

Programme Structure, Curriculum & Scheme of

Examination

2017-19

Master of Technology

(Solar & Alternative Energy)

Programme Code: MTS

Duration – 2 Years Full Time

Program Learning Outcomes - PLO

1. Students will be able to demonstrate a fundamental understanding of energy and power by solving energy/power problems relating to energy transfer, energy efficiency and energy conversion
2. Students will be able to identify and describe the major sources of energy used in society today
3. Students will be able to identify and describe emerging and possible future sources of energy in our society
4. Students will be able to construct a working physical model of energy conversion, energy storage, or energy utilization
5. Students will be able to effectively communicate technical aspects of renewable energy project in a formal written report

Credits Summary

M.Tech - Solar and Alternative Energy (02 Years/ 04 Semesters)						
Semester	Core Course (CC+PC)	Domain Electives (DE)	Value Added Course (VAC)	Open Electives (OE)	Non- Teaching Credit Courses (NTCC)	Total
I	14	4	4	3	-	25
II	22	3	4	3	-	32
III	32	3	4	3		42
IV	30	-	-	-		30
Total	98	10	12	9	-	129

**CC= Core Course, DE= Domain Elective, OE= Open Elective, VA= Value Added Course
NTCC= Non - Teaching Credit Courses (NTCC)**

PROGRAMME STRUCTURE

FIRST SEMESTER

Code	Title	Category	L	T	P	Credit
MTS 101	Renewable Energy & Thermodynamics	CC	4	-	-	4
MTS 102	Electronics Devices & Circuits	CC	3	-	-	3
MTS 103	Semiconductor Device Fabrication Technologies	CC	4	-	-	4
MTS 104	Introduction to Materials	CC	3	-	-	3
MTS 121	Practical – I	CC	-	-	10	5
DE Electives: Student has to select 1 Course from the list of following DE Elective						
MTS 105	Instrumentation Techniques & Characterization	DE	4	-	-	4
MTS 106	Simulation Modeling and Analysis	DE	4	-	-	4
OPEN ELECTIVE						
	Open Elective – 2	OE	3	-	-	3
Value Added						
BCS 111	Communication Skills – I	VA	1	-	-	1
BSS 111	Behavioural Science – I	VA	1	-	-	1
FLT 111	Foreign Language – I French	VA	2	-	-	2
FLG 111	German					
FLS 111	Spanish					
FLC 111	Chinese					
TOTAL						30
Note:- CC - Core Course, VA - Value Added Course, OE - Open Elective, DE - Domain Elective, FW - Field Work						

SECOND SEMESTER

Code	Title	Category	L	T	P	Credit
MTS 201	Solar Thermal Engineering	CC	3	-	-	3
MTS 202	Inorganic Semiconductors Solar Cells	CC	3	-	-	3
MTS 203	Organic Photovoltaics	CC	3	-	-	3
MTS 204	Wind Energy & Energy Conversion System	CC	3	-	-	3
MTS 221	Practical – II	CC	-	-	10	5

MTS 255	Seminar & Project	CC	-	-	-	5
DE Electives: Student has to select 1 Course from the list of following DE Elective						
MTS 205	Energy Systems: Fuel Cells, Tidal, Geothermal,	DE	3	-	-	3
MTS 206	Advanced Refrigeration	DE	3	-	-	3
OPEN ELECTIVE						
	Open Elective-2	OE	3	-	-	3
Value Added						
BCS 211	Communication Skills – II	VA	1	-	-	1
BSS 211	Behavioural Science – II	VA	1	-	-	1
FLT 211	Foreign Language – II	VA	2	-	-	2
FLG 211	French					
FLS 211	German					
FLC 211	Spanish					
	Chinese					
TOTAL						32
Note:- CC - Core Course, VA - Value Added Course, OE - Open Elective, DE - Domain Elective, FW - Field Work						

SUMMER TRAINING DURING THE SUMMER BREAK						
THIRD SEMESTER						
Code	Title	Category	L	T	P	Credit
MTS 301	Design & Engineering of Solar Photovoltaic Cells & Panels	CC	3	-	-	3
MTS 302	Instrumentation, Electronics, & Integration of Renewable Energy Sources	CC	3	-	-	3
MTS 303	Energy Generation from other sources like, Nanomaterials & Biowaste	CC	3	-	-	3
MTS 304	Research Methodology	CC	3	-	-	3
MTS 370	Minor Project: Energy Efficient Building Design	CC	-	-	-	6
MTS 321	Practical – III	CC	-	-	10	5
MTS 350	Summer Training (Evaluation)	CC	-	-		9
DE Electives: Student has to select 1 Course from the list of following DE Elective						
MTS 305	Energy Management Related to Renewable Energy Systems	DE	3	-	-	3
MTS 306	Bio-Fuels	DE	3	-	-	3
OPEN ELECTIVE						
	Open Elective-3	OE	3	-	-	3
Value Added						
BCS 311	Communication Skills – III	VA	1	-	-	1
BSS 311	Behavioural Science – III	VA	1	-	-	1
FLT 311	Foreign Language – III French	VA	2	-	-	2
FLG 311	German					
FLS 311	Spanish					
FLC 311	Chinese					
TOTAL						42
Note:- CC - Core Course, VA - Value Added Course, OE - Open Elective, DE - Domain Elective, FW - Field Work						

FOURTH SEMESTER

MTS 455	Dissertation	CC	-	-	-	30	
	TOTAL					30	

Curriculum & Scheme of Examination

RENEWABLE ENERGY AND THERMODYNAMICS

Course Code: MTS 101

Credit Units: 04

Course Objective:

Course provides introduction to different renewable energy sources. Develops understanding of energy, heat, work, efficiency, and ideal thermodynamic cycle mechanisms involved with renewable energy systems. In-depth understanding of solar radiation reaching the earth.

Module I

Introduction, different forms of energy, Thermodynamic system - types – properties – state-equilibrium – processes – cycles – Temperature – Zeroth Law of thermodynamics – First Law of thermodynamics for closed and open systems – Concept of internal energy – Limitations of first law – Second Law of thermodynamics – Concept of Entropy

Module II

Heat Transfer in Renewable Energy Systems - conduction, convection and radiation, Heat transfer and engineering concepts to the renewable energy systems (e.g., solar, geothermal and wind) and the supporting technologies (thermal energy storage, solid state hydrogen storage/compression, fuel cell, rechargeable battery, and thermoelectric).

Module III

The solar energy resource, Earth & Sun Relation,; Analysis of Indian solar radiation data and applications, Geothermal Energy and Ground-Source, Application of thermal dynamics in analysis, design and control of heating/cooling systems.

Module IV

Historical and latest developments; state of art of wind energy technology; turbine rating; cost of energy; Indian scenario and worldwide developments; present status and future trends. Nature of atmospheric winds, wind resource characteristics and assessment; anemometry and wind statistics; speed frequency distribution and effect of height; wind rose; weibull distribution; atmospheric turbulence; gust wind speed; effect of topography, Introduction to aerodynamics of blade and rotor

Module V

Introduction to bioconversions; bioconversions of solar energy into bio-fuels; production of biomass (photosynthesis) Algal biofuel; biogas; bio-diesel; bio-based alcohols; sources; production and industrial applications; present and future scenario of bio-based conversions of solar energy into useful energy.

Examination Scheme:

Components	CT	Assignment	V/Q	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Heat and Thermodynamics: R. H. Dittman and M. W. Zemansky
- Heat Transfer-a basic Approach: Ozisik
- Renewable energy engineering and technology-edited by V. V.N. Kishore
- Paul Gipe, Wind Energy Comes of Age, John Wiley & Sons Inc.
- L.L. Freris, Wind Energy Conversion System, Printice Hall.
- Tony Burton et al, Wind energy Hand Book, John Wiley & Sons Inc.
- Directory, Indian Windpower 2004, CECL, Bhopal.

ELECTRONICS DEVICES AND CIRCUITS

Course Code: MTS 102

Credit Units: 03

Course Objective:

To enable the students to understand the basics of Electronic devices and circuits.

Course Contents:

Module I

pn junction, V I characteristics of pn junction diode, rectifier, zener diode and its application, LED, Diode circuits; clipper, clamper circuits

Module II

BJT characteristics; BJT biasing; CE-biasing circuits: fixed bias, emitter-stabilized bias, voltage-divider bias, JFET, MOSFET.

Module III

Operational amplifier: basic model; OpAmp as inverting amplifier; non-inverting amplifier; summing amplifier, integrator; differentiator; Schmitt trigger.

Module IV

Logic Gates, Introduction to combinational circuits, combination circuit: Multiplexer: Decoder, Encoder; Minimization techniques: K MAP.

Module V

Introduction to Sequential Design. Flip-flop: latch; S-R flip-flop; JK master slave flip-flop; D-flip flop; FF type conversion;

Examination Scheme:

Components	CT	Assignme nt	V/Q	Attendan ce	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- R.L. Boylestad, L. Nashelsky, Electronic devices and circuit theory, Prentice Hall,
- R.A. Gayakwad, Op-amps and linear integrated circuits, Prentice Hall of India,
- M. Morris Mano, Digital Design, Prentice Hall of India,
- R P Jain, Modern Digital Electronics, Tata McGrawHill,

SEMICONDUCTOR DEVICE FABRICATION TECHNOLOGIES

Course Code: MTS 103

Credit Units: 04

Course Objective:

Basic introduction to semiconductor device fabrication processes.

Course Contents:

Module I: Recessing environments and wafer cleaning technology

Introduction to Clean room technology, clean room classification and operations, Wafer preparation, cleaning of wafers, wet cleaning, dry cleaning

Module II: Dopant Diffusion and related operations

Equipment for diffusion and related operations, laws of diffusion, dopants and dopant sources, oxidation of silicon, diffusion process control

Module III: Photolithography and Etching

Optical, electron and X-ray lithography, ion lithography. Etch mechanisms, selectivity and profile control, Reactive plasma etching techniques and equipment, plasma processing processes, wet chemical etching

Module IV: Ion implantation

Charged particles and fields, ion implantation basics and processes, ion implantation for substrate doping, technology trends

Module V: Metallization

Introduction to vacuum science and technology, Metal deposition techniques, physical Vapor deposition: thermal evaporation, e-beam and sputtering techniques, silicide process, Metal CVD, copper metallization

Examination Scheme:

Components	CT	Assignment	V/Q	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- ULSI Technology C.Y. Chang & S.M. Sze
- Introduction to Semiconductor Manufacturing Technology, Hang Kiao
- The Theory and Practice of Microelectronics, Sorab K. Gandhi.
- Fundamentals of semiconductor device fabrication, S.M. Sze

INTRODUCTION TO MATERIALS

Course Code: MTS 104

Credit Units: 03

Course Objective:

Basic introduction of materials including organic, inorganic, polymer, crystalline and imperfections in crystals etc.

Course Contents:

Module I: Kinds of matter

Solid, liquid and gas, inorganic, organic, polymers, monomers etc., conductors, semiconductors, insulator etc.

Module II: Structure of Matter

Amorphous, crystalline, semi-crystalline, crystals, polycrystals, liquid crystals, Structures: particles, wires, rods, clusters, solid solutions, Details of crystals: growth, crystal planes, crystal structures, crystal orientation.

Module III: Types of Material

Different types of materials, Composite materials (ceramics, alloys silicates), polycrystalline materials including polymers.

Module IV: Properties & Morphology of materials

Morphology of materials, Mechanical Properties: Hardness, compressive & tensile strengths, Electronic, thermal conductivity and optical absorption

Module V: Imperfections in solids

Grain boundaries their relation to mechanical properties, Dislocations in single crystals (linear defects and screw dislocation), Imperfection dependent properties of crystals,

Examination Scheme:

Components	CT	Assignment	V/Q	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Introduction to Solid State Physics - C. Kittel
- Solid State Physics - A. J. Dekker
- Solid State Physics - R. K Puri and V. K. Babar
- Elements materials science -Van Vlack

INSTRUMENTATION TECHNIQUES AND CHARACTERIZATION

Course Code: MTS 105

Credit Units: 04

Course Objective:

Understanding of various sophisticated analytical techniques and their applications to characterize nanomaterials.

Course Contents:

Module I: Scanning Microscopy

Scanning Probe, SEM, TEM, STM, AFM, Optical microscope and their description, operational principle and application for analysis of nanomaterials.

Module II: Spectroscopic Characterization Technique

UV-VIS-IR Spectrophotometer, Principle of operation and application for band gap measurements.

Module III: Structural Analysis Techniques

XRD (Single Crystal), XRF, - detailed principle, operation and applications.

Module IV: X-ray Spectroscopy for Chemical Analysis

X-ray analysis, ESCA, limitations and scope of application for various nanomaterials.

Module V: Particle size & thermal analyzer

Measurements of size of nanoparticles. DTA, TGA, and DSC measurements in characterization of nanostructured materials.

Examination Scheme:

Components	CT	Assignment	V/Q	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Encyclopedia of Nanotechnology - Hari Singh Nalwa.
- Introduction to Nanotechnology -Charles P. Poole Jr. and Frank J. Owens.
- X-ray diffraction procedures -H.P. Klug and L.E. Alexander.
- The Powder Method - I.V. Azaroff and M.J. Buerger.
- Introduction to Solids - I.V. Azaroff
- Elements of X-ray diffraction - A.D Cullity
- Differential Thermal Analysis - R.C. Mackenzie
- Thermal Methods of Analysis - W.W. Wendlandt

SIMULATION, MODELLING AND ANALYSIS

Course Code: MTS 106

Credit Units: 04

Course Objective:

Understanding of various techniques of simulation and mathematical modelling.

Module I Simulation:

Introduction, Simulation techniques, Advantages and limitations of Simulation technique, Applications of Simulation, Monte Carlo Simulation, Generation of random numbers, Simulation languages

Module II Modeling:

Principles of mathematical modeling, classification of Models, Modeling of macro and microscopic engineering (mechanical) problems using first order and second order differential equations, simultaneous ODEs, Laplace Transformation

Module III Inventory Models

Necessity of maintaining inventory, Inventory costs, Inventory control problems, classification of fixed order quantity Inventory models, Inventory models with deterministic demand, Classical EOQ Models, safety stock inventory control systems.

Module IV Forecasting Models

Inventory models with probabilistic demand, Forecasting of demand, forecasting methods, Decomposition of Times Series into trend, seasonal, cyclical, and irregular components, Deterministic Trend/Seasonal Forecasting Models, Exponential Smoothing Forecasting Models, Nonlinear Time Series Models

Module V Queuing Models

Applications of Queuing models, Elements of queuing system, operating characteristics of queuing System, Waiting time and Idle time costs, transient and steady state of the system, Kendall's notation for representing queuing models, classification of queuing models, Single channel queuing theory, Models for arrival and service times, $(M/M/1):(FCFS/\infty/\infty)$ Model

References :

1. Modeling and Simulation in Science, Engineering and Technology, Series Ed.: **Bellomo**, Nicola, A product of Birkhäuser Boston
2. Modeling and Simulation-Based Systems Engineering Handbook, Daniele Gianni, Andrea D'Ambrogio, Andreas Tolk, CRC Press
3. Simulation of Dynamic Systems with Matlab and Simulink, Klee, Harold CRC Press Inc, Taylor & Francis Group: Boca Raton London New York (2007)
4. Simulation, Ross, Sheldon M. , Elsevier: Amsterdam, 2006
5. Simulation Modeling and Analysis with ARENA, Altiook, T. and Melamed, Benjamin Elsevier: Amsterdam, 2007
6. Simulation, Modeling and Analysis, 3/e, Averill M. Law, W. David Kelton, TMH
7. Principles of Modeling and Simulation A Multidisciplinary Approach, John A. Sokolowski, Catherine M. Banks, Wiley online library, A JOHN WILEY & SONS, INC., PUBLICATION

PRACTICAL - I

Course Code: MTS 121

Credit Units: 05

Experiment List

1. Rectification and I-V characteristics of a diode.
2. Analysis and absorbance calculation of unknown component in solution through UV/VIS Spectrophotometry.
3. (a) To prepare thin films of polymer by spin coating technique.
(b) To study the absorption spectra using UV –spectrophotometer.
4. To design clipping circuit for given specification and hence to plot its output.
5. Preparation of thin films of polymer doped with carbon nanotubes and their electrical characterization.
6. To record and study the emission spectra of a light emitting diode.

Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

COMMUNICATION SKILLS – I

Course Code: BCS 111

Credit Units: 01

Course Objective:

The Course is designed to give an overview of the four broad categories of English Communication thereby enhance the learners' communicative competence.

Course Contents:

Module I: Listening Skills

Effective Listening: Principles and Barriers

Listening Comprehension on International Standards

Module II: Speaking Skills

Pronunciation and Accent

Reading excerpts from news dailies & magazines

Narrating Incident; Story telling.

Extempore & Role Plays

Module III: Reading Skills

Vocabulary: Synonyms, antonyms, diminutives, homonyms, homophones

Idioms & phrases

Foreign words in English

Module IV: Writing Skills

Writing Paragraphs

Précis Writing

Letter writing

Coherence and structure

Essay writing

Module V: Activities

News reading

Picture reading

Movie magic

Announcements

Examination Scheme:

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

Text & References:

- Working in English, Jones, Cambridge
- Business Communication, Raman – Prakash, Oxford
- Speaking Personally, Porter-Ladousse, Cambridge
- Speaking Effectively, Jermy Comfort, et.al, Cambridge

BEHAVIOURAL SCIENCE - I
(SELF-DEVELOPMENT AND INTERPERSONAL SKILLS)

Course Code: BSS 111

Credit Units: 01

Course Objective:

This course aims at imparting an understanding of:

Self and the process of self exploration

Learning strategies for development of a healthy self esteem

Importance of attitudes and their effect on work behaviour

Effective management of emotions and building interpersonal competence.

Course Contents:

Module I: Understanding Self

Formation of self concept

Dimension of Self

Components of self

Self Competency

Module II: Self-Esteem: Sense of Worth

Meaning and Nature of Self Esteem

Characteristics of High and Low Self Esteem

Importance & need of Self Esteem

Self Esteem at work

Steps to enhance Self Esteem

Module III: Emotional Intelligence: Brain Power

Introduction to EI

Difference between IQ, EQ and SQ

Relevance of EI at workplace

Self assessment, analysis and action plan

Module IV: Managing Emotions and Building Interpersonal Competence

Need and importance of Emotions

Healthy and Unhealthy expression of emotions

Anger: Conceptualization and Cycle

Developing emotional and interpersonal competence

Self assessment, analysis and action plan

Module V: Leading Through Positive Attitude

Understanding Attitudes

Formation of Attitudes

Types of Attitudes

Effects of Attitude on

Behaviour

Perception

Motivation

Stress

Adjustment

Time Management

Effective Performance

Building Positive Attitude

Module VI: End-of-Semester Appraisal

Viva based on personal journal
Assessment of Behavioural change as a result of training
Exit Level Rating by Self and Observer

Text & References:

- Towers, Marc: Self Esteem, 1st Edition 1997, American Media
- Pedler Mike, Burgoyne John, Boydell Tom, A Manager's Guide to Self-Development: Second edition, McGraw-Hill Book Company.
- Covey, R. Stephen: Seven habits of Highly Effective People, 1992 Edition, Simon & Schuster Ltd.
- Khera Shiv: You Can Win, 1st Edition, 1999, Macmillan
- Gegax Tom, Winning in the Game of Life: 1st Edition, Harmony Books
- Chatterjee Debashish, Leading Consciously: 1998 1st Edition, Viva Books Pvt. Ltd.
- Dr. Dinkmeyer Don, Dr. Losoncy Lewis, The Skills of Encouragement: St. Lucie Press.
- Singh, Dalip, 2002, Emotional Intelligence at work; First Edition, Sage Publications.
- Goleman, Daniel: Emotional Intelligence, 1995 Edition, Bantam Books
- Goleman, Daniel: Working with E.I., 1998 Edition, Bantam Books.

FRENCH - I

Course Code: FLT 111

Credit Units: 02

Course Objective:

To familiarize the students with the French language

- with the phonetic system
- with the syntax
- with the manners
- with the cultural aspects

Course Contents:

Module A: pp. 01 to 37: Unités 1, 2, Unité 3 Objectif 1,2

Only grammar of Unité 3: objectif 3, 4 and 5

Contenu lexical: Unité 1: Découvrir la langue française : (oral et écrit)

1. se présenter, présenter quelqu'un, faire la connaissance des

autres, formules de politesse, rencontres

2. dire/interroger si on comprend

3. Nommer les choses

Unité 2: Faire connaissance

1. donner/demander des informations sur une personne, premiers contacts, exprimer ses goûts et ses préférences

2. Parler de soi: parler du travail, de ses activités, de son pays, de sa ville.

Unité 3: Organiser son temps

1. dire la date et l'heure

Contenu grammatical:

1. organisation générale de la grammaire

2. article indéfini, défini, contracté

3. nom, adjectif, masculin, féminin, singulier et pluriel

4. négation avec « de », "moi aussi", "moi non plus"

5. interrogation : Inversion, est-ce que, qui, que, quoi, qu'est-ce que, où, quand, comment, quel(s), quelle(s)

Interro-négatif : réponses : oui, si, non

6. pronom tonique/disjoint- pour insister après une préposition

7. futur proche

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

GERMAN - I

Course Code: FLG 111

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Course Contents:

Module I: Introduction

Self introduction: heissen, kommen, wohnen, lernen, arbeiten, trinken, etc.

All personal pronouns in relation to the verbs taught so far.

Greetings: Guten Morgen!, Guten Tag!, Guten Abend!, Gute Nacht!, Danke sehr!, Danke!, Vielen Dank!, (es tut mir Leid!),

Hallo, wie geht's?: Danke gut!, sehr gut!, prima!, ausgezeichnet!,
Es geht!, nicht so gut!, so la la!, miserabel!

Module II: Interviewspiel

To assimilate the vocabulary learnt so far and to apply the words and phrases in short dialogues in an interview – game for self introduction.

Module III: Phonetics

Sound system of the language with special stress on Diphthongs

Module IV: Countries, nationalities and their languages

To make the students acquainted with the most widely used country names, their nationalities and the language spoken in that country.

Module V: Articles

The definite and indefinite articles in masculine, feminine and neuter gender. All Vegetables, Fruits, Animals, Furniture, Eatables, modes of Transport

Module VI: Professions

To acquaint the students with professions in both the genders with the help of the verb “sein”.

Module VII: Pronouns

Simple possessive pronouns, the use of my, your, etc.

The family members, family Tree with the help of the verb “to have”

Module VIII: Colours

All the color and color related vocabulary – colored, colorful, colorless, pale, light, dark, etc.

Module IX: Numbers and calculations – verb “kosten”

The counting, plural structures and simple calculation like addition, subtraction, multiplication and division to test the knowledge of numbers.

“Wie viel kostet das?”

Module X: Revision list of Question pronouns

W – Questions like who, what, where, when, which, how, how many, how much, etc.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

SPANISH – I

Course Code: FLS 111

Credit Units: 02

Course Objective:

To enable students acquire the relevance of the Spanish language in today's global context, how to greet each other. How to present / introduce each other using basic verbs and vocabulary.

Course Contents:

Module I

A brief history of Spain, Latin America, the language, the culture...and the relevance of Spanish language in today's global context.
Introduction to alphabets

Module II

Introduction to 'Saludos' (How to greet each other. How to present / introduce each other).
Goodbyes (despedidas)
The verb llamarse and practice of it.

Module III

Concept of Gender and Number
Months of the years, days of the week, seasons. Introduction to numbers 1-100, Colors,
Revision of numbers and introduction to ordinal numbers.

Module IV

Introduction to SER and ESTAR (both of which mean To Be).Revision of 'Saludos' and 'Llamarse'. Some adjectives, nationalities, professions, physical/geographical location, the fact that spanish adjectives have to agree with gender and number of their nouns. Exercises highlighting usage of Ser and Estar.

Module V

Time, demonstrative pronoun (Este/esta, Aquel/aquella etc)

Module VI

Introduction to some key AR /ER/IR ending regular verbs.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras

CHINESE – I

Course Code: FLC 111

Credit Units: 02

Course Objective:

There are many dialects spoken in China, but the language which will help you through wherever you go is Mandarin, or Putonghua, as it is called in Chinese. The most widely spoken forms of Chinese are Mandarin, Cantonese, Gan, Hakka, Min, Wu and Xiang. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Show pictures, dialogue and retell.

Getting to know each other.

Practicing chart with Initials and Finals. (CHART – The Chinese Phonetic Alphabet Called “Hanyu Pinyin” in Mandarin Chinese.)

Practicing of Tones as it is a tonal language.

Changes in 3rd tone and Neutral Tone.

Module II

Greetings

Let me Introduce

The modal particle “ne”.

Use of Please ‘qing’ – sit, have tea etc.

A brief self introduction – Ni hao ma? Zaijian!

Use of “bu” negative.

Module III

Attributives showing possession

How is your Health? Thank you

Where are you from?

A few Professions like – Engineer, Businessman, Doctor, Teacher, Worker.

Are you busy with your work?

May I know your name?

Module IV

Use of “How many” – People in your family?

Use of “zhe” and “na”.

Use of interrogative particle “shenme”, “shui”, “ma” and “nar”.

How to make interrogative sentences ending with “ma”.

Structural particle “de”.

Use of “Nin” when and where to use and with whom. Use of guixing.

Use of verb “zuo” and how to make sentences with it.

Module V

Family structure and Relations.

Use of “you” – “mei you”.

Measure words

Days and Weekdays.

Numbers.

Maps, different languages and Countries.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I” Lesson 1-10

SOLAR THERMAL ENGINEERING

Course Code: MTS 201

Credit Units: 03

Course Objective:

To cover areas related with the fundamentals of solar energy, storage, and design of solar appliances.

Course Contents:

Module I: Introduction Solar spectrum, solar radiation, instruments (pyrheliometers, pyranometers), solar radiation on horizontal surface (estimation of average solar radiation, estimation of clear sky radiation), solar thermal energy conversion.

Module II: Flat plate collector

Flat plate collector (FPC) (glazing material, collector plates), classification (evacuated tubular collectors, Types of FPCs), testing of collectors, heat transfer coefficients, optimization of heat losses, determination of fin efficiency, thermal analysis of FPC, effect of heat capacity in FPC.

Module III: Solar Concentrator

Characteristic parameters, classification, types of concentrators (tracking concentrator, non-tracking concentrators), geometrical optics in concentrators, theoretical solar image, thermal analysis, tracking methods, materials for concentrators.

Module IV: Energy Storage

Sensible heat storage, liquid media storage, solid media storage, dual media storage, basics of latent heat storage, chemical storage.

Module V: Applications

Solar air heater, solar crop drying, solar distillation, solar house, solar water heating systems, heating of swimming pool by solar energy, solar cooling.

Examination Scheme:

Components	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Solar Energy: Fundamentals, design, modeling and applications, Authored by G. N. Tiwari
- Renewable Energy Engineering and Technology, Edited by V.V. N. Kishore

INORGANIC SEMICONDUCTORS SOLAR CELLS

Course Code: MTS 202

Credit Units: 03

Course Objective:

This course covers the basic operating principles, fabrication, and design of solar cells. Provides an in-depth knowledge on efficiency and lifetime measurements of the solar cells.

Course Contents:

Module I: Solar Cells and Sunlight

Outline of solar cell development, physical source of sunlight, review of solar intensity at the Earth's surface, solar insolation data, space-based solar power.

Module II: Review of Semiconductor Properties

Crystal structures and orientations, forbidden energy gaps, dynamics of electrons and holes, carrier density, carrier transport, generation and recombination of carriers due to light, direct and in-direct band gap semiconductors, basic device physics, p-n junction diode, solar cell output parameters, characteristic lifetime, diffusion length, diffusion coefficient, absorption coefficient, efficiency limits, losses, and measurements.

Module III: Standard Silicon Solar Cell Technology

Review of fabrication technology, polysilicone and single crystal silicon cell technologies. Solar cells to solar cell module, energy accounting, improved silicon cell technology.

Module IV: Design of Solar Cells

Introduction, collection probability of generated carriers, junction depth, lateral resistance of top layer. Doping of substrate, back surface fields, top layer limitations, top contact design, optical design, other device structures, solar cell spectral response and characterization.

Module V: Other Semiconductor Materials

Polysilicone silicon, amorphous silicone, gallium arsenide solar cells, copper sulfide and cadmium sulfide solar cells

Examination Scheme:

Components	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Martin A. Green, Solar Cells-Operating Principles, Technology, and System Applications
- M. S. Tyagi, Introduction to Semiconductor Materials and Devices

ORGANIC PHOTOVOLTAICS

Course Code: MTS 203

Credits Units: 03

Course Objective:

Introduction to a new class of solar cell technology: processing and performance of organic solar cells.

Course Contents:

Module I: General Properties of Organic Semiconductors

Introduction to organic semiconductors, polarons, excitons, p and n- type organic semiconductors, structural properties of organic semiconductors, photo generation of free charges, comparison between organic and inorganic semiconductors

Module II: Properties of organic photovoltaic materials

Donor, acceptor materials and donor/ acceptor interfaces, substrate and electrode materials and electrode/semiconductor interfaces, conjugate polymers and fullerene blend, transport properties of conjugate polymers

Module III: Photovoltaic Characterization

Power conversion efficiency, equivalent circuit diagram, open circuit voltage V_{oc} , upper limit of V_{oc} , effect of shunt resistance, photocurrent and short circuit current I_{sc} , interpretation of IV characteristics

Module IV: Quantum solar energy conversion and application to organic solar cell

Solar radiation, Optical properties of organic photovoltaic materials, doping of organic photovoltaic materials, desired properties of organic photovoltaic materials and electrodes, fabrication of single layer devices, performance of single layer devices.

Module V: Organic bulk hetero-junction; hybrid; and dye sensitized solar cells

Device architectures of bulk hetero- junction solar cells, fabrication and performance of double layer devices; hybrid polymer/ nanocrystal photovoltaic devices; Dye sensitized solar cells: operating principle and cell structure.

Examination Scheme:

Components	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Organic photovoltaics: mechanism, materials and devices, Sam Shajing Sun, Niyazi Serdar Sariciftci
- Organic photovoltaics: concepts and realization, Christoph J. Brabec - Technology & Engineering – 2003
- Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technologies
- Christoph Brabec, Vladimir Dyakonov, Ullrich Scherf - Technology & Engineering - 2008

WIND ENERGY: ENERGY CONVERSION SYSTEM

Course Code: MTS 204

Credit Units: 03

Course Objective:

To give an insight into the context and importance of wind energy sources and their potential, present status, fundamental principles, applications and environmental aspects.

Course Contents:

Module I: Aerodynamics of blade and rotor

Aerodynamics of aerofoil, Lift; drag and stall, Effect of Reynold's number, Actuator disc, Momentum theory and Betz coefficient.

Module II: Design of wind turbine blade

Effect of stall and blade pitch on coefficient of power vs tip speed ratio and coefficient of torque vs tip speed ratio characteristics, Optimal choice of cut-in, rated and cut-out wind speeds, Blade materials.

Module III: Wind turbine design

Vertical and horizontal axis turbines, Design characteristics, Multiple stream tube theory, Vortex wake structure, Tip losses, Rotational sampling.

Module IV: Wind turbine design programs

Aerodynamic loads, Tower shadow; wind shear, Blade coning, gyroscopic, transient and extreme loads, Aerodynamic damping and stability, teetering motion, stiff and soft, towers, Power train dynamics.

Module V: Control Mechanisms

Pitch control and yaw control, Electrical and Mechanical aerodynamic braking, teeter mechanism, Wind turbine dynamics with DC and AC generators: induction and synchronous generators.

Examination Scheme:

Components	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Paul Gipe, Wind Energy Comes of Age, John Wiley & Sons Inc.
- L. L. Freris, Wind Energy Conversion System, Printice Hall.
- Tony Burton et al, Wind energy Hand Book, John Wiley & Sons Inc.
- Directory, Indian Windpower 2004, CECL, Bhopal.

ENERGY SYSTEMS: FUEL CELLS, TIDAL, GEOTHERMAL, BIO FUELS, AND BIO MASS

Course Code: MTS 205

Credit Units: 03

Course Objective:

This course covers the basic operating principles, fabrication, and design of solar cells. Provides an in-depth knowledge on efficiency and lifetime measurements of the solar cells.

Course Contents:

Module I: Biomass and its Conversion Technologies

Origin of Biomass: Resources: Classification and characteristics; Techniques for biomass assessment; Growth kinetics of biomass, Biomass productivity: Application of remote sensing in forest assessment; Biomass estimation, Xenobiotics, Biodegradation and biodegradability of substrate.

Module II: Biofuels

Enzymatic conversion of biomass, Enzyme kinetics, Biochemistry and process parameters of biomethanation; Biogas digester types; Digester design and biogas utilisation; Economics of biogas plant with their environmental and social impacts; Bioconversion of substrates into alcohol: Methanol & ethanol Production, organic acids, solvents, amino acids, antibiotics etc.

Module III: Fuel Cells

Introduction, electrochemistry, alkaline fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, direct methonal fuel cells, fuel processing, proton exchange membrane fuel cells, fuel processing, hydrogen storage, life cycle assessment of fuel cell systems.

Module IV: Geothermal Energy: Introduction and overview, source of heat, miming of geothermal heat, the physics of geothermal resources, volcano related heat sources and fluid, geothermal waters, technologies for exploration, environmental implications.

Module V: Tidal Power

The nature of the resource, physics, power generation, technical factors, environmental factors, tidal energy potential, tidal barrage, tidal stream tidal current turbines.

Examination Scheme:

Components	CT	Assignment	V	Attendan ce	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Renewable Energy – Power for a sustainable future –G. Boyle
- Renewable Energy Engineering and Technology-edited by V. V.N. Kishore
- Fuel Cells – Principles and Applications – B. Vishwanathan and M. A. Scibioh

ADVANCED REFRIGERATION

Course Code: MTS 206

Credit Units: 03

Course Objective:

This course covers the basic principles of refrigeration, cryogenics and alternate system of refrigeration

Course Contents:

Module I: Introduction : Review of Second law of thermodynamics, COP, Unit of Refrigeration Reversed Carnot Cycle, Bell Coleman cycle, Vapour Compression Refrigeration system, Vapour absorption Refrigeration system.

Module II: Psychrometry : Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

Module III: Solar Cooling : Potential and scope of solar cooling, Types of solar cooling systems, Solar collectors and storage systems for solar refrigeration and air-conditioning, Solar operation of vapour absorption and vapour compression refrigeration cycles and their thermodynamic assessment, Rankine cycle, sterling cycle based solar cooling systems.

Module IV: Solar Powered Refrigeration : Jet ejector solar cooling systems, Fuel assisted solar cooling systems, Solar desiccant cooling systems, Open cycle absorption / desorption solar cooling alternatives, Advanced solar cooling systems,

Module V: Solar Powered Air-conditioning: Thermal modeling for continuous and intermittent solar refrigeration and air-conditioning systems, Refrigerant storage for solar absorption cooling systems, Solar thermoelectric refrigeration and air-conditioning, Solar thermo acoustic cooling and hybrid air-conditioning, Solar economics of cooling systems.

factors, tidal energy potential, tidal barrage, tidal stream tidal current turbines.

Examination Scheme:

Components	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	05	05	05	70

Text & References:

- Refrigeration and Air – Conditioning By C.P. Arora
- Refrigeration and Air – Conditioning By P.K. Nag
- Refrigeration and Air – Conditioning By P. L. Ballaney
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PRACTICAL - II

Course Code: MTS 221

Credit Units: 05

Experiment List:

1. Fabrication of thermo couple based on thin films and its characterization.
2. Fabrication and characterization of MOS.
3. I-V measurements on Silicon Solar Cell.
4. Measurements of life time of minority carries in p-n junction solar cell.
5. Fabrication of organic LED and characterization.
6. Extraction of Bio-Fuel.
7. Multivibrator-Designs and analysis.

Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

SEMINAR AND PROJECT

Course Code: MTS 255

Credit Units: 05

Topics for the Project/Seminar

- | | |
|--|---------------------|
| 1. Minority carrier Life time measurements - | Dr. Vasuda. Bhatia |
| 2. Organic Thin Film Devices for Energy Applications - | Dr. Kanchan. Saxena |
| 3. Bio-fuels using Algae - | Dr. Vasuda Bhatia |

Students are required to select one topic for the project. A final report comprising of the following headers to be submitted to the committee prior to presentation.

1. Cover page-indicating title of the project, Guide's name
2. Introduction
3. Literature Survey
4. Methodology/Work Plan
5. Experimental set-up
6. Experimental data
7. Results and Discussion
8. Conclusion
9. Future Plan
10. References
11. Acknowledgments

Examination Scheme:

Project work	65 %
Seminar	20 %
Viva	10 %

Attendance	5%
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Total:	100
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COMMUNICATION SKILLS - II

Course Code: BCS 211

Credit Units: 01

Course Objective:

To enrich the understanding of English language and communication, structure, style, usage, and vocabulary for global business purposes.

Course Contents:

Module I: Fundamentals of Communication

Role and purpose of communication: *7 C's of communication*

Barriers to effective communication

Enhancing listening

Forms of Communication: one-to-one, informal and formal

Module II: Verbal Communication (Written)

Business Letter

Social correspondence

Writing resume and Job applications

Module III: Speaking skills

Conversational English

Guidelines to give an effective presentation

Activities to include:

Presentations by students

Just a minute

Examination Scheme:

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

Text & References:

- Business Communication, Raman – Prakash, Oxford
- Textbook of Business Communication, Ramaswami S, Macmillan
- Speaking Personally, Porter-Ladousse, Cambridge

BEHAVIOURAL SCIENCE - II
(BEHAVIOURAL COMMUNICATION AND RELATIONSHIP
MANAGEMENT)

Course Code: BSS 211

Credit Units: 01

Course Objective:

This course aims at imparting an understanding of:
Process of Behavioural communication
Aspects of interpersonal communication and relationship
Management of individual differences as important dimension of IPR

Course Contents:

Module I: Behavioural Communication

Scope of Behavioural Communication
Process – Personal, Impersonal and Interpersonal Communication
Guidelines for developing Human Communication skills
Relevance of Behavioural Communication in relationship management

Module II: Managing Individual Differences in Relationships

Principles
Types of issues
Approaches
Understanding and importance of self disclosure
Guidelines for effective communication during conflicts

Module III: Communication Climate: Foundation of Interpersonal Relationships

Elements of satisfying relationships
Conforming and Disconfirming Communication
Culturally Relevant Communication
Guideline for Creating and Sustaining Healthy Climate

Module IV: Interpersonal Communication

Imperatives for Interpersonal Communication
Models – Linear, Interaction and Transaction
Patterns – Complementary, Symmetrical and Parallel
Types – Self and Other Oriented
Steps to improve Interpersonal Communication

Module V: Interpersonal Relationship Development

Relationship circle – Peer/ Colleague, Superior and Subordinate
Initiating and establishing IPR
Escalating, maintaining and terminating IPR
Direct and indirect strategies of terminating relationship
Model of ending relationship

Module VI: End-of-Semester Appraisal

Viva based on personal journal
Assessment of Behavioural change as a result of training

Exit Level Rating by Self and Observer

Text & References:

- Vangelist L. Anita, Mark N. Knapp, Inter Personal Communication and Human Relationships: Third Edition, Allyn and Bacon
- Julia T. Wood. Interpersonal Communication everyday encounter
- Simons, Christine, Naylor, Belinda: Effective Communication for Managers, 1997 1st Edition Cassell
- Harvard Business School, Effective Communication: United States of America
- Beebe, Beebe and Redmond; Interpersonal Communication, 1996; Allyn and Bacon Publishers.

FRENCH - II

Course Code: FLT 211

Credit Units: 02

Course Objective:

- To enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French.
- To make them learn the basic rules of French Grammar.

Course Contents:

Module A: pp.38 – 47: Unité 3: Objectif 3, 4, 5, 6

Module B: pp. 47 to 75 Unité 4, 5

Contenu lexical: Unité 3: Organiser son temps

2. donner/demander des informations sur un emploi du temps, un horaire SNCF – Imaginer un dialogue
3. rédiger un message/ une lettre pour ...
 - i) prendre un rendez-vous/ accepter et confirmer/ annuler
 - ii) inviter/accepter/refuser
4. Faire un programme d'activités
imaginer une conversation téléphonique/un dialogue

Propositions- interroger, répondre

Unité 4: Découvrir son environnement

1. situer un lieu
2. s'orienter, s'informer sur un itinéraire.
3. Chercher, décrire un logement
4. connaître les rythmes de la vie

Unité 5: s'informer

1. demander/donner des informations sur un emploi du temps passé.
2. donner une explication, exprimer le doute ou la certitude.
3. découvrir les relations entre les mots
4. savoir s'informer

Contenu grammatical: 1. Adjectifs démonstratifs

2. Adjectifs possessifs/exprimer la possession à l'aide de :
 - i. « de » ii. A+nom/pronom disjoint
3. Conjugaison pronominale – négative, interrogative -
construction à l'infinitif
4. Impératif/exprimer l'obligation/l'interdiction à l'aide de « il
faut.... »/ «il ne faut pas... »
5. passé composé
6. Questions directes/indirectes

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

GERMAN – II

Course Code: FLG 211

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Introduction to Grammar to consolidate the language base learnt in Semester I

Course Contents:

Module I: Everything about Time and Time periods

Time and times of the day.

Weekdays, months, seasons.

Adverbs of time and time related prepositions

Module II: Irregular verbs

Introduction to irregular verbs like to be, and others, to learn the conjugations of the same, (fahren, essen, lessen, schlafen, sprechen und ähnliche).

Module III: Separable verbs

To comprehend the change in meaning that the verbs undergo when used as such

Treatment of such verbs with separable prefixes

Module IV: Reading and comprehension

Reading and deciphering railway schedules/school time table

Usage of separable verbs in the above context

Module V: Accusative case

Accusative case with the relevant articles

Introduction to 2 different kinds of sentences – Nominative and Accusative

Module VI: Accusative personal pronouns

Nominative and accusative in comparison

Emphasizing on the universal applicability of the pronouns to both persons and objects

Module VII: Accusative prepositions

Accusative prepositions with their use

Both theoretical and figurative use

Module VIII: Dialogues

Dialogue reading: ‘In the market place’

‘At the Hotel’

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmoe, Deutsch als Fremdsprache 1A, Grundkurs

SPANISH – II

Course Code: FLS 211

Credit Units: 02

Course Objective:

To enable students acquire more vocabulary, grammar, Verbal Phrases to understand simple texts and start describing any person or object in Simple Present Tense.

Course Contents:

Module I

Revision of earlier modules.

Module II

Some more AR/ER/IR verbs. Introduction to root changing and irregular AR/ER/IR ending verbs

Module III

More verbal phrases (eg, Dios Mio, Que lastima etc), adverbs (*bueno/malo, muy, mucho, bastante, poco*).

Simple texts based on grammar and vocabulary done in earlier modules.

Module IV

Possessive pronouns

Module V

Writing/speaking essays like my friend, my house, my school/institution, myself....descriptions of people, objects etc, computer/internet related vocabulary

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras

CHINESE – II

Course Code: FLC 211

Credit Units: 02

Course Objective:

Chinese is a tonal language where each syllable in isolation has its definite tone (flat, falling, rising and rising/falling), and same syllables with different tones mean different things. When you say, “ma” with a third tone, it mean horse and “ma” with the first tone is Mother. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Drills

Practice reading aloud

Observe Picture and answer the question.

Tone practice.

Practice using the language both by speaking and by taking notes.

Introduction of basic sentence patterns.

Measure words.

Glad to meet you.

Module II

Where do you live?

Learning different colors.

Tones of “bu”

Buying things and how muchit costs?

Dialogue on change of Money.

More sentence patterns on Days and Weekdays.

How to tell time. Saying the units of time in Chinese. Learning to say useful phrases like – 8:00, 11:25, 10:30 P.M. everyday, afternoon, evening, night, morning 3:58, one hour, to begin, to end etc.

Morning, Afternoon, Evening, Night.

Module III

Use of words of location like-li, wai hang, xia

Furniture – table, chair, bed, bookshelf,.. etc.

Description of room, house or hostel room.. eg what is placed where and how many things are there in it?

Review Lessons – Preview Lessons.

Expression ‘yao’, ‘xiang’ and ‘yaoshi’ (if).

Days of week, months in a year etc.

I am learning Chinese. Is Chinese difficult?

Module IV

Counting from 1-1000

Use of “chang-chang”.

Making an Inquiry – What time is it now? Where is the Post Office?

Days of the week. Months in a year.

Use of Preposition – “zai”, “gen”.

Use of interrogative pronoun – “duoshao” and “ji”.

“Whose”??? Sweater etc is it?

Different Games and going out for exercise in the morning.

Module V

The verb “qu”

Going to the library issuing a book from the library

Going to the cinema hall, buying tickets

Going to the post office, buying stamps

Going to the market to buy things.. etc

Going to the buy clothes Etc.

Hobby. I also like swimming.

Comprehension and answer questions based on it.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I” Lesson 11-20

DESIGN AND ENGINEERING OF SOLAR PHOTOVOLTAIC CELLS AND PANELS

Course Code: MTS 301

Credit Units: 03

Course Objective:

This course covers the design and engineering of solar cells along with their modules and panels.

Course Contents:

Module I: Introduction of Design and Engineering of Solar Cells

Various Commercialized, Un-commercialized Designs of Solar Cells (Homo-junction, multi-junction and concentrator solar cells; c- / a- / pc- / mc- Si solar cells, CIGS, CIS, CdTe, quantum dots, organic, inorganic-organic hybrid, dye-sensitized solar cells), Various Processes for Maximizing the Light-Trapping and Absorption in Solar Cells, Anti-reflection coating & Surface texturing, Back surface reflector, Self-cleaning surface.

Module II: Packaging of Solar Photovoltaic Modules

Cell matrix, Layers of modules, Lamination, post-lamination and curing, Special modules.

Module III: Electrical & Optical Performance of Solar Photovoltaic Modules

Electrical & thermal characteristics, Fabrication spread and Mismatch losses, Local shading and Hot spot formation, Field performance of module, Troubleshooting of solar cells.

Module IV: Module Manufacturing of Commercialized Solar Cells

Module manufacturing of a-Si solar cells (Continuous roll-to-roll manufacturing, a-Si on glass substrate, manufacturing cost, safety & other issues, module performance), Module manufacturing of CIGS, CIS, CdTe solar cells.

Module V: Photovoltaic Power System Configuration and their Applications

Grid-independent PV system for small devices and appliances, PV systems for remote consumers, Decentralized grid-connected PV systems, Centralized grid-connected PV systems.

Examination Scheme:

Components	CT(2)	A	V(1)	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Solar Photovoltaics (Fundamentals, Technologies and Application) by Chetan Singh Solanki; Handbook of Photovoltaic Science and Engineering by Antonio Luque & Steven Hegedus - Wiley; Lecture notes.

INSTRUMENTATION, ELECTRONICS, AND INTEGRATION OF RENEWABLE ENERGY SOURCES

Course Code: MTS 302

Credit Units: 03

Course Objective:

To enable the students to understand the Electronic Instrumentation.

Course Contents

Module I: Bridges and their application

Introduction, Wheatstone bridge, Maxwell bridge, Hay bridge, Kelvin bridge, Wien bridge.

Module II: Sensors / Transducer & Signal converters

Definition and characteristics of Transducers/ Sensors for Temperature, Light, Magnetic Field, Strain, Pressure, Flow, Displacement, Rotation, Acceleration etc., A/D and D/A conversion.

Module III: Data Acquisition Programme

Multi-channel System, PC based data Acquisition Systems: GPIB, CAMAC, VXI, PXI.

Module IV: PV systems-components & application

Batteries for PV Systems, Dc to Dc converters, DC to Ac converter, Charge controllers, MPRT.

Module V: PV system design and Application

PV system-Standalone configuration, design methodology, wire sizing, hybrid system and grid connected PV systems.

Examination Scheme:

Component	CT	Assignment	V	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- W.D. Cooper, A.D. Helfrick, Electronic instrumentation and measurement Techniques, Prentice Hall of India.
- Chetan Singh Solanki, Solar Photovoltaic Hall of India.

ENERGY GENERATION FROM OTHER SOURCES LIKE, NANOMATERIALS AND BIOWASTE

Course Code: MTS 303

Credit Units: 03

Course Objective:

This course covers the novel concepts of energy generation from various sources, like nano - materials, and bio-wastes.

Course Contents:

Module I: Space and Terrestrial Quality Solar Cells

Photolithography, diffusion, metallization, anti-reflection, dicing, packaging, characterization.

Module II: 3rd – Generation and Novel Concepts of Solar Cells

Up/ Down Conversion Solar Cells, Plasmonic Solar Cells, Silicon Nanostructures and tandem Cells, Thermoelectric Cells & Thermophotonics, Hot Carrier Cells, Novel Nanomaterials and Concepts of Hybrid Inorganic / Organic Photovoltaics.

Module III: Emerging Dye-Sensitized Solar Cell Technologies and Concepts

Mechanism and Construction of Dye-Sensitized Solar Cells (DSSC), Electron Transport and Lifetime Study, Parameters Influencing the Electron Diffusion Coefficient and Lifetime, Emerging Nanomaterials, Dyes and Electrolytes for DSSC, Device Architectures, Latest Trends, Developments and Market overview.

Module IV: Energy Storage using Novel Nanomaterials

Introduction to nanomaterials, Development of nanomaterials for energy storage applications, Hydrogen storage in single walled carbon, nanomaterials. Synthesis and characterization approaches, studies of kinetics, energy-release mechanisms and catalytic activity, Nanomaterials for Lithium ion batteries, Nanomaterials engineering in electrodes.

Module V: Energy Generation through Biowaste and Biomass

Production of biomass - broad classification, Agro and forestry residues utilization through conversion routes: biological, chemical and thermochemical, Bioconversion mechanism, sources of waste undergoing bio-treatment, biogas. Thermochemical conversion of biomass, Conversion to solid, liquid and gaseous fuels, pyrolysis, gasification and their economics, Chemical conversion process, hydrolysis and hydrogenation, solvent extraction of hydrocarbons.

Examination Scheme:

Components	CT(2)	A	V(1)	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Solar Photovoltaics (Fundamentals, Technologies and Application) by Chetan Singh Solanki; Third Generation Photovoltaics (Advanced Solar Energy Conversion) by Martin A. Green; Lecture notes

RESEARCH METHODOLOGY

Course Code: MTS 304

Credit Units: 03

Course Objective:

This course covers the concepts of research and flow of research in an organized manner

Module I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process, Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance

Module - II

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches

Module III Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Module IV :Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Module V: Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. (5%) 10. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Examination Scheme:

Components	CT(2)	A	V(1)	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

ENERGY MANAGEMENT RELATED TO SOLAR, WIND, AND OTHER RENEWABLE ENERGY SYSTEMS

Course Code: MTS 305

Credit Units: 03

Course Objective:

This course covers the basic principles of energy management, economics of solar energy and design of energy efficient building.

Course Contents:

Module I: Renewable Energy Economics

Energy scenario, environmental policies, energy policies, economics of energy infrastructure, rural renewable energy economics.

Module II: Energy Audit

Energy Audit concepts, Elements, Measurements, Mass and energy balances, Evaluation of energy conserving opportunities, case study.

Module III: Economic Benefits Solar Energy

Solar energy benefits, environmental benefits, solar energy cost and economic impact, understanding the cost of solar energy, economics of installing solar panel, solar cooling concepts and economic benefits.

Module IV: Solar Industrial Economics

Solar power plants, integration with industrial process, integration with grid, storage of energy, economics.

Module V: Planning of Energy Efficient Building

Green building design, solar heating, passive solar heating homes and concepts, other lightening methods, use of bio-energy; energy, water and material efficiency, cost analysis.

Examination Scheme:

Components	CT(2)	A	V(1)	Attendance	EE(1)
Weightage (%)	15	5	5	5	70

Text & References:

- Renewable Energy: Power For A Sustainable Future, Second Ed. Edited By Godfrey Boyle
Solar Engineering Of Thermal Processes - J. A. Duffie, W. A. Beckman, Solar Energy Laboratory Lecture Notes

Bio-Fuels

Course Code: MTS 306

Credit Units: 03

Course Objective:

This course covers the concepts of recent and ongoing work in the field of Bio-diesel and bio-fuels.

Module I: Need for Alternate fuels for I.C engines: Vegetable oils, alcohol's, L.P.G, C.N.G, properties, emission characteristics, F/ A ratio.

Module II: Bio-Gas, Gobar Gas, Design and construction of Biogas plant, Merits and Demerits of Biogas, Emission characteristics of Biogas

Module III: Bio-diesels: What are bio-diesels Need of bio-diesels, Trans-esterification process, Properties of bio-diesels v/s petro-diesel, Performance and emission characteristics of bio-diesels v/s Petro diesel operation

Module IV: Dual fuel Engine: Need and advantages, the working principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, Biogas and Producer gas in CI engines in dual fuel mode. Engine modifications required

References:

1. Internal Combustion Engines Theory & Practice by G.F. Taylor
2. Introduction to IC Engines by Richard Stone.
3. Internal Combustion engines by V. Ganeshan
4. John B Heywood," Internal Combustion Engine Fundamentals", Tata McGraw-Hill 1988
5. Patterson D.J. and Henein N.A, "Emissions from combustion engines and their Control," Ann Arbor Science publishers Inc, USA, 1978
6. Gupta H.N, "Fundamentals of Internal Combustion Engines", Prentice Hall of India, 2006

MINOR PROJECT: ENERGY EFFICIENT BUILDING DESIGN

Course Code: MTS 370

Credit Units: 06

Course Objective:

To give a training of handling various projects with the help of minor project on 'Energy Efficient Building Design.'

Course Contents:

Students will get exposure of how to carried out the project successfully. During this they will get an opportunity to interact with visiting faculties, who have their expertise in the same field. Students will submit their report to AIRAE after being examined by guide / supervisor under whom he/she will work.

Assessment Scheme:

Continuous Evaluation: 40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation: 60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

PRACTICAL - III

Course Code: MTS 321

Credit Units: 05

Experiment List

1. Power generation using Wind Mill.
2. Extraction of bio fuels from Algae.
3. Fabrication of dye sensitized solar cell.
4. Spectral response of a Silicon Solar Cell.
5. Angular distribution response of Solar Cell.
6. Internal resistance of a Silicon Solar Cell.
7. Temperature response of a Solar Cell.
8. Energy generation using Bio Cells / Bio Batteries.
9. Thermocouple fabrication and measurement.
10. Electrode preparation for biosensor application.

Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA -Internal Assessment, EE- External Exam, PR- Performance, LR - Lab Record, V - Viva.

COMMUNICATION SKILLS - III

Course Code: BCS 311

Credit Units: 01

Course Objective:

To initiate the learners with the basic mechanics of writing skills and facilitate them with the core skills required for communication in the professional world.

Course Contents:

Module I: Mechanics and Semantics of Sentences

Writing effective sentences

Style and Structure

Module II: Developing writing skills

Inter - office communication: Business Letter; E mails; Netiquette

Intra - office communication: Memos, Notices, Circulars, Minutes

Report Writing

Module III: Business Presentations

Planning, design and layout of presentation

Information Packaging

Audience analysis

Audio visual aids

Speaking with confidence

Case Studies

Examination Scheme:

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF - Communication Assessment File

GD - Group Discussion

GP - Group Presentation

Text & References:

- Krishnaswamy, N, Creative English for Communication, Macmillan
- Raman Prakash, Business Communication, Oxford.

BEHAVIOURAL SCIENCE - III (LEADING THROUGH TEAMS)

Course Code: BSS 311

Credit Units: 01

Course Objective:

This course aims to enable students to:
Understand the concept and building of teams
Manage conflict and stress within team
Facilitate better team management and organizational effectiveness through universal human values.

Course Contents:

Module I: Teams: An Overview

Team Design Features: team vs. group
Effective Team Mission and Vision
Life Cycle of a Project Team
Rationale of a Team, Goal Analysis and Team Roles

Module II: Team & Sociometry

Patterns of Interaction in a Team
Sociometry: Method of studying attractions and repulsions in groups
Construction of sociogram for studying interpersonal relations in a Team

Module III: Team Building

Types and Development of Team Building
Stages of team growth
Team performance curve
Profiling your Team: Internal & External Dynamics
Team Strategies for organizational vision
Team communication

Module IV: Team Leadership & Conflict Management

Leadership styles in organizations
Self Authorized team leadership
Causes of team conflict
Conflict management strategies
Stress and Coping in teams

Module V: Global Teams and Universal Values

Management by values
Pragmatic spirituality in life and organization
Building global teams through universal human values
Learning based on project work on Scriptures like Ramayana, Mahabharata, Gita etc.

Module VI: End-of-Semester Appraisal

Viva based on personal journal
Assessment of Behavioural change as a result of training
Exit Level Rating by Self and Observer

Text & References:

- Organizational Behaviour, Davis, K.
- Hoover, Judhith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
- LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
- Dick, Mc Cann & Margerison, Charles: Team Management, 1992 Edition, viva books
- J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996); Pfeiffer & Company
- Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

FRENCH – III

Course Code: FLT 311

Credit Units: 02

Course Objective:

To provide the students with the know-how

- To master the current social communication skills in oral and in written.
- To enrich the formulations, the linguistic tools and vary the sentence construction without repetition.

Course Contents:

Module B: pp. 76 - 88 Unité 6

Module C: pp. 89 to 103 Unité 7

Contenu lexical: Unité 6: se faire plaisir

1. acheter : exprimer ses choix, décrire un objet (forme, dimension, poids et matières) payer
2. parler de la nourriture, deux façons d'exprimer la quantité, commander un repas au restaurant
3. parler des différentes occasions de faire la fête

Unité 7: Cultiver ses relations

1. maîtriser les actes de la communication sociale courante
(Salutations, présentations, invitations, remerciements)
2. annoncer un événement, exprimer un souhait, remercier, s'excuser par écrit.
3. caractériser une personne (aspect physique et caractère)

Contenu grammatical:

1. accord des adjectifs qualificatifs
2. articles partitifs
3. Négations avec de, ne...rien/personne/plus
4. Questions avec combien, quel...
5. expressions de la quantité
6. ne...plus/toujours - encore
7. pronoms compléments directs et indirects
8. accord du participe passé (auxiliaire « avoir ») avec l'objet direct

9. Impératif avec un pronom complément direct ou indirect

10. construction avec « que » - Je crois que/ Je pense que/ Je
sais que

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C - Project + Presentation

I - Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

GERMAN - III

Course Code: FLG 311

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Course Contents:

Module I: Modal verbs

Modal verbs with conjugations and usage, Imparting the finer nuances of the language

Module II: Information about Germany (ongoing)

Information about Germany in the form of presentations or "Referat"- neighbors, states and capitals, important cities and towns and characteristic features of the same, and also a few other topics related to Germany.

Module III: Dative case

Dative case, comparison with accusative case, Dative case with the relevant articles

Introduction to 3 different kinds of sentences - nominative, accusative and dative

Module IV: Dative personal pronouns

Nominative, accusative and dative pronouns in comparison

Module V: Dative prepositions

Dative preposition with their usage both theoretical and figurative use

Module VI: Dialogues

In the Restaurant,
At the Tourist Information Office,
A telephone conversation

Module VII: Directions

Names of the directions

Asking and telling the directions with the help of a roadmap

Module VIII: Conjunctions

To assimilate the knowledge of the conjunctions learnt indirectly so far

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C - Project + Presentation I - Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

SPANISH – III

Course Code: FLS 311

Credit Units: 02

Course Objective:

To enable students acquire knowledge of the Set/definite expressions (idiomatic expressions) in Spanish language and to handle some Spanish situations with ease.

Course Contents:

Module I

Revision of earlier semester modules

Set expressions (idiomatic expressions) with the verb *Tener, Poner, Ir...*

Weather

Module II

Introduction to *Gustar...*and all its forms. Revision of *Gustar* and usage of it

Module III

Translation of Spanish-English; English-Spanish. Practice sentences.

How to ask for directions (using *estar*)

Introduction to IR + A + INFINITIVE FORM OF A VERB

Module IV

Simple conversation with help of texts and vocabulary

En el restaurante

En el instituto

En el aeropuerto

Module V

Reflexives

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C - Project + Presentation

I - Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras -Nivel Elemental

CHINESE – III

Course Code: FLC 311

Credit Units: 02

Course Objective:

Foreign words are usually imported by translating the concept into Chinese, the emphasis is on the meaning rather than the sound. But the system runs into a problem because the underlying name of personal name is often obscure so they are almost always transcribed according to their pronunciation alone. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Drills, Dialogue practice, Observe picture and answer the question, Introduction of written characters, Practice reading aloud, Practice using the language both by speaking and by taking notes, Character writing and stroke order

Module II

Measure words, Position words e.g. inside, outside, middle, in front, behind, top, bottom, side, left, right, straight, Directional words – beibian, xibian, nanbian, dongbian, zhongjian, Our school and its different building locations, What game do you like? Difference between “hii” and “neng”, “keyi”.

Module III

Changing affirmative sentences to negative ones and vice versa, Human body parts, Not feeling well words e.g. ; fever, cold, stomach ache, head ache, Use of the modal particle “le”, Making a telephone call, Use of “jiu” and “cal” (Grammar portion), Automobiles e.g. Bus, train, boat, car, bike etc, Traveling, by train, by airplane, by bus, on the bike, by boat.. etc.

Module IV

The ordinal number “di”, “Mei” the demonstrative pronoun e.g. mei tian, mei nian etc, use of to enter to exit, Structural particle “de” (Compliment of degree), Going to the Park., Description about class schedule during a week in school, Grammar use of “li” and “cong”, Comprehension reading followed by questions.

Module V

Persuasion-Please don't smoke, Please speak slowly, Praise – This pictorial is very beautiful, Opposites e.g. Clean-Dirty, Little-More, Old-New, Young-Old, Easy-Difficult, Boy-Girl, Black-White, Big-Small, Slow-Fast ... etc, Talking about studies and classmates, Use of “it doesn't matter”, Enquiring about a student, description about study method, Grammar: Negation of a sentence with a verbal predicate.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I, Part-2” Lesson 21-30

SUMMER TRAINING

Course Code: MTS 350

Credit Units: 09

Course Objective:

To evaluate the project carried out in the industry during the summer internship.

Summer Training Programme

During the summer training, each student will be given an opportunity to interact with R&D institutions/Industries, where she/he will work on a project and get training of handling Solar Cell's fabrication / processing units for a short duration of 45-60 days. Students will submit the work to AIRAE after being examined by a guide/supervisor of the institute under whom she/he will work.

Examination Scheme:

Project : 60%

Presentation/Seminar : 20%

Viva : 20%

Total : 100%

DISSERTATION

Course Code: MTS 455

Credit Units: 30

Course Objective:

To give an in depth understanding of the research problem and to generate experimental expertise. The students will work in a R & D institutions / industries.

Course Contents:

To carry out research project on specific problem for dissertation

Dissertation of six months in a R&D institution or industry. The students will work on a project either under the joint guidance of a Professor/Scientist in that organization. The work after completion will be submitted to Amity Institute of Renewable and Alternative Energy(AIRAE) , which is a part of their M. Tech (Solar and Alternative Energy) degree programme of this Amity University Rajasthan.

Examination Scheme:

Project : 60%
Presentation/Seminar : 20%
Viva : 20%

Total : 100%