroller software Program.

Lab3: Program microcontroller software for Simple LED Blinking.

Lab4: Control an LED based Program by Interface a Switch with microcontroller.
Lab5: Program microcontroller internal timer to implement delays.
Lab6: Interface and control a seven-segment display using the microcontroller.
Lab7: Connect microcontroller and computer with UART protocol to understand serial communication between them

INTRODUCTION TO UNMANNED AERIAL VEHICLE (UAV) AERODYNAMICS

Course Code: DAT - 213
Total Contact Hours: 160

		T	P	C
Theory:	**64**			
Practical:	**96**	**2**	**3**	**3**

AIMS

The aim of this course is to develop a comprehensive understanding of the fundamental principles of UAV aerodynamics and flight performance. Students will become familiar with the characteristics of the atmosphere and their effects on flight. The course will enable learners to understand the behavior of low-speed airflow and the principles of low-speed aerodynamics, while also introducing the basic concepts of high-speed and unconventional aerodynamic characteristics. Furthermore, students will gain knowledge of the aerodynamic characteristics of propellers and their role in UAV propulsion. The course will also focus on the stability and maneuverability principles of different types of UAVs, enabling students to understand how flight control and balance are maintained. In addition, learners will become familiar with the basic flight conditions, operational states, and performance characteristics of unmanned aerial vehicles.

COURSE CONTENTS

1. Introduction to UAVs and Atmospheric Environment — 6 Hours

- 1.1. Overview of UAV types and applications
- 1.2. Classification of UAVs (fixed-wing, rotary-wing, hybrid, multirotor)
- 1.3. Role of aerodynamics in UAV flight performance
- 1.4. Composition and structure of the atmosphere
- 1.5. Atmospheric properties: pressure, temperature, density
- 1.6. International Standard Atmosphere (ISA) model
- 1.7. Influence of altitude and weather on UAV performance

2. Fundamentals of Aerodynamics — 6 Hours

- 2.1. Basic aerodynamic terminology and concepts
- 2.2. Forces acting on an aircraft (lift, drag, thrust, weight)
- 2.3. Airflow concepts (laminar vs turbulent flow)
- 2.4. Reynolds number and its significance in UAV flight
- 2.5. Boundary layer concept
- 2.6. Introduction to airfoils and wings

3. Low-Speed Aerodynamics — 9 Hours

- 3.1. Characteristics of low-speed airflow
- 3.2. Mechanism of Lift generation at low speeds
- 3.3. Airfoil characteristics for low-speed UAVs
- 3.4. Angle of attack and lift coefficient
- 3.5. Drag components (induced drag, parasitic drag)
- 3.6. Stall phenomenon and stall recovery
- 3.7. Low-speed aerodynamic design considerations for UAVs

4. High-Speed and Unconventional Aerodynamics — 9 Hours

- 4.1. Characteristics of high-speed airflow
- 4.2. Compressibility effects and Mach number
- 4.3. Shock waves and drag rise (basic understanding)
- 4.4. Introduction to swept wings Aerodynamics
- 4.5. Unconventional UAV configurations
- 4.6. Flying wing

4.7. Blended wing body
4.8. VTOL and hybrid UAVs platforms
4.9. Aerodynamic challenges of unconventional design

5. Propeller Aerodynamics **7 Hours**

5.1. Operating principle of propellers
5.2. Propeller geometry: diameter, pitch, blade angle
5.3. Thrust generation by propellers
5.4. Propeller efficiency and performance
5.5. Factors affecting propeller selection for UAVs
5.6. Comparison of propellers for fixed-wing and multirotor UAVs
5.7. Basic propeller matching with motors

6. UAV Stability and Control **9 Hours**

6.1. Concepts of stability and controllability
6.2. Static and dynamic stability (basic level)
6.3. Longitudinal, lateral, and directional stability
6.4. Control surfaces and their functions
6.5. Stability characteristics of:
  6.5.1. Fixed-wing UAVs
  6.5.2. Multirotor UAVs
  6.5.3. Hybrid UAVs
6.6. Effect of center of gravity on UAV stability

7. UAV Maneuverability and Flight Control **9 Hours**

7.1. Principles of maneuverability
7.2. Turning, climbing, and descending maneuvers
7.3. Understanding of coordinated turns
7.4. Effect of control inputs on UAV motion
7.5. Role of flight control systems
7.6. Introduction to autopilot and flight stabilization system

8. Basic Flight Performance of UAVs **9 Hours**

8.1. Basic flight states: takeoff, climb, cruise, descent, landing
8.2. Performance parameters:
  8.2.1. Range
  8.2.2. Endurance
  8.2.3. Maximum speed
  8.2.4. Rate of climb
  8.2.5. Payload effects on UAV performance
8.3. Energy consumption and efficiency
8.4. Basic performance calculations

RECOMMENDED BOOKS

1. “Advanced UAV Aerodynamics, Flight Stability and Control”--Marqués & Da Ronch, Wiley
2. “Understanding Aerodynamics: Arguing from the Real Physics” – Doug McLean

INSTRUCTIONAL OBJECTIVES

1. Identification of UAV components
2. Airfoil and propeller demonstrations
3. Simple wind tunnel or simulation experiments
4. UAV flight simulation exercises

5. Pre-flight checks and basic flight observation
6. Case studies of common UAV platforms

LIST OF PRACTICALS

Lab1: Measure and analyze Atmospheric properties:(temperature, pressure, density, and humidity)
Lab2: Observe airflow behavior and identify laminar and turbulent boundary layers over aerodynamic surfaces
Lab3: Calculate Reynolds number for UAV wings & study its effect on lift and drag characteristics
Lab4: Analyze Lift, drag, and moment coefficient vs angle of attack for low speed Airfoils
Lab5: Study Mach number effects on lift and drag
Lab6: Study the effect of speed increase on UAV stability.
Lab7: Analyze geometric characteristics of aircraft or UAV propellers: (pitch, diameter, blade angle, and airfoil section)
Lab8: Evaluate aircraft static stability in different axes: (Longitudinal, lateral, and directional stability analysis using models or simulation)
Lab9: Estimate maximum endurance and range of UAV

INTRODUCTION TO UNMANNED AERIAL VEHICLE (UAV) AUTOPILOT SYSTEM

Course Code: DAT 223
Total Contact Hours: 160

		T	P	C
Theory:	**64**			
Practical:	**96**	**2**	**3**	**3**

AIMS

This course introduces students to the working principles, architecture, hardware, and software of UAV autopilot systems. It covers flight control concepts, sensor integration, control algorithms, mission planning, and failsafe mechanisms used in modern unmanned aerial vehicles. Practical exposure to popular autopilot platforms such as Pixhawk and ArduPilot is included.

COURSE CONTENTS

1. Introduction to UAV Autopilot **6 hours**
- 1.1. Definition of autopilot system
- 1.2. Manual vs stabilized vs autonomous flight
- 1.3. Evolution of UAV autopilot systems
- 1.4. Role of autopilot in UAV flight operations
- 1.5. Applications of UAV autopilot systems

2. Autopilot System Architecture **8 hours**
- 2.1. Basic block diagram of UAV autopilot
- 2.2. Flight controller unit (FCU)
- 2.3. Input and output signal flow
- 2.4. Communication interfaces (PWM, UART, I2C, CAN)
- 2.5. Ground Control Station (GCS) overview

3. Sensors for Autopilot Systems **10 hours**
- 3.1. Inertial Measurement Unit (IMU)
- 3.2. Sensor: Gyroscope, Accelerometer and Magnetometer
- 3.3. Navigation Sensors GPS and Barometer
- 3.4. Sensor fusion concept
- 3.5. Sensor errors, noise and calibration

4. Flight Control and Stabilization **10 hours**
- 4.1. UAV coordinate systems and flight axes
- 4.2. Altitude and position control
- 4.3. PID controller basics
- 4.4. Roll, Pitch and Yaw stabilization
- 4.5. Flight modes (Manual, Stabilize, Loiter, Auto, RTL)

5. Autopilot Software and Firmware **9 hours**
- 5.1. Open-source autopilot platforms
  - 5.1.1. ArduPilot (PX4)
- 5.2. Firmware structure and parameters
- 5.3. Mission Planner / QGroundControl software
- 5.4. Firmware installation and updates

6. Mission Planning and Autonomous Flight **9 hours**
- 6.1. Waypoint navigation
- 6.2. Mission planning using GCS

6.3. Autonomous Takeoff, landing, and RTL missions
6.4. Geo-fencing and altitude limits
6.5. Autonomous safety checks

7. Failsafe and Safety Systems **6 hours**

7.1. Signal loss failsafe
7.2. Low battery failsafe
7.3. GPS failure management
7.4. Emergency landing procedures
7.5. UAV safety regulations

8. Practical Applications and Case Studies **6 hours**

8.1. Multirotor vs Fixed-wing autopilot system
8.2. Commercial UAV autopilot systems
8.3. Industry case studies
8.4. Future trends in UAV autopilot technology

REFERENCE BOOKS

1. Unmanned Aircraft Systems – R. Austin
2. Small Unmanned Aircraft Systems – R. Beard

INSTRUCTIONAL OBJECTIVES

After completing instruction in this course, students will be able to:

1. Conceptual Understanding of UAV Autopilot Systems

1.1. Explain the purpose and working principle of an autopilot system in UAVs
1.2. Differentiate clearly between manual, stabilized, and fully autonomous flight modes
1.3. Describe the historical development of UAV autopilot systems from basic stabilization to intelligent autonomous systems
1.4. Identify real-world applications where autopilot systems are essential (surveillance, mapping, agriculture, delivery, etc.)

2. Autopilot System Architecture and Signal Flow

2.1. Draw and explain the block diagram of a UAV autopilot system
2.2. Identify the functions of the flight controller unit (FCU)
2.3. Explain how input signals from sensors and RC receivers are processed
2.4. Describe output signals sent to motors, ESCs, and control surface
2.5. Introduce students to communication protocols (PWM, UART, I2C, CAN) and their practical use
2.6. Demonstrate the role and functionality of a Ground Control Station (GCS)

3. Sensors and Data Acquisition

3.1. Explain the working principles of IMU sensors
3.2. Teach the function of:
  3.2.1. Gyroscope (angular motion)
  3.2.2. Accelerometer (linear motion)
  3.2.3. Magnetometer (heading)
3.3. Explain how GPS and barometer are used for position and altitude estimation
3.4. Introduce the concept of sensor fusion in simple, non-mathematical terms
3.5. Identify common sensor errors and demonstrate basic calibration procedures

4. Flight Control and Stabilization Concepts

4.1. Explain UAV coordinate systems and axes (X, Y, Z)

4.2. Describe how attitude, altitude, and position control are achieved
4.3. Introduce PID control at a conceptual and practical level (no heavy mathematics)
4.4. Explain how roll, pitch, and yaw stabilization works in multirotor UAVs
4.5. Demonstrate different flight modes and explain when each mode is used:
4.6. Manual, Stabilize, Loiter, Auto, Return to Launch (RTL)

5. Autopilot Software and Firmware Operation

5.1. Introduce open-source autopilot platforms, focusing on:
  5.1.1. ArduPilot (detailed)
  5.1.2. PX4 (overview)
5.2. Explain the structure of autopilot firmware and parameter system
5.3. Demonstrate installation and configuration using:
  5.3.1. Mission Planner
  5.3.2. QGroundControl
5.4. Teach firmware flashing, updating, and version selection
5.5. Explain the importance of parameter tuning and safety check

6. Mission Planning and Autonomous Operations

6.1. Teach students how to create waypoint missions
6.2. Demonstrate mission planning using GCS software
6.3. Explain autonomous
6.4. Takeoff, Landing, RTL operations
6.5. Introduce geo-fencing and altitude limits for safety
6.6. Perform pre-flight autonomous system check

7. Failsafe Mechanisms and UAV Safety

7.1. Explain different failsafe conditions and their importance
7.2. Demonstrate: RC signal loss failsafe, Low battery failsafe, GPS failure response
7.3. Teach emergency landing procedures
7.4. Introduce students to basic UAV safety regulations and responsible operation practices
7.5. Emphasize risk management and system reliability

8. Practical Exposure and Industry Awareness

8.1. Compare multirotor and fixed-wing autopilot systems
8.2. Introduce commercial autopilot systems used in industry
8.3. Discuss real-world case studies of UAV autopilot deployment
8.4. Explore future trends, including AI-assisted flight control and autonomous swarm systems
8.5. Prepare students for advanced UAV studies and industrial applications

LIST OF PRACTICALS

Lab 1: Identify the major hardware components used in UAV autopilot systems.
Lab 2: Understand proper wiring and power supply connections for an autopilot system.
Lab 3: Install and setup Mission Planner / QGroundControl
Lab 4: Upload and manage firmware for the autopilot controller
Lab 5: Configure essential parameters required for UAV operation
Lab 6: Calibrate the inertial measurement sensors (accelerometer and gyroscope) used for flight stabilization.
Lab 7: Compass calibration and interference testing
Lab 8: Configure the GPS module and verify satellite connectivity.
Lab 9: Calibrate the radio transmitter and receiver for manual control
Lab 10: Configure and test different UAV flight modes (Manual, Stabilize, Loiter, Auto)
Lab 11: Perform standard pre-flight inspection and safety verification.

Lab 12: Create and test UAV missions using Software-In-The-Loop simulation (SITL)
Lab 13: Evaluate autonomous flight behavior using simulated missions.
Lab 14: Configure safety mechanisms for emergency situations (RC loss, low battery, GPS loss)
Lab 15: analyze flight data and evaluate UAV system performance.

INTRODUCTION TO UNMANNED AERIAL VEHICLE (UAV) MOTORS AND BATTERIES

Course Code: DAT 233
Total Contact Hours: 160

	T	P	C
Theory: 64			
Practical : 96	**2**	**3**	**3**

AIMS

The objective of this course is to provide students with an understanding of the fundamental principles of electric motors used in UAV propulsion systems and their applications in different UAV platforms. Students will learn to identify, select, and test various motor types according to specific UAV requirements. The course also introduces battery chemistry, characteristics, and safe handling procedures, with emphasis on the use of common UAV power sources such as Lithium Polymer Battery. In addition, students will study the implementation of battery management systems and proper charging protocols. Finally, the course develops practical skills in maintenance, troubleshooting, and repair of UAV propulsion systems.

COURSE CONTENTS

1. FUNDAMENTALS OF ELECTRIC MOTORS **7 Hours**

1.1. Introduction to Electric Motors
- 1.1.1. Motor classification: DC, AC, and Special Purpose Motors
- 1.1.2. Electromagnetic principles: Lorentz force, torque generation
- 1.1.3. Electrical parameters: Voltage, Current, Torque, Speed, Power
- 1.1.4. Efficiency and power losses in motors

1.2. DC Motors Overview
- 1.2.1. Brushed DC motor construction and operation
- 1.2.2. Types of DC motors (Series, Shunt and Compound wound)
- 1.2.3. Speed-torque characteristics
- 1.2.4. Advantages and limitations of motors for UAV use

1.3. Motor Specifications and Datasheet
- 1.3.1. Reading and interpreting motor datasheets
- 1.3.2. Kv rating (RPM per Volt)
- 1.3.3. No-load current (I0)
- 1.3.4. Internal resistance (Rm)
- 1.3.5. Maximum current and power ratings

2. BRUSHLESS DC (BLDC) MOTORS FOR UAV **8 Hours**

2.1. BLDC Motor Fundamentals
- 2.1.1. Construction of BLDC motors (Stator, rotor, windings, permanent magnets)
- 2.1.2. Inrunner vs Outrunner configurations
- 2.1.3. poles and slots
- 2.1.4. Winding types: Delta and Wye (Star)

2.2. BLDC Motor Operation
- 2.2.1. Electronic commutation principle
- 2.2.2. Three-phase operation and timing
- 2.2.3. Back-EMF and its role in motor control

2.2.4. Torque production and ripple

2.3. BLDC Motor Characteristics

2.3.1. Kv rating and its significance for UAV
2.3.2. Motor efficiency graphs
2.3.3. Thermal considerations
2.3.4. Motor timing and advance

2.4. Motor Selection for UAV Applications

2.4.1. Thrust requirements calculation
2.4.2. Power-to-weight ratio considerations
2.4.3. Multi-rotor vs fixed-wing motor selection

3. BATTERY FUNDAMENTALS — 7 Hours

3.1. Electrochemistry Basics

3.1.1. Electrochemical cells (Anode, cathode and electrolyte)
3.1.2. Cell voltage and capacity
3.1.3. Series and parallel cell configurations
3.1.4. Energy density (Wh/kg) and power density (W/kg)

3.2. UAV Battery Terminology

3.2.1. Voltage (Nominal, fully charged and discharge cutoff)
3.2.2. Capacity (mAh, Ah)
3.2.3. C-rating (Discharge rate)
3.2.4. Internal resistance
3.2.5. State of Charge (SoC) and Depth of Discharge (DoD)

3.3. Battery Performance Factors

3.3.1. Temperature effects
3.3.2. Discharge curves and voltage sag
3.3.3. Cycle life and calendar life
3.3.4. Self-discharge rate

4. LITHIUM POLYMER (LiPo) BATTERIES — 8 Hours

4.1. LiPo Battery Construction

4.1.1. Cell structure and materials
4.1.2. Pouch cell design
4.1.3. Battery configurations (1S to 12S)
4.1.4. Balance leads and main discharge leads

4.2. LiPo Battery Specifications

4.2.1. Cell voltage range (3.0V - 4.2V)
4.2.2. Storage voltage (3.8V per cell)
4.2.3. C-rating interpretation (continuous vs burst)
4.2.4. Internal resistance measurement

4.3. LiPo Safety and Handling

4.3.1. Fire and explosion hazards
4.3.2. Physical damage prevention
4.3.3. Overcharge and over-discharge protection
4.3.4. Storage and transportation guidelines
4.3.5. Disposal procedures

4.4. LiPo Failure Modes

4.4.1. Puffing and swelling causes

4.4.2. Internal short circuits
4.4.3. Thermal runaway
4.4.4. Cell imbalance effects

5. OTHER BATTERY TECHNOLOGIES FOR UAV — 5 Hours

5.1. Lithium-Ion (Li-Ion) Batteries
5.1.1. 18650 and 21700 cell types
5.1.2. Comparison with LiPo
5.1.3. Applications in long-endurance UAV

5.2. Lithium Ion Phosphate (LiFePO4)
5.2.1. Safety characteristics
5.2.2. Voltage profile differences
5.2.3. Cycle life advantages

5.3. Emerging Technologies
5.3.1. Solid-state batteries
5.3.2. Lithium-Sulfur batteries
5.3.3. Hydrogen fuel cells for UAV

6. BATTERY CHARGING SYSTEMS — 8 Hours

6.1. Charging Principles
6.1.1. CC-CV (Constant Current - Constant Voltage) charging
6.1.2. Balance charging importance
6.1.3. Charging rates: 1C, 2C, fast charging
6.1.4. Temperature monitoring during charge

6.2. Charger Types and Features
6.2.1. Simple balance chargers
6.2.2. Programmable chargers (IMAX B6, etc.)
6.2.3. Parallel charging boards
6.2.4. Field charging solutions

6.3. Charging Safety Protocol
6.3.1. Pre-charge inspection
6.3.2. Charging environmental requirements
6.3.3. Fire safety equipment
6.3.4. Unattended charging risks

7. BATTERY MANAGEMENT SYSTEMS (BMS) — 8 Hours

7.1. BMS Function
7.1.1. Cell voltage monitoring
7.1.2. Current sensing
7.1.3. Temperature monitoring
7.1.4. State of Charge estimation

7.2. Protection Features
7.2.1. Overcharge protection
7.2.2. Over-discharge protection
7.2.3. Overcurrent protection
7.2.4. Short circuit protection
7.2.5. Thermal protection

7.3. Cell Balancing

7.3.1. Passive balancing methods
7.3.2. Active balancing method
7.3.3. Balancing algorithms

8. PROPELLER FUNDAMENTALS **6 Hours**

8.1. Propeller Theory

8.1.1. Thrust generation principles
8.1.2. Pitch, diameter, and blade count
8.1.3. Propeller efficiency
8.1.4. Reynolds number effects

8.2. Propeller Selection

8.2.1. Motor-propeller matching
8.2.2. Thrust tables and calculators
8.2.3. Folding vs fixed propellers
8.2.4. Material considerations (plastic, carbon fiber

9. MOTOR-PROPELLER-BATTERY INTEGRATION **7 Hours**

9.1. System Design Calculations

9.1.1. All-Up-Weight (AUW) calculation
9.1.2. Thrust-to-weight ratio requirements
9.1.3. Power consumption estimation
9.1.4. Flight time calculation

9.2. Performance Optimization

9.2.1. Efficiency optimization techniques
9.2.2. Current drawing measurement and analysis
9.2.3. Temperature monitoring during operation
9.2.4. Bench testing procedures

9.3. Practical Integration

9.3.1. Motor mounting techniques
9.3.2. Wiring and connector selection
9.3.3. Heat management solutions
9.3.4. Vibration dampening

REFERENCE BOOKS

1. "Brushless DC Motors Used in Industrial Applications" - Yashvant Jani
2. "Electric Motors and Drives" - Austin Hughes, Bill Drury (Elsevier)
3. "Battery Management Systems for Large Lithium-Ion Battery Packs" - Davide Andrea
4. "Lipo Manual" - FMA Direct
5. "Model Airplane Propeller Theory" - Martin Hepperle
6. "Multirotor Aerial Vehicles: Modeling, Estimation, and Control" - Quan Quan
7. DJI Academy Training Materials
8. Motor manufacturer datasheets and application notes
9. www.ecalc.ch - Online propulsion calculator
10. www.rcbenchmark.com - Thrust stand guides

INSTRUCTIONAL OBJECTIVES

1. FUNDAMENTALS OF ELECTRIC MOTORS

1.1. Explain the electromagnetic principles behind motor operation
1.2. Differentiate between DC motor types and their characteristics
1.3. Calculate motor power, torque, and efficiency from given parameters
1.4. Interpret motor datasheets and select appropriate motors for applications

2. BRUSHLESS DC (BLDC) MOTORS FOR UAV

2.1. Describe BLDC motor construction and identify component
2.2. Explain the electronic commutation process
2.3. Calculate motor performance based on Kv rating
2.4. Select appropriate BLDC motors for specific UAV applications
2.5. Analyze motor efficiency curves and thermal performance

3. BATTERY FUNDAMENTALS

3.1. Explain electrochemical principles of batteries
3.2. Calculate battery capacity, energy, and discharge rates
3.3. Interpret battery specifications and performance curves
3.4. Analyze effects of temperature and load on battery performance

4. LITHIUM POLYMER (LiPo) BATTERIES

4.1. Describe LiPo cell construction and configurations
4.2. Calculate voltage, capacity, and C-rating requirements
4.3. Apply safety procedures for LiPo handling and storage
4.4. Identify and respond to battery failure modes
4.5. Measure internal resistance and assess battery health

5. OTHER BATTERY TECHNOLOGIES FOR UAV

5.1. Compare different lithium battery chemistries
5.2. Evaluate battery technology suitability for specific applications
5.3. Discuss emerging battery technologies and their potential

6. BATTERY CHARGING SYSTEMS

6.1. Explain CC-CV charging algorithm
6.2. Configure and operate battery chargers' safety
6.3. Perform parallel charging with proper precautions
6.4. Implement field charging procedures

7. BATTERY MANAGEMENT SYSTEMS (BMS)

7.1. Describe BMS functions and protection features
7.2. Explain cell balancing methods and algorithms
7.3. Troubleshoot BMS-related issues
7.4. Integrate BMS with UAV power systems

8. PROPELLER FUNDAMENTALS

8.1. Explain propeller aerodynamics and thrust generation
8.2. Calculate propeller efficiency and performance
8.3. Select appropriate propellers for given motor specifications
8.4. Analyze propeller pitch and diameter effects on performance

9. MOTOR-PROPELLER-BATTERY INTEGRATION

9.1. Calculate complete propulsion system requirements
9.2. Design power distribution systems for multi-rotor UAV
9.3. Perform bench testing and data analysis
9.4. Optimize system efficiency and flight time

LIST OF PRACTICALS

Lab 1: Identify different motor types (Brushed DC, BLDC In runner, Outrunner
Lab 2: Read and interpret motor specifications from datasheets
Lab 3: Measure motor physical dimensions and weight
Lab 4: Identify motor wire connections and winding configurations
Lab 5: Measure no-load current and RPM and plot speed vs voltage characteristics
Lab 6: Calculate motor efficiency at different loads
Lab 7: Setup motor with known propeller on thrust stand
Lab 8: Measure RPM at various voltages
Lab 9: Calculate and verify Kv rating
Lab 10: Compare measured Kv with manufacturer specification
Lab 11: Configure ESC settings using programming card
Lab 12: Test different motor timing settings
Lab 13: Configure and test DShot protocol
Lab 14: Compare response times between protocols
Lab 15: Analyze motor smoothness at different settings
Lab 16: Identify different battery types (LiPo, Li-Ion, LiFePO4)
Lab 17: Read battery labels and specifications
Lab 18: Identify cell count and configurations
Lab 19: Check battery balance lead voltages and use battery analyzer to measure IR per cell
Lab 20: Compare IR across cells in pack
Lab 21: Assess battery health based on IR readings
Lab 22: Track IR changes over charge cycles
Lab 23: Setup charger for specific battery configuration

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 لمر اقلم الصلوته و ایتا الزکوة و حج البیت و صوم رمضان

() الدین النصیحته

() المنشاء موتمن

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

() لیسلم علیه اذا لقیه و لیشمته 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، عفوودرگزر، 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 وفرائض:

عمومی مقاصد:

() اسلامی معاشرے کا ایک اچھا فرد بن سکے

خصوصی مقاصد:

() والدین کے حقوق وفرائض 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

() مختلف 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 وفرائض 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 ومفہوم کو بیان کر سکے

() اسلام میں حسن واخلاق کی اہمیت بیان کر سکے

() قرآن وسنت کی روشنی میں صبر واستقلال کی اہمیت بیان کر سکے

() ایفائے عہد کی اہمیت بیان کر سکے

() اخوت کے معنی ومفہوم بیان کر سکے

() اخوت اسلامی کی اہمیت بیان کر سکے

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

نصاب (سال سوئم)

GEN 301

ٹی	پی	سی
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کل وقت 12 گھنٹے

مطالعہ پاکستان

حصہ دوئم

موضوعات:

() قیام پاکستان
() باؤنڈری کمیشن
() ریڈکلف ایوارڈ
() تقسیم بنگال
() تقسیم پنجاب
() مسئلہ مہاجرین
() ریاست کا الحاق
() ریاست جموں کشمیر
() نہری پانی کا تنازعہ
() قرارداد پاکستان
() علماء کے بائیس نکات
() 1956۔1962۔اور 1973 کے دساتیر کی اسلامی/انسانی حقوق کی دفعات (8تا28)۔
() اقلیتوں کے حقوق۔دیگر محروم طبقات کے حقوق
() پاکستان کا محل وقوع اور اسکی جغرافیائی اہمیت۔+GSP کا تعارف اور عملی طریقہ کار
() قدرتی وسائل (تیل، گیس، کوئلہ)

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 (8-28)۔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

GEN301

نصاب اخلاقیات

سال سوئم

ٹی	پی	سی
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

() مخنث 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

METALWORKING TECHNOLOGY (FITTER TRAINING)

Course Code: DAT 311
Total Contact Hours: 96

	T	P	C
Theory: 0			
Practical : 96	**0**	**3**	**1**

COURSE DESCRIPTION（课程介绍）

This course is a professional basic practical course tailored for vocational college students majoring in mechanical and equipment manufacturing fields. Based on national vocational skill standards and enterprise post requirements, it focuses on fitter basic skills, safety operations and practical part processing. Adopting a "practice-oriented" teaching model, it integrates safety education, skill training and professional quality cultivation. Students will progressively master core fitter skills from basic tool operation to comprehensive part processing, laying a solid foundation for future engineering practice and professional work.

Course Objectives（课程目标）

By the end of the academic year, students will be able to:

1. Abide by workshop safety regulations and implement safe operating procedures in metalworking practice.
2. Master the use of common fitter tools, equipment and measuring instruments.
3. Analyze simple part drawings and formulate basic machining process plans.
4. Complete basic fitter operations such as marking, sawing, filing, drilling and tapping.
5. Inspect processed parts and judge whether they meet technical requirements.
6. Cultivate professional qualities of safety awareness, team cooperation and rigorous work attitude.

COURSE CONTENTS（详细课程内容）

1. Course Introduction and Safety Education

1. Overview of metalworking practice and course arrangement
2. Workshop safety regulations and labor protection requirements
3. Safety hazards and accident prevention in fitter operations
4. Emergency handling of common safety accidents
5. Cultivation of safe and civilized operation awareness

2. Basic Knowledge of Fitter Tools and Equipment

1. Introduction to common fitter tools: marking tools, sawing tools, filing tools
2. Use and maintenance of drilling machines, milling machines and fitter workbenches
3. Common measuring instruments: steel ruler, vernier caliper, micrometer
4. Selection principles of tools and equipment for different operations
5. Daily maintenance and storage of tools and equipment

3. Basic Fitter Operations (I): Marking and Sawing

1. Marking basis and operation steps
2. Marking accuracy control and common problems handling
3. Sawing operation: tool installation, posture adjustment and force control
4. Prevention and handling of saw blade damage
5. Practical training: marking and sawing of simple workpieces

4. Basic Fitter Operations (II): Filing and Finishing

1. Filing methods: flat filing, cross filing, finish filing
2. Control of workpiece flatness and surface roughness
3. Finishing operations for workpiece surfaces

4. Common defects in filing and correction methods
5. Practical training: filing and finishing of sawn workpieces

5. Basic Fitter Operations (III): Drilling and Tapping

1. Drilling operation: drill bit selection, installation and drilling process
2. Drilling accuracy control and hole deviation prevention
3. Tapping and threading: tap selection and operation steps
4. Common problems in tapping: breakage, sliding wire and solutions
5. Practical training: drilling and tapping of workpieces

6. Part Drawing Analysis and Process Planning

1. Reading methods of simple part drawings and technical requirements
2. Formulation of basic machining process plans
3. Selection of processing methods and sequence arrangement
4. Compilation of simple process cards
5. Case analysis: process planning of nut workpieces

7. Part Inspection and Quality Control

1. Use of measuring instruments for size and shape inspection
2. Judgment of workpiece quality and tolerance analysis
3. Correction methods for unqualified workpieces
4. Quality awareness cultivation and process improvement
5. Practical training: inspection of processed parts

8. Comprehensive Practical Training

1. Comprehensive project: processing of standard nuts or simple parts
2. Integration of multi-process operations and process optimization
3. Team cooperation in batch processing tasks
4. Problem-solving in practical operation
5. Summary and evaluation of comprehensive training results

REFERENCE BOOKS（推荐教材）

1. Metalworking Technology – Xiong Tao (Chemical Industry Press)
2. Manual of Mechanical Processing Technology - Li Hong

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Understand the significance and application of metalworking practice in mechanical manufacturing.
2. Master the core safety regulations and form a solid safety operation awareness.
3. Acquire the ability to use common fitter tools, equipment and measuring instruments proficiently.
4. Learn to analyze simple part drawings and formulate reasonable machining processes.
5. Develop skills in basic fitter operations and complete workpiece processing independently.
6. Grasp the basic methods of part inspection and quality control.
7. Cultivate the professional quality of rigorous work, active cooperation and continuous improvement.
8. Establish a correct view of labor and recognize the value of practical skills.
9. Enhance problem-solving abilities in engineering practice scenarios.
10. Lay a foundation for learning professional courses and engaging in mechanical-related work.
11. Understand the norms and requirements of enterprise production posts.
12. Develop good working habits of tool maintenance and workplace organization.
13. Be able to summarize practical experience and optimize processing operations.
14. Improve the ability to adapt to practical work and team collaboration.
15. Cultivate the sense of responsibility for product quality and production safety.

LIST OF PRACTICALS（实践工作）

Lab1: Workshop Safety Education and Emergency Drill	6 Hours
Lab2: Fitter Tools and Equipment Familiarization and Maintenance	6 Hours
Lab3: Marking and Sawing Operation Training	6 Hours
Lab4: Filing and Surface Finishing Practice	6 Hours
Lab5: Drilling and Tapping Operation Training	6 Hours
Lab6: Measuring Instruments Use and Part Inspection Practice	6 Hours
Lab7: Part Drawing Analysis and Process Planning Exercise	6 Hours
Lab8: Simple Workpiece Processing (Single Process)	6 Hours
Lab9: Comprehensive Project: Nut Machining Practice	6 Hours
Lab10: Batch Processing Task with Team Cooperation	6 Hours
Lab11: Unqualified Workpiece Correction and Process Improvement	6 Hours
Lab12: Comprehensive Practical Assessment	8 Hours
Lab13: Workplace Organization and Tool Storage Training	8 Hours
Lab14: Practical Experience Summary and Sharing	6 Hours
Lab15: Case Analysis of Fitter Operation Defects	8 Hours

Recommended Equipment（推荐设备）

1. Fitter Workbenches and Vice Clamps
2. Common Fitter Tools (Marking Gauge, Hacksaw, File, Tap, Drill Bit)
3. Drilling Machines and Milling Machines
4. Measuring Instruments (Vernier Caliper, Micrometer, Steel Ruler)
5. Labor Protection Equipment (Safety Helmet, Protective Goggles, Work Gloves)
6. Training Consumables (Carbon Steel Plates, Bars)
7. Tool Storage Racks and Workplace Cleaning Tools

UAV ASSEMBLY AND DEBUGGING

Course Code: DAT 312
Total Contact Hours: 128

	T	P	C
Theory: 32			
Practical : 96	**1**	**3**	**2**

COURSE DESCRIPTION（课程介绍）

This course introduces the structure, aerodynamic layout, flight and control principles of multi-rotor unmanned aerial vehicle (UAV) systems; assembly of multi-rotor UAV systems (frame, flight control system, power system, communication system); system debugging such as flight parameter setting, radio frequency alignment, and geomagnetic calibration for multi-rotor UAVs; and flight operations such as four-sided hovering, fixed-point spinning, and horizontal flight path flying for multi-rotor UAVs.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:

1. Be familiar with the performance parameters, overall structure and flight principles of multi-rotor UAVs
2. Be able to proficiently use relevant assembly tools to complete the full assembly of multi-rotor UAVs.
3. Be able to proficiently operate various instruments and equipment in accordance with UAV technical manuals to conduct comprehensive and standardized system debugging of multi-rotor UAVs
4. Be able to proficiently complete all types of basic flight maneuvers of multi-rotor UAVs through two training modes: dual-control flight and solo flight, during field training.

COURSE CONTENTS（详细课程内容）

1. Introduction to UAV structure and system — 6 Hours

- 1.1. Basic structure and propulsion system of multi-rotor UAV
- 1.2. UAV flight control system
- 1.3. UAV communication and navigation system
- 1.4. UAV mission payload system

2. Tools, materials, and operational safety for drone assembly and debug — 6 Hours

- 2.1. Introduction to assembly and debug tools and materials for multi-rotor drones Levels of UAV autonomy
- 2.2. Operation safety of drone assembly and debug tools
- 2.3. Drone assembly craft

3. Assembly of multi-rotor unmanned aerial vehicles — 6 Hours

- 3.1. Drone frame assembly
- 3.2. Drone power system assembly
- 3.3. Drone flight control system assembly
- 3.4. Drone remote control transceiver system assembly

4. Debug of multi-rotor unmanned aerial vehicles — 6 Hours

- 4.1. Remote control setup and debugging
- 4.2. Remote control communication connection debugging
- 4.3. Drone flight control system setup and debugging
- 4.4. Drone parameter setting and debugging

5. Drone flight operation **8 Hours**

5.1. Basic flight operations
5.2. Fixed-point hovering flight towards the tail
5.3. Fixed-point hovering flight towards the nose
5.4. Fixed-point hovering flight towards the left
5.5. Fixed-point hovering flight towards the right
5.6. 360-degree rotating flight
5.7. 8-character flight

REFERENCE BOOKS（推荐教材）

1. Assembly, debugging, and flight training of multi-rotor drones – Wang gu chang
2. Drone assembly and debugging – Lu xiu feng

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Understand the basic terms and core concepts of multi-rotor UAVs, and establish a basic understanding of the UAV field.
2. Master the basic structure and flight principles of multi-rotor UAVs, and understand the core logic of their flight.
3. Master the basic structure and flight principles of multi-rotor UAVs, and understand the core logic of their flight.
4. Be familiar with the assembly process, debugging methods, and flight implementation points of the F450 quadcopter.
5. Be familiar with the precautions for the use of multi-rotor UAVs and establish a sense of safe operation.
6. Have the ability to search for UAV-related literature and materials and be able to independently obtain the required professional information.
7. Have the ability to correctly use tools related to UAV assembly, debugging and flight.
8. Have the ability to assemble and debug multi-rotor UAVs and be able to independently complete basic assembly and standard debugging operations.
9. Have the ability to troubleshoot general faults during the flight operation of multi-rotor UAVs to ensure flight safety.
10. Have the ability to operate multi-rotor UAVs to complete fixed-point flight and route flight, meeting the requirements of basic flight operations.

LIST OF PRACTICALS（实践工作）

Lab 1: Introduction to Drone assembly tool	**4 Hours**
Lab 2: Safe use of drone assembly tools	**6 Hours**
Lab 3: Understanding of drone structure	**6 Hours**
Lab 4: Understanding of power system	**6 Hours**
Lab 5: Drone frame assembly	**6 Hours**
Lab 6: Drone power system assembly	**6 Hours**
Lab 7: Drone flight control system assembly	**6 Hours**
Lab 8: Drone remote control transceiver system assembly	**6 Hours**
Lab 9: Remote control setup and debugging	**6 Hours**
Lab 10: Remote control communication connection debugging	**6 Hours**
Lab 11: Drone flight control system setup and debugging	**6 Hours**
Lab 12: Drone parameter setting and debugging	**8 Hours**

Lab 13: Fixed-point hovering flight operation	**8 Hours**
Lab 14: 360-degree rotating flight	**8 Hours**
Lab 15: 8-character flight	**8 Hours**

Recommended Equipment（推荐设备）

1. F450 drone frame
2. Pixhawk flight control
3. Remote controller
4. Mission Planner (debug)

DRONE FORMATION FLIGHT

Course Code: DAT 313
Total Contact Hours: 160

	T	P	C
Theory: 64			
Practical : 96	**2**	**3**	**3**

COURSE DESCRIPTION（课程介绍）

This course provides in-depth knowledge of multi-agent UAV systems, focusing on coordination, communication, formation control, and swarm behavior. Students progressively move from basic concepts to complex multi-UAV missions, using simulations and project-based learning suitable for diploma-level students.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:

1. Explain principles of multi-agent and swarm UAV systems
2. Design and simulate cooperative UAV missions
3. Implement formation and leader-follower control
4. Apply basic swarm intelligence rules
5. Analyze communication failures and safety issues
6. Develop a complete multi-UAV simulation project

COURSE CONTENTS（详细课程内容）

1. Introduction to Multi-Agent UAV Systems — 6 Hours

- 1.1. Overview of UAV systems
- 1.2. Limitations of single UAV systems
- 1.3. Definition of agents and multi-agent systems
- 1.4. Characteristics of intelligent agents
- 1.5. Advantages and challenges of multi-UAV systems
- 1.6. Applications of multi-agent UAVs

2. Levels of Autonomy in UAV Systems — 4 Hours

- 2.1. Manual vs autonomous UAVs
- 2.2. Levels of UAV autonomy
- 2.3. Role of onboard intelligence
- 2.4. Human–UAV interaction
- 2.5. Autonomous decision-making basics

3. UAV Communication Systems — 8 Hours

- 3.1. Basics of UAV communication
- 3.2. UAV-to-Ground (U2G) communication
- 3.3. UAV-to-UAV (U2U) communication
- 3.4. Communication range and latency
- 3.5. Centralized vs decentralized communication
- 3.6. Introduction to MAVLink protocol (conceptual)

4. Multi-Agent Coordination — 4 Hours

- 4.1. Coordination in multi-agent systems
- 4.2. Cooperative vs competitive agents
- 4.3. Information sharing among UAVs
- 4.4. Consensus concept (introductory)
- 4.5. Coordination challenges in UAV swarms

5. Task Allocation in Multi-UAV Systems **6 Hours**

5.1. Definition of task allocation
5.2. Centralized task assignment
5.3. Distributed task assignment
5.4. Static vs dynamic task allocation
5.5. Examples of task allocation in UAV missions

6. Formation Control of UAVs **4 Hours**

6.1. Concept of formation flying
6.2. Types of formations (line, V, circle, grid)
6.3. Leader-Follower approach
6.4. Advantages and limitations of formation control
6.5. Formation maintenance concepts

7. Introduction to Swarm Intelligence **6 Hours**

7.1. Biological inspiration (birds, ants, bees)
7.2. Definition of swarm intelligence
7.3. Emergent behavior
7.4. Simple swarm rules
7.5. Comparison between formation control and swarm behavior

8. Swarm Models for UAVs **4 Hours**

8.1. Boids model (conceptual understanding)
8.2. Separation, alignment, cohesion
8.3. Decentralized control in swarms
8.4. Benefits of swarm-based UAV systems

9. Multi-UAV Path Planning **6 Hours**

9.1. Path planning vs mission planning
9.2. Coverage path planning
9.3. Cooperative navigation
9.4. Collision avoidance concepts
9.5. Obstacle avoidance basics

10. Fault Tolerance and Reliability **6 Hours**

10.1. UAV failure types
10.2. Communication failure scenarios
10.3. Redundancy in multi-agent systems
10.4. Fault detection and recovery (conceptual)
10.5. Importance of reliability in UAV swarms

11. Safety, Ethics, and Regulations **4 Hours**

11.1. Safety issues in multi-UAV operations
11.2. Airspace management challenges
11.3. Ethical considerations of UAV swarms
11.4. Privacy and security concerns
11.5. Overview of UAV regulations (general)

12. Applications and Case Studies **6 Hours**

12.1. Search and rescue operations
12.2. Surveillance and monitoring
12.3. Agricultural applications
12.4. Disaster management
12.5. Future trends in multi-agent UAV systems

REFERENCE BOOKS（推荐教材）

1. **Introduction to Multi-Agent Systems** – Michael Wooldridge
2. **Swarm Robotics** – Erol Şahin

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Understand the fundamental concepts of multi-agent and swarm-based UAV systems.
2. Develop knowledge of the limitations of single UAV systems and the advantages of operating UAVs in coordinated groups.
3. Learn the basic principles of communication between multiple UAVs and between UAVs and ground control stations.
4. Understand different levels of autonomy and decision-making mechanisms used in UAV systems.
5. Acquire the ability to analyze centralized and decentralized control architectures in multi-UAV operations.
6. Gain a conceptual understanding of coordination and cooperation strategies among UAV agents.
7. Learn task allocation methods for effective distribution of missions among multiple UAVs.
8. Understand the principles of formation flying and basic formation control techniques.
9. Develop awareness of swarm intelligence concepts inspired by natural and biological systems.
10. Understand basic swarm models and their application in UAV systems.
11. Learn fundamental concepts of multi-UAV path planning, collision avoidance, and obstacle avoidance.
12. Develop an understanding of fault tolerance, reliability, and safety in multi-agent UAV systems.
13. Create awareness of ethical, legal, and regulatory issues related to multi-UAV operations.
14. Analyze real-world applications and case studies of multi-agent UAV systems in civilian and industrial fields.
15. Prepare students for advanced studies or industrial training in autonomous and cooperative UAV technologies.

LIST OF PRACTICALS（实践工作）

Lab 1: Introduction to Multi-UAV Simulation Environment	4 Hours
Lab 2: Single UAV Mission Simulation	6 Hours
Lab 3: Two-UAV Communication Setup	8 Hours
Lab 4: Centralized Control of Multiple UAVs	4 Hours
Lab 5: Distributed Control in Multi-UAV Systems	6 Hours
Lab 6: Task Allocation Among UAVs	6 Hours
Lab 7: Leader-Follower Formation Simulation	8 Hours
Lab 8: Formation Change Maneuver	4 Hours
Lab 9: Introduction to Swarm Behavior	6 Hours
Lab 10: Boids Model Implementation	4 Hours
Lab 11: Multi-UAV Area Coverage	6 Hours
Lab 12: Obstacle Avoidance in Multi-UAV Systems	6 Hours
Lab 13: Collision Avoidance Between UAVs	6 Hours
Lab 14: Communication Failure Scenario	4 Hours

Lab 15: UAV Failure & Fault Tolerance	6 Hours
Lab 16: Search and Rescue Mission Simulation	6 Hours
Lab 17: Surveillance & Monitoring Mission	6 Hours

Recommended Equipment（推荐设备）

1. Python (basic level)
2. MATLAB / Simulink
3. Gazebo (introductory)
4. Mission Planner (demonstration)

UAV GROUND STATION SYSTEM

Course Code: DAT 314
Total Contact Hours: 192

	T	P	C
Theory: 96			
Practical : 96	**3**	**3**	**4**

COURSE DESCRIPTION（课程介绍）

This course is tailored for vocational college students majoring in UAV Application Technology, focusing on the practical operation and application of UAV ground stations (GCS). Centering on open-source GCS, commercial GCS and DJI GCS, it adopts a "practice-oriented" teaching model, reducing theoretical knowledge and emphasizing hands-on skills. Students will master the operation, configuration and scenario-based application of mainstream ground stations, laying a solid foundation for engaging in UAV operation, maintenance and mission execution.

COURSE OBJECTIVES（课程目标）

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

1. Clarify the core composition, classification and functional scope of UAV ground stations
2. Proficiently operate open-source GCS (Mission Planner, QGroundControl) to complete routine missions
3. Skilled use DJI commercial GCS (DJI GS Pro, DJI Pilot) for scenario-based precision operations
4. Plan missions, monitor flight status in real time and handle common abnormalities via GCS
5. Sort out and use flight data and video streams through ground stations
6. Independently complete comprehensive UAV missions with corresponding ground stations

COURSE CONTENTS（详细课程内容）

1. Introduction to UAV Ground Station Systems — 8 Hours

1. Classification of UAV ground stations: open-source, commercial (focus on DJI series)
2. Core functions of GCS and application scenarios (inspection, plant protection, aerial survey)
3. Overview of mainstream GCS products and their applicability to vocational posts
4. Safety norms and key precautions for GCS operation

2. UAV-Ground Communication for Ground Stations (Practical Focus) — 12 Hours

1. Common communication methods for GCS $WiFi, 4G/5G$ and connection steps
2. Key points of communication link establishment and stability inspection
3. Common communication faults (interruption, delay) and quick troubleshooting
4. Basic understanding of data transmission content (flight parameters, video stream)

3. Application of Open-Source UAV Ground Stations (I): Mission Planner — 12 Hours

1. Installation, environment configuration and interface familiarization
2. UAV connection, parameter calibration and initialization operation
3. Waypoint mission planning: setting, path adjustment and parameter configuration
4. Real-time monitoring of flight status and parameter observation
5. Practical training: aerial survey and inspection mission execution
6. Flight log export and simple sorting

4. Application of Open-Source UAV Ground Stations (II): QGroundControl — 12 Hours

1. Multi-platform installation (Windows, Android) and configuration
2. Functional module interpretation and interface operation
3. Advanced mission planning: area coverage, waypoint loiter
4. Video stream reception, display and storage

5. Practical training: obstacle avoidance mission simulation and execution

5. Application of DJI Commercial UAV Ground Stations (Key Module) 12 Hours

1. Overview of DJI GCS: DJI GS Pro, DJI Pilot and applicable UAV models
2. App installation, account binding and UAV connection (Phantom, Mavic, Matrice)
3. Basic operation: flight mode switching, camera adjustment and real-time monitoring
4. Precision mission planning: terrain following, area mapping, waypoint repetition
5. Scenario-based training: agricultural plant protection, power line inspection
6. Intelligent functions: obstacle avoidance setting, emergency return to home
7. Flight data synchronization and album management

6. Application of Other Commercial UAV Ground Stations 8 Hours

1. Overview of domestic commercial GCS and their functional characteristics
2. Operation comparison and cross-GCS mission adaptation
3. Selection methods of commercial GCS for different scenarios
4. Software update, maintenance and common fault handling

7. Mission Execution and Abnormality Handling via GCS 12 Hours

1. Pre-flight GCS inspection (hardware connection, software configuration)
2. In-flight adjustment: waypoint modification, mode switching
3. Common alarms (low battery, communication loss) and response operations
4. Emergency control: forced landing, manual takeover
5. Post-flight work: data sorting, equipment inspection

8. Industry Application Cases and Practical Simulation 12 Hours

1. Power inspection: GCS-based patrol mission and defect recording
2. Agricultural plant protection: precision spraying via DJI GS Pro
3. Emergency rescue: real-time monitoring and mission scheduling
4. Comprehensive scenario simulation and mission practice

9. Safety, Regulations and Post Specifications 8 Hours

1. Safety operation norms for GCS in UAV missions
2. Airspace regulations and GCS operation compliance
3. Data security and post operation specifications
4. Emergency plan drill for GCS-related accidents

REFERENCE BOOKS（推荐教材）

1. 《DJI Ground Station Pro Operation Guide》– DJI Official Manual

2. 《Mission Planner & QGroundControl Practical Manual》– Industry Training Materials

INSTRUCTIONAL OBJECTIVES

The instructional objectives of this course are to enable students to:

1. Clarify the functional positioning of UAV ground stations in vocational applications.
2. Proficiently operate open-source GCS to complete basic and advanced missions.
3. Skilled use DJI GCS for precision operations in different industry scenarios.
4. Master GCS communication link establishment and common fault handling.
5. Acquire GCS-based mission planning, real-time monitoring and abnormality handling capabilities.
6. Learn to sort out and use flight data to meet work needs.
7. Grasp GCS operation safety norms and industry regulations.

8. Select appropriate GCS according to mission and UAV type.
9. Cultivate practical operation and problem-solving abilities in GCS application.
10. Adapt to UAV operation-related posts requiring GCS skills.
11. Accumulate practical experience through scenario-based simulation training.
12. Establish standardized operation habits and safety awareness.
13. Independently complete comprehensive UAV missions via GCS.
14. Lay a foundation for obtaining UAV operation certificates.
15. Understand the latest application trends of mainstream GCS.

LIST OF PRACTICALS（实践工作）

Lab 1: GCS Basic Operation: Hardware Connection and Software Installation	**6 Hours**
Lab 2: Mission Planner: UAV Connection and Parameter Calibration	**6 Hours**
Lab 3: Waypoint Mission Planning and Execution with Mission Planner	**6 Hours**
Lab 4: QGroundControl: Area Coverage Mission Training	**6 Hours**
Lab 5: DJI GS Pro: Installation, Connection and Interface Familiarization	**6 Hours**
Lab 6: DJI GCS Waypoint Mission Training	**6 Hours**
Lab 7: Agricultural Plant Protection Mission Simulation via DJI GS Pro	**6 Hours**
Lab 8: Communication Fault Simulation and Troubleshooting	**6 Hours**
Lab 9: Flight Data Sorting with Open-Source GCS	**6 Hours**
Lab 10: Commercial GCS Operation Comparison and Compatibility Test	**6 Hours**
Lab 11: Power Inspection Mission Practice with GCS	**6 Hours**
Lab 12: Emergency Handling Drill: Low Battery and Communication Loss	**6 Hours**
Lab 13: Comprehensive Project (I): Aerial Photography with Open-Source GCS	**6 Hours**
Lab 14: Comprehensive Project (II): Precision Operation with DJI GCS	**6 Hours**
Lab 15: Safety Specification Drill and Post Operation Inspection	**6 Hours**
Lab 16: GCS Maintenance and Software Update Practice	**6 Hours**

Recommended Equipment（推荐设备）

1. Open-Source GCS (Mission Planner, QGroundControl)
2. DJI GCS Apps (DJI GS Pro, DJI Pilot)
3. DJI UAV Platforms (Mavic, Phantom, Matrice series)
4. GCS Hardware Kit (host computer, joystick, communication module)
5. Tablet/Smartphone for DJI GCS Operation

DRONE AERIAL PHOTOGRAPHY APPLICATION

Course Code: DAT 322
Total Contact Hours: 128

	T	P	C
Theory: 32			
Practical : 96	**1**	**3**	**2**

COURSE DESCRIPTION（课程介绍）

This course focuses on aerial photography, practical operation and basic application. It covers aerial photography, UAV selection, flight control skills, composition methods and simple post-processing. Combined with the practical orientation of higher vocational education, through intensive theoretical explanation and on-site training, it cultivates students' ability to carry out low-altitude aerial photography operations standardized, adapts to the needs of basic aerial photography positions in the industry, and balances practicality and post adaptability.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:
1. Master the core operation methods of aerial photography UAVs and basic theoretical knowledge of aerial photography, and clarify the specifications for low-altitude aerial photography operations.
2. Be able to standardly complete basic operations such as low-altitude fixed-point aerial photography and route aerial photography, and have the ability of aerial photography composition and picture selection..
3. Master simple post-processing methods of aerial photography pictures and be able to meet the post-processing needs of basic aerial photography operations.
4. Establish a sense of safe operation in aerial photography, have post adaptability, and meet the practical requirements of basic aerial photography positions in the industry.

COURSE CONTENTS（详细课程内容）

1. Aerial Photography UAV Cognition and Basic Operation 4 Hours
- 1.1. Practical operation of starting, shutting down and basic status inspection of aerial photography UAVs
- 1.2. Practical operation of aerial photography UAV remote control calibration and basic flight parameter setting
- 1.3. Recognition and use of aerial photography UAV key components and accessories

2. Basic Flight Control Training for Aerial Photography 6 Hours
- 2.1. Practical training of low-altitude hovering, fixed-point take-off and landing (basic control)
- 2.2. Practical operation of low-altitude straight-line route and polyline route aerial photography
- 2.3. Practical training of emergency handling during low-altitude aerial photography flight

3. Aerial Photography Composition and Framing Skills 6 Hours
- 3.1. Practical training of basic aerial photography composition (horizontal composition, diagonal composition)
- 3.2. Practical operation of aerial photography image framing, angle adjustment and picture selection
- 3.3. Practical training of composition adaptation for different aerial photography scenes

4. Aerial Photography Material Collection and Sorting 6 Hours

4.1. Aerial Photography Material Collection and SortingPractical operation of standardized collection of aerial photography materials
4.2. Practical training of classification and sorting of aerial photography materials
4.3. Practical operation of preliminary screening and defect judgment of aerial photography materials

5. Simple Post-processing of Aerial Photography 4 Hours

5.1. Practical operation of simple post-editing and color grading of aerial photography materials
5.2. Practical training of basic cropping and correction of aerial photography pictures
5.3. Practical operation of exporting and saving processed aerial photography works

6. Comprehensive Aerial Photography Training and Safety Specifications 6 Hours

6.1. Comprehensive practical operation of simulated on-site aerial photography tasks
6.2. Practical training of implementing aerial photography safety operation norms
6.3. Comprehensive assessment and practical drill of aerial photography skills

REFERENCE BOOKS（推荐教材）

1. Aerial photography post-processing computer (installed with simple editing software for material processing) –Li Changhai, Zhang Xunli, etc.

UAV Photography and Videography: Flight Techniques + Aerial Movement + Post-retouching + Video Production – Zhang Zihao

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Master the core theory of aerial photography and the key knowledge of UAV aerial photography safety and operation norms, laying a solid theoretical foundation for practical operation.
2. Proficiently master basic aerial photography operation skills and simple post-processing skills, and be able to flexibly apply them in practical aerial photography tasks.
3. 3. Literacy Objective: Cultivate professional literacy such as rigorous work attitude, standardized operation habits and safety-first awareness in aerial photography work, meeting the professional quality requirements of related posts.

LIST OF PRACTICALS（实践工作）

Lab 1: Practical operation of aerial photography UAV start-up, shutdown and basic status inspection **8 Hours**

Lab 2. Practical operation of aerial photography UAV remote control calibration and basic flight parameter setting **8 Hours**

Lab 3. Practical training of low-altitude hovering and fixed-point take-off and landing of aerial photography UAVs **8 Hours**

Lab 4. Practical operation of low-altitude straight-line and polyline route aerial photography **8 Hours**

Lab 5. Practical training of basic aerial photography composition (horizontal, diagonal) operation **8 Hours**

Lab 6. Practical operation of aerial photography image framing and shooting angle adjustment **12 Hours**

Lab 7. Practical operation of standardized collection and preliminary sorting of aerial photography materials **8 Hours**

Lab 8. Practical training of simple cropping and color grading of aerial photography pictures **12 Hours**

Lab 9. Practical operation of emergency handling during aerial photography flight (such as signal loss) **12 Hours**

Lab 10. Comprehensive practical drill and assessment of simulated on-site aerial photography tasks **12 Hours**

Recommended Equipment（推荐设备）

1. Multi-rotor aerial photography UAV (equipped with shooting function, suitable for beginner operation)
2. UAV remote controller (matching the aerial photography UAV, supporting basic flight control and parameter adjustment)
3. UAV battery and charger (ensuring normal operation time for practical training)
4. Mobile phone/tablet (for UAV flight monitoring, parameter setting and aerial photography preview)
5. Aerial photography post-processing computer (installed with simple editing software for material processing)

UAV SURVEYING AND MAPPING APPLICATION

Course Code: DAT 323
Total Contact Hours: 160

	T	P	C
Theory: 64			
Practical : 96	**2**	**3**	**3**

COURSE DESCRIPTION（课程介绍）

This course is designed for vocational college students majoring in UAV Application Technology and related fields, focusing on the practical application techniques of UAVs in surveying and mapping. Centering on the complete workflow of UAV surveying tasks, it covers core stages such as mission planning, data acquisition, image processing, and result generation. The course adopts a "project-oriented, practice-focused" teaching model. Students will master the basic principles of UAV surveying, execution methods for common surveying tasks, and the use of mainstream surveying data processing software, cultivating versatile technical talents capable of UAV field surveying and office data processing.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:

1. Understand the basic principles, system composition, and industry application scope of UAV surveying
2. Select appropriate UAV platforms, sensors, and operation modes based on different surveying task requirements
3. Proficiently complete surveying mission route planning and master the field data acquisition process for UAV surveying
4. Identify and address common issues and data anomalies in surveying operations
5. Use professional software to process aerial survey images and generate standard surveying products such as orthophotos and Digital Surface Models (DSM)
6. Adhere to surveying operation safety standards and data security management requirements
7. Independently or collaboratively complete UAV surveying projects in typical scenarios

COURSE CONTENTS（详细课程内容）

1. Overview of UAV Surveying and Mapping — 6 Hours

1. Definition, Characteristics, and Current Development of UAV Surveying
2. Composition of UAV Surveying Systems
3. Industry Application Scenarios: Topographic Surveying, Engineering Monitoring, Natural Resource Investigation, etc.
4. Introduction to Relevant Regulations and Standards

2. Surveying Mission Planning and Route Design — 8 Hours

1. Aerial Survey Parameters: Flight Altitude, Overlap, Resolution, etc.
2. Operation of Route Planning Software
3. Key Points in Route Design for Different Surveying Tasks
4. Analysis of Meteorological and Environmental Factors Affecting Aerial Surveys

3. Practical Field Data Acquisition — 8 Hours

1. Pre-flight Inspection: Equipment Preparation, Airspace and Site Assessment
2. Introduction to Ground Control Point (GCP) Layout and Measurement
3. Execution and Monitoring of UAV Aerial Survey Flight Operations
4. On-site Data Quality Check and Re-flight Strategies

4. Fundamentals of Aerial Image Processing **8 Hours**

1. Preprocessing and Organization of Aerial Survey Images
2. Introduction to the Principles and Workflow of Aerial Triangulation
3. Introduction to Software Interface and Workflow

5. Application of Aerial Survey Image Processing Software **10 Hours**

1. Creating a New Project and Marking Control Points
2. Aerial Triangulation Processing and Interpretation of Quality Reports
3. Real-scene 3D Model Production
4. Orthophoto and DSM Output
5. Earthwork Volume Calculation and Profile Analysis

6. Individual 3D Modeling **8 Hours**

1. Creating a New Project and Data Import
2. Acquisition of Individual 3D Model Components
3. Texture Mapping and Editing
4. Data Checking and Result Organization
5. Application Examples of 3D Models in Engineering and Planning

7. Map Production and Application **8 Hours**

1. Introduction to Map Elements and Cartographic Symbols
2. Acquisition and Editing of Topographic Map Elements
3. Layout and Beautification of Topographic Map Borders
4. Data Checking and Result Organization
5. Thematic Map Production

8. Industry Cases and Comprehensive Practical Training **8 Hours**

1. Full-process Simulation of a Topographic Mapping Project
2. Engineering Earthwork Measurement and Progress Monitoring Project
3. Comprehensive Project Practice: Complete Task Execution from Planning to Final Output

REFERENCE BOOKS（推荐教材）

1. UAV Tilt Photogrammetry Surveying Technology – Edited by Liu Renzhao, Ma Xiao, Wuhan University Press
2. DJI Terra Official Operation Manual and Tutorials
3. Relevant Industry Standards and Specifications

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Systematically explain the technical workflow and key stages of UAV surveying.
2. Proficiently use route planning software to design different surveying tasks.
3. Safely and standardizedly execute field data acquisition tasks for UAV surveys.
4. Independently use at least one mainstream aerial survey processing software to complete image processing and result generation.
5. Perform basic accuracy analysis and quality checks on surveying products.
6. Understand tilt photogrammetry technology and complete simple 3D modeling.
7. Possess the ability to solve common problems encountered in field and office surveying work.
8. Understand the different application scenarios for various surveying products.
9. Develop comprehensive vocational abilities for team collaboration in completing surveying projects.

10. Establish awareness of surveying safety production and data confidentiality.

LIST OF PRACTICALS（实践工作）

Lab 1: Operation of Surveying Route Planning Software and Task Design	**6 Hours**
Lab 2: Field Flight and Data Acquisition for UAV Aerial Survey	**6 Hours**
Lab 3: Layout and Measurement of Ground Control Points	**8 Hours**
Lab 4: Preprocessing and Aerial Triangulation of Aerial Images	**6 Hours**
Lab 5: Orthophoto Generation and Mosaicking	**6 Hours**
Lab 6: Digital Surface Model (DSM) Generation and Application Analysis	**8 Hours**
Lab 7: Earthwork Volume Calculation and Analysis	**6 Hours**
Lab 8: Comprehensive Project Processing with Aerial Triangulation Software	**8 Hours**
Lab 9: Acquisition of Individual Model Components and Texture Editing	**6 Hours**
Lab 10: 3D Campus Scene Modeling	**6 Hours**
Lab 11: Topographic Map Element Extraction and Simple Cartography	**8 Hours**
Lab 12: Campus Topographic Map Production	**6 Hours**
Lab 13: Full-process Comprehensive Project Practice (Group Project)	**8 Hours**
Lab 14: Visit or Demonstration of Industry Software/Equipment	**8 Hours**

Recommended Equipment（推荐设备）

1. Multirotor UAV Surveying Platforms (DJI Phantom 4 RTK, Mavic 4E)
2. Route Planning and Control Software (DJI Pilot)
3. Aerial Survey Data Processing Software (ContextCapture, DJI Terra)
4. High-performance Computer Workstations (for image processing)
5. Surveying Auxiliary Equipment: RTK GPS Receivers, Ground Target Boards, etc.
6. 3D Model Viewing and Editing Software
7. Map Element Acquisition and Editing Software

UAV INTELLIGENT PERCEPTION AND INFORMATION PROCESSING

Course Code: DAT 333
Total Contact Hours: 160

	T	P	C
Theory: 64			
Practical : 96	**2**	**3**	**3**

COURSE DESCRIPTION（课程介绍）

This course is an integrated theory-practice professional extension course designed for students majoring in UAV Application Technology and related fields in vocational colleges. It focuses on the intelligent applications of UAVs, covering the working principles of intelligent perception devices such as UAV attitude and heading reference systems, vision sensors, and LiDAR, as well as core information processing technologies including sensor data filtering and fusion, image processing, and machine learning. Through simulation experiments and project development, the course aims to deepen students' understanding of UAV intelligent perception systems, cultivate their practical innovation capabilities in solving complex engineering problems within intelligent application scenarios, and align with the demand for versatile technical talents in emerging fields such as the low-altitude economy.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:

1. Explain the basic principles and functions of commonly used UAV sensors (e.g., IMU, GNSS, vision sensors, LiDAR).
2. Understand the fundamental concepts of data fusion and filtering for UAV attitude and heading determination systems.
3. Master the installation, debugging methods, and application scenarios of sensor modules like ultrasonic, vision, and LiDAR for UAVs.
4. Understand typical application patterns of machine learning and artificial intelligence (AI) in UAV perception.
5. Build and test simple UAV intelligent perception functional modules in a simulation environment.
6. Possess the ability to complete the design and practice of a comprehensive intelligent perception application project under instructor guidance.
7. Be familiar with safety protocols and professional ethics in UAV intelligent system development.

COURSE CONTENTS（详细课程内容）

1. Fundamentals of Intelligent Perception Systems and Sensors — 12 Hours

1. Overview of UAV Intelligent Perception System Architecture
2. Basic Characteristics and Classification of Sensors
3. Introduction to Selection and Application of Common Sensors for UAV Platforms

2. Attitude & Positioning Sensors and Data Processing — 16 Hours

1. Principles of Inertial Measurement Unit: Accelerometer, Gyroscope
2. Gyroscope Calibration and Zero-Bias Calculation
3. Accelerometer Calibration and Attitude Angle Calculation
4. Auxiliary Sensors: Barometer, Magnetometer
5. Principles and Applications of Global Navigation Satellite System
6. GNSS Module Installation and Debugging
7. Introduction to Multi-sensor Data Fusion and Filtering Algorithms

3. Ranging and Environmental Perception Sensors **12 Hours**

1. Ultrasonic Radar Principles and Ranging Applications
2. Optical Flow Sensor Principles and Applications
3. LiDAR Principles, Point Cloud Data, and Introduction to SLAM Technology
4. Simulation Environment Setup and Sensor Model Invocation

4. Visual Perception and Fundamentals of Image Processing **12 Hours**

1. Image Sensor Working Principles and Camera Models
2. Basic Operations of Digital Image Processing
3. Fundamental Concepts of Feature Extraction and Target Recognition
4. Introduction to Vision-based Pose Estimation

5. Application of Artificial Intelligence in UAV Perception **12 Hours**

1. Basic Concepts of Artificial Intelligence and Machine Learning
2. Introduction to Deep Learning Environment Setup and Toolchain
3. Typical Application Cases: Implementation of Target Detection and Image Classification in UAV Scenarios
4. Design and Workflow of Intelligent Perception Comprehensive Projects

REFERENCE BOOKS（推荐教材）

1. PX4 Official Development Documentation and User Guide
2. OpenMV Example Library
3. Official Tutorials for Related AI Frameworks

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1. Systematically describe the composition and information flow of a UAV intelligent perception system.
2. Differentiate the advantages, disadvantages, and applicable scenarios of different attitude and positioning sensors.
3. Explain the significance of multi-sensor data fusion for improving UAV state estimation accuracy.
4. Complete the installation and debugging of modules such as ultrasonic sensors, LiDAR, and optical flow sensors.
5. Operate simulation software to complete basic functional tests for LiDAR or vision sensors.
6. Set up a visual system development environment and perform simple example tests.
7. Explain the fundamental principles of how AI technology empowers UAV intelligent perception.
8. Collaborate within a team to complete the simulation of an intelligent perception algorithm application in a defined scenario.
9. Follow experimental protocols to operate simulation software and development tools safely and standardizedly.
10. Understand the demand direction for UAV intelligent perception technology in emerging industries like the low-altitude economy.

LIST OF PRACTICALS（实践工作）

Lab 1: Gyroscope Data Acquisition and Zero-Bias Calculation **6 Hours**
Lab 2: Accelerometer Data Acquisition and Attitude Angle Calculation **6 Hours**

Lab 3: GNSS Module Installation and Debugging	**6 Hours**
Lab 4: Ultrasonic Module Installation, Debugging, and Ranging Accuracy Analysis	**6 Hours**
Lab 5: LiDAR Module Installation and Debugging	**6 Hours**
Lab 6: Optical Flow Module Installation and Debugging	**6 Hours**
Lab 7: Simulation Environment Setup and Testing	**6 Hours**
Lab 8: Initial Experience with UAV SLAM Mapping in a Simulation Environment	**6 Hours**
Lab 9: Visual System Development Environment Deployment and Testing	**6 Hours**
Lab 10: Simple Target Detection Based on Vision Module	**6 Hours**
Lab 11: Route Tracking Based on Vision Module	**6 Hours**
Lab 12: AI Application Development Environment Configuration and Verification	**6 Hours**
Lab 13: End-to-end Exercise on AI-based Target Detection	**6 Hours**
Lab 14: AI-based Target Recognition and Tracking in a Simulation Environment	**6 Hours**
Lab 15: Group Comprehensive Project Topic Selection and Development	**6 Hours**
Lab 16: Group Comprehensive Project Results Presentation and Defense	**6 Hours**

Recommended Equipment（推荐设备）

1. Multirotor UAV Development Platform (Pixhawk open-source flight controller)
2. Sensor Module Kit: IMU, Ultrasonic, Optical Flow, LiDAR, OpenMV
3. High-performance Embedded Computing Device: Jetson series or similar edge computing modules
4. Simulation Software: AirSim
5. AI Development Platform: Python development environment, YOLO environment

THE OPERATION OF UAV FLIGHT

Course Code: DAT 343
Total Contact Hours: 224

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

COURSE DESCRIPTION（课程介绍）

This course is a core skills course for students majoring in UAV Application Technology at vocational colleges, serving as a key bridge connecting foundational professional theory with industry practice.
The course fully implements the integrated talent cultivation model of "project-based teaching and real-scenario training," closely aligning with national strategies for low-altitude economic development and industry demands for UAV professionals. The course design aims to cultivate versatile technical talents with three-dimensional capabilities in "precise control + intelligent analysis + scenario application," emphasizing a progressive skill development path from "simulation to actual aircraft, from visual line-of-sight (VLOS) to beyond visual line-of-sight (BVLOS), and from basic flight to mission execution."
The course fully reflects the vocational education characteristic of "learning by doing." The content deeply integrates UAV flight principles, aviation regulations, flight simulation, multi-rotor and fixed-wing aircraft operation, emergency handling, and typical industry application cases. It aims to enable students, through systematic training, to meet the corresponding assessment requirements for the Civil Unmanned Aircraft Operator License (CAAC) and possess preliminary capabilities to solve practical engineering problems.

COURSE OBJECTIVES（课程目标）

By the end of the academic year, students will be able to:
1. Master the composition, flight principles, and performance characteristics of UAV systems.
2. Precise Control Ability: Skillfully and stably operate multi-rotor and fixed-wing UAVs to complete take-off/landing, route flight, maneuvers, and emergency handling in complex environments.
3. Mission Execution Ability: Plan flight missions based on typical application scenarios, operate ground station systems, and complete basic data collection tasks.

COURSE CONTENTS（详细课程内容）

1.Laws, Regulations & Flight Safety (Theory Focus) 4 Hours

1.Interpretation of key provisions of the "Interim Regulations on Flight Management of Unmanned Aircraft."
2.Airspace classification, flight application, and reporting procedures.
3.Legal responsibilities of UAV operators and case-based warning education.
4.Pre-flight inspection, risk identification, and emergency plan formulation.

2.Flight Principles & System Composition (Theory Focus) 4 Hours

1.Comparison of structure and flight principles between multi-rotor and fixed-wing UAVs.
2.Subsystems: power, navigation, flight control, communication, mission payload.
3.Flight performance and the impact of low-altitude meteorology (wind, temperature, precipitation).

3.Flight Simulation & Ground Station Theory (Theory Focus) 4 Hours

1.Interface and settings of mainstream flight simulation software (e.g., Phoenix, RealFlight).
2.Remote controller channel allocation and control surface response principles.

3.Task planning, route design, and data link principles of ground station software (e.g., Mission Planner).

4.Introduction to Industry Applications (Theory Focus) 4 Hours

1.Aerial Photography & Surveying: Principles of orthophoto and oblique photography.
2.Inspection & Security: Characteristics of tasks like power line inspection and pipeline patrol.
3.Overview of precision agriculture and emergency rescue applications.

5.Practical Training Module:Stage 1–Flight Simulation Training 4 Hours

1.Basic Simulator Operation: Building remote control muscle memory; multi-rotor hover, translation, yaw; fixed-wing straight flight, level turns.
2.Emergency Situation Simulation: Handling procedures for simulated engine failure, strong wind interference, signal loss, etc.

6.Practical Training Module:Stage 2–Multi-rotor UAV Flight 4 Hours

1.Actual Aircraft Take-off/Landing & VLOS Maneuvers: Safety procedures; tail-in hover, 8-point hover; rectangular and circular route flights.
2.Beyond Visual Line-of-Sight (BVLOS) Flight: Using ground stations for BVLOS route planning, auto-flight, waypoint mission execution, and data transmission.
3.Complex Environment & Application Training: Simulated flight in urban corridors, forest gaps; target photography with mounted camera.

7.Practical Training Module: Stage 3–Fixed-wing UAV Flight 4 Hours

1.Fixed-wing Take-off/Landing & Route Flight: Hand-launch and taxi take-off training; circuit pattern flight training; point landing.
2. Fixed-wing Mission Flight: Planning and execution of fixed-wing aerial survey routes (e.g., power line corridor inspection).

8.Practical Training Module:Stage 4–Integrated Application & Assessment 4 Hours

1.Typical Industry Application Projects:
Project I: Digital Campus Aerial Survey.Group completion of orthophoto data collection and stitching for a campus area.
Project II: Simulated Power Line Inspection.Planning inspection routes and simulating identification of tower defects.
2.License Examination Intensive Training:Targeted, standardized intensive training according to CAAC practical exam subjects.

REFERENCE BOOKS（推荐教材）

1.《UAV Simulation Flight and Control Technology(2nd Edition)》,edited by Yang Yu, Northwestern Polytechnical University Press,2024.(A national "14th Five-Year Plan" textbook covering simulation,multi-rotor/fixed-wing operation,GCS use,and regulations.)
2.Interim Provisions on the Management of Civil Unmanned Aircraft System Pilots and related updated regulatory documents (issued by the Civil Aviation Administration of China-CAAC).
3."Interim Regulations on Flight Management of Unmanned Aircraft" (State Council and Central Military Commission Order No.761).
4.Industry whitepapers and case study collections published by leading companies (e.g.,DJI,XAG).
5.CAAC UAV Pilot License Examination Training Syllabus and online question banks.

INSTRUCTIONAL OBJECTIVES（教学目标）

The instructional objectives of this course are to enable students to:

1.Theory Instruction: Students can accurately recite key aviation regulations and explain flight principles, achieving a minimum 80% accuracy rate on theoretical tests, laying a foundation for the license theory exam.
2.Flight Simulation Stage: Students can stably complete all basic maneuvers for multi-rotor and fixed-wing UAVs in the simulator, with a 100% pass rate for emergency simulation.
3.Multi-rotor Actual Flight Stage: 100% of students can independently and safely complete VLOS flight assessment subjects; over 70% can complete BVLOS mission planning and execution.
4.Course (Comprehensive Assessment):
Skill Assessment: Pass the integrated practical assessment combining simulation, actual flight, and mission execution.
Certificate Articulation: Encourage and organize students to take the CAAC UAV Operator License exam, realizing "course-certificate integration."
Ability Achievement: Students can independently or in a group, for a given simple application scenario (e.g., small area aerial photography), complete the entire workflow from task analysis, flight planning, safety reporting, field operation to data acquisition.

LIST OF PRACTICALS（实践工作）

Lab 1:Foundational -Standardized Skill Progression Training **64 Hours**
Format: Individual training. Foundational skills (e.g., hovering, route flying) are decomposed into sequential "levels." Students must pass each level under instructor supervision. Performance contributes to the regular assessment grade.
Objective: Solidify fundamental piloting skills for every student, ensuring a baseline quality of training.
Lab 2:Comprehensive -Group Industry Application Project **64 Hours**
Format: 3-4 person project teams. Teams select a project (e.g., "Digital Campus Modeling" or "Simulated Facility Inspection") and complete a project plan, conduct field work, and deliver a final report/presentation.
Objective: Simulate real-world workplace workflows, exercising skills in task planning, team collaboration, on-site problem-solving, and technical reporting.
Lab 3:Advanced -License Examination Intensive Camp **64 Hours**
Format: Voluntary participation during extracurricular time. Conducts high-intensity, standardized training strictly following the CAAC exam syllabus and grading criteria.
Objective: Concentrate resources to assist motivated students in efficiently obtaining professional qualifications, thereby enhancing the course's recognition and students' employability.

Recommended Equipment（推荐设备）

1.Flight Simulation System:Professional software(e.g.,Phoenix RC, RealFlight) with compatible remote controllers and computers.(For all initial control training and emergency procedure practice.)
2.Multi-rotor Trainer Aircraft:Entry-level camera drones from mainstream brands (e.g., DJI), prioritizing portability and durability.(For basic actual aircraft flight training: takeoff/landing, VLOS maneuvers.)
3.Multi-rotor Industry Aircraft:Models supporting third-party GCS and capable of carrying various mission payloads. (For BVLOS flight, route planning, and industry application project teaching.)
4.Fixed-wing Trainer Aircraft:High-wing, easy-to-maintain trainer models made of materials like balsa wood or EPO.(For understanding fixed-wing aircraft operation and their advantages in endurance and large-area patrol.)
5.Ground Station:Laptops installed with open-source GCS software (e.g.,Mission Planner,QGroundControl).(For mission planning and data acquisition tasks.)

6.Support Equipment:Safety fencing,marker cones,walkie-talkies,first-aid kits,battery management systems.