

CURRICULUM
FOR
DIPLOMA PROGRAMME
IN
INSTRUMENTATION ENGINEERING
(N-2022 SCHEME)
3rd Year (5th & 6th Semester)
FOR THE STATE OF HIMACHAL PRADESH



Implemented w.e.f. Session 2024-25

Prepared by:-

Composite Curriculum Development Centre,

Directorate of Technical Education, Vocational & Industrial Training,
Sundernagar, District- Mandi (H.P.)

Certificate

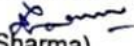
The curriculum for 3-years Diploma in Instrumentation Engineering for the state of Himachal Pradesh has been designed and drafted by the constituted committee. The drafted curriculum is designed around the guidelines of "AICTE Model Curriculum for Diploma Courses in Engineering and Technology-2019". Best efforts have been put to develop a curriculum to impart industry relevant knowledge and skill in addition to inculcating core values and ethics in the students. Further, all the inputs and directions given in various meetings related to the curriculum development have been incorporated in this curriculum.



(Er. Pawan Chandel)
HOD-Instrumentation Engineering
Govt. Polytechnic Kangra (HP)



(Er. Karan Singh Thakur)
Lecturer-Instrumentation Engineering
Govt. Polytechnic Kangra (HP)



(Er. Vikal Sharma)
Lecturer-Instrumentation Engineering
Govt. Polytechnic Kangra (HP)



(Er. Varun)
Lecturer-Instrumentation Engineering
Govt. Polytechnic Kangra (HP)

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THREE YEAR DIPLOMA IN

Instrumentation Engineering

5th & 6th Semester

SALIENT FEATURES

Program	Diploma in Instrumentation Engineering
Duration	Three Years (Six Semesters)/ Two Years (Four Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE: <ul style="list-style-type: none">• 3yr Diploma after 10th• 2yr Diploma after 12th (Science/Vocational) or ITI.
Intake	As prescribed by H.P. Takniki Shiksha Board /AICTE
Pattern	Semester System

The course content for 5th & 6th Semester Instrumentation Engineering facilitates the students to grasp the basic knowledge following:-

- Implementation of Instrumentation in Industries through field instruments.
- Control of Processes through field instruments including sensors/transducers, controllers & final control elements.
- Industrial Electronics/Power Electronics & Control of Drives.
- Computer based Instrumentation (Virtual Instrumentation).
- Applied Instrumentation & Utilities.
- Biomedical Instrumentation/ Medical Electronics.
- Analytical Instruments.
- Control System used in Industries using PLC, SCADA & DCS.
- Automation, Utilities & its Applications
- Entrepreneurship.

Course Code and Definitions

Course Code	Definitions
IE	Instrumentation Engineering
L	Lecture
T	Tutorial
P	Practical
HS	Humanities and Social Science Courses
BS	Basic Science Courses
ES	Engineering science Courses
PC	Programme Core Courses
PE	Programme Elective Courses
OE	Open Elective Courses
AU	Audit Courses
SI	Summer Internship
PR	Project
SE	Seminar
DCS	Doubt Clearing Session

List of Programme Core Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEPC301	Industrial Instrumentation-II	2	2	-	4	2 (2+0+0)	V
2	IEPC303	Industrial Instrumentation-II Lab	-	-	2	2	1 (0+0+1)	V
3	IEPC305	Process Control-II	2	2	-	4	2 (2+0+0)	V
4	IEPC307	Process Control-II Lab	-	-	2	2	1 (0+0+1)	V
5	IEPC302	Logic Controllers & Distributed Control System	3	1	-	4	3 (3+0+0)	VI
6	IEPC304	Logic Controllers & Distributed Control System Lab	-	-	2	2	1 (0+0+1)	VI
7	IEPC306	Automation, Utilities & its Applications	3	1	-	4	3 (3+0+0)	VI
Total Credits							13	

List of Programme Elective Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEPE301-I	Applied Instrumentation and Utilities	2	2	-	4	2 (2+0+0)	V
2	IEPE301-II	Industrial Electronics						
3	IEPE303-I	Applied Instrumentation and Utilities Lab	-	-	2	2	1 (0+0+1)	V
4	IEPE303-II	Industrial Electronics Lab						
5	IEPE305-I	Biomedical Instrumentation	2	2	-	4	2 (2+0+0)	V
6	IEPE305-II	Virtual Instrumentation						
7	IEPE307-I	Biomedical Instrumentation Lab	-	-	2	2	1 (0+0+1)	V
8	IEPE307-II	Virtual Instrumentation Lab						
Total Credits							06	

List of Open Elective Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	--OE---	Open Elective-I/MOOCs*	3	1	-	4	3 (3+0+0)	V
2	--OE---	Open Elective-II*	3	1	-	4	3 (3+0+0)	VI
3	--OE---	Open Elective-III*	3	1	-	4	3 (3+0+0)	VI

**Guidelines w.r.t MOOCs & Open Elective Courses/Subjects are attached as Annexure-A and The List of Open Electives Course along with the Curriculum is attached as Annexure-B.*

List of Project Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	PR301	Major Project	-	2	2	4	1	V
2	PR302	Major Project	-	2	6	8	3	VI

List of Humanities & Social Science Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	HS302	Entrepreneurship and Start-ups	4	0	0	4	4 (4+0+0)	VI

List of Audit Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	AU302	Indian Constitution	2	-	-	2	-	VI

List of Seminar

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	SE302	Seminar	-	-	2	2	1 (0+0+1)	VI

List of Student Centered Activities

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	-----	SCA	-	-	2	2	-	V
2	-----	SCA	-	-	2	2	-	VI

STUDY AND EVALUATION SCHEME (5th Semester)

Sr. No.	Subjects	Code No.	Study Scheme			Total Study Hr/Week	Credits	Evaluation Scheme									Total Marks
			Hours/ Week					Internal			External						
			L	DCS	P			Th	Pr	Total Marks	Th	Hrs	Pr	Hrs	Total Marks		
1	Industrial Instrumentation-II	IEPC301	2	2	-	4	2	40	--	40	60	3 hr	--	--	60	100	
2	Industrial Instrumentation-II Lab	IEPC303	-	-	2	2	1	--	40	40	--	--	60	3 hr	60	100	
3	Process Control-II	IEPC305	2	2	-	4	2	40	--	40	60	3 hr	--	--	60	100	
4	Process Control-II Lab	IEPC307	-	-	2	2	1	--	40	40	--	--	60	3 hr	60	100	
5	Program Elective-III (Choose one of the following) (Applied Instrumentation and Utilities / Industrial Electronics)	IEPE301-I / IEPE301-II	2	2	-	4	2	40	--	40	60	3 hr	--	--	60	100	
6	Program Elective-III Lab (Choose one of the following) (Applied Instrumentation and Utilities Lab / Industrial Electronics Lab)	IEPE303-I / IEPE303-II	-	-	2	2	1	--	40	40	--	--	60	3 hr	60	100	

7	Program Elective-IV (Choose one of the following) (Biomedical Instrumentation / Virtual Instrumentation)	IEPE305-I / IEPE305-II	2	2	-	4	2	40	--	40	60	3 hr	--	--	60	100
8	Program Elective-IV Lab (Choose one of the following) (Biomedical Instrumentation Lab / Virtual Instrumentation Lab)	IEPE307-I / IEPE307-II	-	-	2	2	1	--	40	40	--	--	60	3 hr	60	100
9	Open Elective-I/MOOCs*	--OE---	3	1	-	4	3	40	--	40	60	3 hr	--	--	60	100
10	Internship – II**	SI-II	-	-	-	-	3	--	40	40	--	--	60	3 hr	60	100
11	Major Project	PR301	-	2	2	4	1	--	40	40	--	--	60	3 hr	60	100
12	Student Centered Activities		-	-	2	2	-	--	25	25	--	--	--	--	---	025
Total			11	11	12	34	19	200	265	465	300	--	360	--	660	1125

* Guidelines w.r.t MOOCs & Open Elective Courses/Subjects are attached as **Annexure-A** and The List of Open Electives Course along with the Curriculum is attached as **Annexure-B**.

** At the end of 4th semester students will undergo 6 weeks of Internship and its credits will be awarded in 5th semester.

STUDY AND EVALUATION SCHEME (6th Semester)

Sr. No.	Subjects	Code No.	Study Scheme			Total Study Hr/Week	Credits	Evaluation Scheme									Total Marks
			Hours/ Week					Internal			External						
			L	DCS	P			Th	Pr	Total Marks	Th	Hrs	Pr	Hrs	Total Marks		
1	Logic Controllers & Distributed Control System	IEPC302	3	1	--	4	3	40	--	40	60	3 hr	--	--	060	100	
2	Logic Controllers & Distributed Control System Lab	IEPC304	--	--	2	2	1	--	40	40	--	--	60	3 hr	060	100	
3	Automation, Utilities & its Applications	IEPC306	3	1	--	4	3	40	--	40	60	3 hr	--	--	060	100	
4	Entrepreneurship and Start-ups##	HS302	4	--	--	4	4	40	--	40	60	3 hr	--	--	060	100	
5	Open Elective- II*	--OE---	3	1	--	4	3	40	--	40	60	3 hr	--	--	060	100	
6	Open Elective- III*	--OE---	3	1	--	4	3	40	--	40	60	3 hr	--	--	060	100	
7	Indian Constitution (Audit Course)##	AU302	2	--	--	2	-	40	--	40	60	3 hr	--	--	060	100	
8	Major Project	PR302	--	2	6	8	3	--	40	40	--	--	60	3 hr	060	100	
9	Seminar	SE302	--	--	2	2	1	--	100	100	--	--	--	--	---	100	
10	Student Centered Activities		--	--	2	2	--	--	25	25	--	--	--	--	---	025	
Total			18	6	12	36	21	240	205	445	360	--	120	--	480	925	

* Guidelines w.r.t Open Elective Courses/Subjects are attached as **Annexure-A** and The List of Open Electives Course along with the Curriculum is attached as **Annexure-B**. ## Subjects Common with other branches.

DIPLOMA PROGRAMME OUTCOME

PO1	Basic and discipline specific knowledge: Apply the knowledge of basic mathematics, science and engineering fundamentals and an engineering specialization to solve the engineering problems.
PO2	Problem analysis: Identify and analyze well defined engineering problems using codified standard methods.
PO3	Design/development of solutions: Design solutions for well defined technical problems and assist with the design of systems components or processes to meet specified needs.
PO4	Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
PO5	Engineering Practices for Society, Sustainability and Environment: Apply appropriate technology in context of society, sustainability environment and ethical practices.
PO6	Project management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
PO7	Life-long learning: Ability to analyze individual needs and engage in updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES

PSO1	Students will have a strong foundation in mathematical, scientific & engineering Fundamentals necessary to formulate, solve & analyze complex instrumentation problems.
PSO2	Apply Instrumentation in multidisciplinary domains related to research & entrepreneurship development. (Domains: Process, Biomedical, Environment, Control etc.)
PSO3	Communicate effectively to work as a team with professional ethics for the benefit of society.

DETAILED CONTENTS
FOR
THIRD YEAR
(5th Semester)

Course Code	:	IEPC301
Course Title	:	Industrial Instrumentation-II
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	IEPC204 (Industrial Instrumentation-I)
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Instrumentation employed in Industry for the measurement of Pressure & Flow.

Course Content

1. Basic Flow Measurement Techniques

- 1.1 Basic Concept of Bernoulli Equation.
- 1.2 Methods of Flow Measurement:
 - 1.2.1 Variable Head/Differential Pressure/Obstruction Type Flow Meters:
 - 1.2.1.1 Basic Operating Principle
 - 1.2.1.2 Concept of Pressure Head.
 - 1.2.1.3 Primary Elements of Differential Flow Meters:
 - 1.2.1.3.1 Orifice Plate
 - 1.2.1.3.2 Venturi Tube
 - 1.2.1.3.3 Flow Nozzle
 - 1.2.1.3.4 Pitot Tube.
 - 1.2.2 Variable Area Flow Meter: Rotameter.

2. Miscellaneous Flow Measurement

- 2.1 Velocity Type Flow Measurement:-
 - 2.1.1 Electromagnetic Flow Meter.
 - 2.1.2 Turbine Type Flow Meter.
 - 2.1.3 Target Type Flow Meter.
 - 2.1.4 Ultrasonic Flow Meter.
 - 2.1.5 Vortex Type Flow Meter.
 - 2.1.6 Anemometer
- 2.2 Mass Flow Measurement:-
 - 2.2.1 Coriolis Mass Flowmeter.
 - 2.2.2 Impact Type Mass Flowmeter.
- 2.3 Positive Displacement Flowmeter.
- 2.4 Open Channel Flow Measurement Technique.

3. Basic Pressure Measurement Techniques

- 3.1 Manometer:
 - 3.1.1 U Tube Manometer
 - 3.1.2 Barometer
 - 3.1.3 Inclined Manometer
 - 3.1.4 Well Type Manometer.
- 3.2 Elastic Pressure Transducers:
 - 3.2.1 Bourdon Tube: C-Type Bourdon Gauge
 - 3.2.2 Diaphragm.
 - 3.2.3 Bellow Type.
- 3.3 Force Balance Type: Dead Weight Tester

4. Miscellaneous Pressure Measurement

- 4.1 Electrical Type Pressure Measurement Technique:
 - 4.1.1 Strain Gauge Pressure Transducer.
 - 4.1.2 Potentiometric Pressure Transducer.
 - 4.1.3 Capacitive Pressure Transducer.
 - 4.1.4 LVDT Type Pressure Transducer.
- 4.2 Measurement of Vacuum:
 - 4.2.1 Pirani Gauge.
 - 4.2.2 Capsule Gauge.
 - 4.2.3 Mcleod Gauge.
 - 4.2.4 Thermal Conductivity Gauge.

Reference Books:

1. Industrial Instrumentation and Control; S. K. Singh; TMH.
2. Introduction to Instrumentation and Measurement; A. K. Ghosh; PHI.
3. Instrumentation Measurement and Analysis; B. C. Nakra and K. K. Chaudhary; TMH.
4. Industrial Instrumentation; Umesh Rathore; S. K. Kataria.
5. Industrial Instrumentation; K. Krishnaswamy; New Age Publication.
6. Measurement, Instrumentation & Sensors; John G. Webster; Springer.

Course Outcome:

After the end of the course the students are expected to learn :

CO-1: About various field instruments used for the measurement of flow.

CO-2: About various field instruments used for the measurement of pressure.

CO-3: About primary sensing & secondary transduction techniques for process parameter measurement.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	16	15
2	20	20
3	12	10
4	16	15
Total	64	60

Course Code	:	IEPC303
Course Title	:	Industrial Instrumentation-II Lab
Numbers of Credits	:	1 (L: 0, DCS: 0, P:2)
Prerequisites	:	IEPC210 (Industrial Instrumentation-I Lab)
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Instrumentation employed in Industry for the measurement of Pressure & Flow.

List of Practicals:

Sr. No.	Practicals
1	To observe the working of Rotameter (Variable Area Flowmeter) for any fluid flow.
2	To observe & measure Flow Rate using Turbine Type Flow Meter.
3	To study Bourdon Tube type Pressure Gauge and identify its parts.
4	To study the construction of Dead Weight Tester& its use in calibration of field instrument.
5	To study about Positive Displacement Type Flow meter.
6	To study different Manometers.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify pressure & flow measuring instruments.

CO-2: To select field instruments based on particular requirement.

CO-3: To understand the application of Dead Weight Tester in Calibration.

Course Code	:	IEPC305
Course Title	:	Process Control-II
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	IEPC206 (Process Control-I)
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Understand Process Control Applications & Process Control Components.

Course Content

1. Controller Tuning:

- 1.1 Selection of Control Mode.
- 1.2 Criteria for Good Control: ISE, IAE and ITAE.
- 1.3 Process Reaction Curve (Cohen Coon Method).
- 1.4 Ziegler-Nichols Method.

2. Process Control Components:

- 2.1 Introduction to Elements of the Final Control- Signal Conversion Elements, Actuators & Control Elements.
- 2.2 Electromechanical Relay
- 2.3 Pneumatic Flapper Nozzle System & its Application as I/P Converter.
- 2.4 Pneumatic Relays
- 2.5 Solenoid Coil
- 2.6 Pneumatic Cylinder- Single & Double Acting.

3. Control Valve:

- 3.1 Introduction to Control Valve.
- 3.2 Control Valve Construction.
- 3.3 Valve Sizing.
- 3.4 Control Valve Characteristics:
 - 3.4.1 Equal Percentage Valve
 - 3.4.2 Quick Opening Valve
 - 3.4.3 Linear Valve
- 3.5 Valve Positioner.
- 3.6 Basic Selection Criteria for Control Valves.

4. Hydraulic-Pneumatic-Electronic Controllers:

- 4.1 Introduction to Hydraulic-Pneumatic-Electronic Controllers.

- 4.2 Comparison of Hydraulic & Pneumatic Systems.
- 4.3 Concept of Hydraulic Proportional Controller
- 4.4 Concept of Pneumatic Proportional Controller
- 4.5 Concept of Electronic Proportional Controller

5. Miscellaneous Topics of Process Control:

- 5.1 Some Basic Examples of Process Control Systems:- Heat Exchanger, Stirrer Tank & Liquid Level Control etc
- 5.2 Control Objectives- Safety, Environmental Protection, Equipment Protection, Smooth Plant Operation, Product Quality, Profit Optimization, Monitoring & Diagnosis.
- 5.3 Benefits of Process Control Systems
- 5.4 Process Control Laws
- 5.5 Basic Idea of Levels of Process Control Systems.

Reference Books:

- 1. Process Control Instrumentation Technology; Curtis D. Johnson; Pearson Education
- 2. Process Control Principles and Applications; Surekha Bhanot; Oxford
- 3. Process System Analysis and Control; Donald R. Coughanowr; McGraw-Hill
- 4. Chemical Process Control; George Stephanopoulos; PHI
- 5. PID Controllers: Theory, Design and Tuning; Karl J. Aström and Tore Hägglund; Instrument Society of America
- 6. Instrument Engineer's Handbook; Bela G Liptak; CRC Press.

Course Outcome:

After the end of the course the students are expected to learn:

CO-1: To identify different industrial controller.

CO-2: To purpose suitable controller tuning technique.

CO-3: To identify different components of pneumatic and hydraulic controllers.

CO-4: To follow the suitable control objectives.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	12	10
2	14	15
3	14	15
4	12	10
5	12	10
Total	64	60

Course Code	:	IEPC307
Course Title	:	Process Control-II Lab
Numbers of Credits	:	1 (L: 0, DCS: 0, P: 2)
Prerequisites	:	IEPC212 (Process Control-I Lab)
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Process Control Terminology & implementation of process control.
- Process Control Components & their application.

List of Practical's:

Sr. No.	Practicals
1	To familiarize with NO-COM-NC contacts of a Relay and observe its working
2	To familiarize with various process control components – Solenoid Coil, Limit Switch, Single Acting Pneumatic Cylinder & Double Acting Pneumatic Cylinder and observe their working on the application of pneumatic air supply.
3	To observe linear relationship between analog input (4-20 mA) & pneumatic output (3-15 PSI) of an I/P Converter.
4	To study & observe important components of process control system like Sensors, I/P Converter, Control Valve.
5	To operate any temperature control system & observe the functioning of controller, final control element & feedback element.
6	To operate any Pressure or Flow or Temperature or Mixed Control Loop.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify various process control components.

CO-2: To understand the concept of 3-15 psi & 4-20mA DC signal.

CO-3: To identify process control loop.

Course Code	:	IEPE301-I
Course Title	:	Applied Instrumentation & Utilities
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Selection of a particular instrument for unique need in industry.
- Basic Plant Utilities.
- Concept of Erection & Maintenance.

Course Content

1. Basic Fundamentals

- 1.1 Need of Instrumentation
- 1.2 Advantage of Instrumentation & Plant Automation
- 1.3 Role of an Instrumentation Engineer In Industry
- 1.4 P&ID / Instrumentation Symbols.
- 1.5 Basic P&ID Diagrams- Pressure/Level/Temperature/Flow Control Loop.

2. Selection of Instruments

- 2.1 Selection Criteria for Instruments as per requirement for Measurement of:-
 - 2.1.1 Pressure
 - 2.1.2 Level
 - 2.1.3 Flow
 - 2.1.4 Temperature
 - 2.1.5 pH
 - 2.1.6 Speed

3. Instrumentation In Plant Utilities

Instrumentation used in following utilities in plant:-

- 3.1 Boiler (Steam Generator)
- 3.2 Water Treatment Plant (for DM Water or RO Water)
- 3.3 Air Compressor and Air Distribution System (for Compressed Air)
- 3.4 Fuel Storage and Forwarding System for Boiler Operation.
- 3.5 HVAC and Chiller System for Centralized AC System.

4. Erection & Commissioning of Instruments

- 4.1 Introduction to Erection & Commissioning

- 4.2 Pre Requirements for Erection/Installation
- 4.3 Pre Requirement for Commissioning
- 4.4 Study of Hook Up Drawing, P&ID and Control Write Up.
- 4.5 Loop Checking
- 4.6 Concept of Instrument Earth & Power Earth
- 4.7 Need of Calibration of Instruments
- 4.8 Check Points for First Start Up.
- 4.9 Task of Commissioning Engineer at Site.

5. Maintenance of Instruments

- 5.1 Objectives of Maintenance
- 5.2 Types of maintenance: Planned and Unplanned Maintenance
 - 5.2.1 Breakdown Maintenance
 - 5.2.2 Preventive maintenance - Periodic Maintenance (Time based maintenance) & Predictive maintenance (Condition based maintenance)
 - 5.2.3 Comparison between preventive and breakdown maintenance; planned and unplanned maintenance
- 5.3 Standard Apparatus Used for Calibration: Dead Weight Tester for Pressure Measuring Instruments, Constant Temp. Bath for Temperature Measuring Instruments.
- 5.4 Important Points to be Considered for Maintenance of Various Field Instruments:- like Pressure Gauges, Pressure Transmitter, Temp. Indicators, RTD, Thermocouple, Level Gauges, Level Transmitter & Flow Transmitters.

Reference Books:

1. Instrument Engineer's Handbook; Bela G. Liptak
2. Process Control Instrumentation Technology; Curtis D. Johnson; Pearson
3. Process Control –Principles & Applications; Surekha Bhanot; Oxford University Press
4. Industrial Machinery Repair: Best Maintenance Practices Pocket Guide; Ricky Smith, R. Keith Mobley; Butterworth-Heinemann Publications

Course Outcome:

After the end of the course the students are expected to learn :

- CO-1: To understand the P&ID diagram of industrial processes.
- CO-2: To purpose suitable instruments for measuring process parameter.
- CO-3: To identify the components of certain industry specific plants.
- CO-4: To follow suitable steps for industrial plant erection and commissioning.
- CO-5: To identify the suitable maintenance techniques of an industrial plant.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	10	10
2	15	15
3	15	15
4	12	10
5	12	10
Total	64	60

Course Code	:	IEPE303-I
Course Title	:	Applied Instrumentation & Utilities Lab
Numbers of Credits	:	1 (L: 0, DCS: 0, P:2)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Selection of a particular instrument for unique need in industry.
- Basic Plant Utilities.
- Concept of Erection & Maintenance.

List of Practicals:

Sr. No.	Practicals
1	To prepare chart to tabulate various P&ID symbols.
2	To prepare chart for any Pressure Control Loop.
3	To prepare chart for any Level Control Loop.
4	To prepare chart for any Flow Control Loop.
5	To prepare chart for any Temperature Control Loop.
6	To interface any Process Control System with PC through any communication medium and to observe is working for any temperature or pressure or flow or level control loop.
7	To operate pneumatic type process control components through compressed air.
8	To study the Concept of Calibration.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: The selection of a particular instrument for unique need in industry.

CO-2: To understand various process control loops & concept of calibration.

CO-3: The concept of operation of process control components.

Course Code	:	IEPE301-II
Course Title	:	Industrial Electronics
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Power Electronics and Control.

Course Content

1. Power Semiconductor devices:

- 1.1 Thyristor: Construction, Operation, Symbol and V-I characteristics of SCR
- 1.2 Thyristor Specifications and Ratings: Voltage Rating, Current Rating, Turn on and Turn off time
- 1.3 Thyristor Turn On (triggering) Methods: Voltage Triggering, Gate Triggering, dv/dt Triggering and Radiation Triggering.
- 1.4 Thyristor Commutation techniques (Natural and Forced)
- 1.5 Thyristor family: TRIAC, DIAC, UJT
- 1.6 Heat sinks: Function/ need of Heat Sink, Types of heat sinks

2. AC-DC Converters (Controlled Rectifiers)

- 2.1 Difference between uncontrolled rectifier & controlled rectifier
- 2.2 Single Phase Fully Controller Half Wave Converter/Rectifier
 - a) With Resistive Load
 - b) With Resistive -Inductive Load
 - c) With Resistive-Inductive Load and freewheeling diode
- 2.3 Single Phase Fully Controller Full Wave Converter/ Rectifier
 - a) With Resistive Load
 - b) With Resistive-Inductive Load
 - c) With Resistive-Inductive Load and freewheeling diode.

3. AC-AC Converters (Cyclo-converters)

- 3.1 Introduction to cyclo-converters
- 3.2 Working Principle and applications of single phase step-down cyclo-converter
- 3.3 Working Principle and applications of single phase step-up cyclo-converter

4. DC-AC Converter (Inverter):

- 4.1 Introduction to inverter
- 4.2 Series Inverter:
 - a) Operation of Series Inverter
- 4.3 Parallel Inverter:
 - a) Operation of Parallel Inverter
- 4.4 Single Phase Inverter:
 - a) Half Bridge Inverter
 - b) Full Bridge Inverter

5. DC-DC Converter (Choppers):

- 5.1 Introduction to Chopper -Step Up & Step Down Chopper.
- 5.2 Concept of duty cycle of chopper.
- 5.3 Classifications of choppers:
 - Class-A, Class-B, Class-C, Class-D & Class-E

Reference Books:

1. Power Electronics; PS Bhimbra; Khanna Publications
2. Power Electronics Circuits, Devices & Applications; Mohd. H. Rashid; Pearson
3. Industrial Electronics; Sunil Kumar; SK Kataria Publication.

Course Outcome:

After the end of the course the students are expected to learn :

CO-1: To identify the components of industrial control board.

CO-2: To understand the Operation of basic Converters (i.e. AC-AC & DC- DC).

CO-3: To identify the components of basic inverters.

CO-4: To select a suitable Chopper for specific application.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	18	20
2	12	10
3	10	10
4	12	10
5	12	10
Total	64	60

Course Code	:	IEPE303-II
Course Title	:	Industrial Electronics Lab
Numbers of Credits	:	1 (L: 0, DCS: 0 , P:2)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Power Electronics and Control.

List of Practicals:

Sr. No.	Practicals
1	To identify the terminals of an SCR and plot the V-I Characteristics of it.
2	To observe input and output waveforms in Half wave Fully Controlled Rectifier Circuit
3	To observe input and output waveforms in Full Wave Fully Controlled Rectifier Circuit.
4	To observe input and output waveforms in Series Inverter Circuit
5	To observe input and output waveforms in Chopper Circuit.
6	To observe input and output waveforms in Cyclo-converter circuit.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: The selection of a particular SCR out of Thyristor Family.

CO-2: To understand the use of controller rectifier circuit.

CO-3: The concept of Inverter, Chopper & Cycloconverter.

Course Code	:	IEPE305-I
Course Title	:	Biomedical Instrumentation
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Instrumentation in Medical Electronics/ Biomedical Engineering.

Course Content

1. Introduction to Biomedical Instrumentation:

- 1.1 Sources/Origin of Bio-Medical/Bio-Electric Signals.
- 1.2 Generalized Block Diagram of Biomedical Instrumentation System.
- 1.3 Various Types of Bio-Medical Electrodes.
- 1.4 Basics of Pulse Rate Measurement.
- 1.5 Blood Pressure Measurement using Sphygmomanometer & Stethoscope.
- 1.6 Basic Concept of Telemedicine Technology & its Applications.
- 1.7 Role of Engineers in Healthcare Facilities.

2. Electrocardiography:

- 2.1 Introduction to ECG & ECG Signal.
- 2.2 ECG Machine Block Diagram.
- 2.3 ECG Record Analysis.
- 2.4 Applications.

3. Electromyography:

- 3.1 Introduction to EMG & EMG Signal.
- 3.2 EMG System Block Diagram
- 3.3 Applications.

4. Electroencephalography:

- 4.1 Introduction to EEG & EEG Signal.
- 4.2 EEG Machine Block Diagram
- 4.3 Applications.

5. Miscellaneous Medical Equipments:

- 5.1 CT Scan: CT Scanner Principle, Block Diagram, Working & Applications.
- 5.2 Pacemakers: Principle of Operation & Need of Pacemakers & Different Types of Pacemakers.
- 5.3 Defibrillators: Principle of Operation & Need of Defibrillators & Different Types of Defibrillators.
- 5.4 Pulse Oximeter.

Reference Books:

1. Handbook of Biomedical; R.S. Khandpur; Tata McGraw Hill
2. Introduction to Medical electronics; Mandeep Singh; PHI

Course Outcome:

After the end of the course the students are expected to learn:

CO-1: To identify the components of specific biomedical instruments.

CO-2: To select a suitable spectroscopic technique among different available technique for a specific application.

CO-3: To identify the components of ECG, EMG, EEG, CT-Scan machines.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	16	15
2	14	15
3	11	10
4	11	10
5	12	10
Total	64	60

Course Code	:	IEPE307-I
Course Title	:	Biomedical Instrumentation Lab
Numbers of Credits	:	1 (L: 0, DCS: 0, P:2)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Instrumentation in Medical Electronics/ Biomedical Engineering.

List of Practicals:

Sr. No.	Practicals
1	To observe the concept of blood pressure measurement using Sphygmomanometer & Stethoscope.
2	To measure the Heart Rate using ECG cum Heart Rate Monitor Trainer.
3	To study ECG & to observe the working of ECG Machine/Trainer.
4	To analyse ECG recorded on ECG Machine.
5	To study EMG & to observe the working of EMG Machine/Trainer.
6	To study EEG & to observe the working of EEG Trainer.
7	To observe the working of Pulse Oximeter & to measure the oxygen level using it.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: The selection of Biomedical Instruments.

CO-2: To understand various Biomedical Instruments.

CO-3: The concept of ECG, EEG & EMG.

Course Code	:	IEPE305-II
Course Title	:	Virtual Instrumentation
Numbers of Credits	:	2 (L: 2, DCS: 2, P: 0)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Computer Based Instrumentation using LabVIEW.
- Virtual Instrumentation.

Course Content

1. Introduction to Virtual Instrumentation

- 1.1 Basics of Virtual Instrumentation.
- 1.2 Comparison of Traditional Instrument with Virtual Instrument.
- 1.3 Comparison of Graphical Programming with Textual Programming.
- 1.4 Various Applications of Virtual Instrumentation.

2. Introduction to LabVIEW

- 2.1 Introduction to LabVIEW
- 2.2 Advantages of LabVIEW
- 2.3 Software Environment in LabVIEW- Front Panel & Block Diagram Window.
- 2.4 Front Panel Window-
 - 2.4.1 Front Panel-Controls Palette (Controls & Indicators).
 - 2.4.2 Front Panel-Toolbar
- 2.5 Block Diagram Window-
 - 2.5.1 Block Diagram-Functions Palette.
 - 2.5.2 Terminals & Nodes
 - 2.5.3 Functions
 - 2.5.4 Wires
- 2.6 Data Types in LabVIEW & Colours Associated with them- Boolean, Numeric (Floating Point & Integer), String Data Type.

3. Data Flow Programming

- 3.1 Introduction to Data Flow Programming.
- 3.2 Creating and Saving a Virtual Instrument (VI).
- 3.3 Creating a Sub-VI from a Section of VI.
- 3.4 Concept of Icon & Connector Pane.
- 3.5 Design a Virtual Instrument for following simple problems:-
 - 3.5.1 Addition, Division, Multiplication & Division of Two Numbers.

- 3.5.2 Convert Temperature from Deg C to Deg F
- 3.5.3 Perform Boolean Operation – AND, OR, NAND, NOR Gate.

4. Repetition/ Loops and Arrays in LabVIEW

- 4.1 Introduction to Repetition/Loops.
- 4.2 FOR Loop
- 4.3 WHILE Loops
- 4.4 Need of Time Delay in Loops
- 4.5 Arrays in LabVIEW:-
 - 4.5.1 1-D Array
 - 4.5.2 2-D Array
- 4.6 Designing a Virtual Instrument for some simple problems on Loops and Arrays:-
 - 4.6.1 To Count n Numbers using FOR Loop.
 - 4.6.2 To Count n Numbers using WHILE Loop (Continue if True & Stop if True- Both)
 - 4.6.3 To Find Factorial of a Number using FOR Loop & Shift Register.
 - 4.6.4 To create 1-D Array to display any data.
 - 4.6.5 To create 2-D (n*m) Array to display any data.

5. Structures and Plotting Data in LabVIEW

- 5.1 Waveform Graphs
- 5.2 Waveform Charts- Strip, Scope and Sweep Chart.
- 5.3 Introduction to Structures:-
 - 5.3.1 Case Structure
 - 5.3.2 Sequence Structure
- 5.4 Formula Node
- 5.5 Designing a Virtual Instrument for some simple problems on Graphs/Charts, Structures and Formula Node:-
 - 5.5.1 To plot any data on Waveform Graph & Waveform Chart.
 - 5.5.2 To perform Addition, Subtraction, Multiplication & Division using Case Structure.
 - 5.5.3 To plot Sinusoidal Wave using Loop, Formula Node & Waveform Graph.

Reference Books:

1. Virtual Instrumentation Using Labview; Jovitha Jerome; PHI Publications
2. Virtual Instrumentation using Labview; Sanjay Gupta; Tata Mc-Graw Hill
3. LabView for Everyone; Lisa K. Well & Jeffery Travis; Prentice Hall

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the various components of Virtual Instrumentation system (i.e. LabVIEW)

CO-2: To purpose LabVIEW program (i.e. VI) for small applications

CO-3: To understand the different functional blocks/ items of the LabVIEW

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	10	10
2	13	10
3	13	10
4	14	15
5	14	15
Total	64	60

Course Code	:	IEPE307-II
Course Title	:	Virtual Instrumentation Lab
Numbers of Credits	:	1 (L: 0, DCS: 0, P: 2)
Prerequisites	:	Nil
Course Category	:	Program Elective Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Role of LabVIEW in Computer Based Instrumentation.
- Development of Virtual Instrument/Programs using LabVIEW for various applications.

List of Practicals:

Sr. No.	Practicals
1	Familiarization with LabVIEW Software working environment (i.e its Front Panel, Block Panel, and various features).
2	Design a VI to perform basic mathematical function on two numbers (i.e. addition, subtraction, multiplication & division).
3	Design a VI to demonstrate Loop operation using FOR Loop.
4	Design a VI to demonstrate Loop operation using WHILE Loop.
5	Design a VI to demonstrate array operation using one/two dimensional array.
6	Design a VI to demonstrate case structure operation.
7	Design a VI to use different types of Waveform Charts (Sweep, Scope & Strip Chart) available in the LabVIEW environment.
8	Design a VI to plot Sinusoidal Wave using Loop, Formula Node & Waveform Graph.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: The selection of various controls/functions/objects/tools in LabVIEW Software.

CO-2: To understand the development of virtual instruments in LabVIEW.

CO-3: The concept of computer based instrumentation.

Course Code	:	SI-II
Course Title	:	Internship-II
Numbers of Credits	:	3 (L: 0, DCS: 0, P: 0)
Prerequisites	:	Nil
Course Category	:	SI (Internship)

Guidelines

An internship of Six weeks after 4th semester during vacations should be undertaken by the students in relevant Industry. The objective of this mandatory internship is to expose the students to the real world of work and get experience with the latest tools, best practices, work & culture, etiquettes and ethics followed in modern industries. The assessment of internship will be carried out in 5th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Course Outcomes:

After completing this course the students will be able to:

CO-1: Get firsthand experience of the culture and practices of real world of work.

CO-2: Appreciate time management, teamwork, adaptability and project management.

CO-3: Improve skills, confidence, competency in specific area of career interests.

CO-4: Able to earn a job reference for their behavior and performance in real projects.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 5th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after

completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behaviour :20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor: 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

Course Code	:	PR301
Course Title	:	Major Project
Numbers of Credits	:	1 (L: 0, DCS: 2, P: 2)
Prerequisites	:	Nil
Course Category	:	Project

Course Learning Objectives:

Project work inculcates skills like problem-solving, creative thinking, time-management, planning, teamwork, leadership, presentation, report-writing, communication etc. The objective of this course is to encourage the students to solve some real problem of some organization or start on their own startup ideas and transform it into reality by the time they complete their diploma programme.

Course Outcomes:

After completing this course the students will be able to :

CO-1. Apply basic software engineering processes in developing a complete project.

CO-2. Conceive, incubate and present a potential startup idea.

CO-3. Design, develop, test and implement a complete project.

CO-4. Present the work carried out in the project in front of reviewers.

Guidelines for Major Project:

1. Major projects should be based on real/ live problems of the Industry/ Govt./ NGO/ MSME/ Rural Sector or an innovative idea having the potential of a Startup. Main objective of the major project is to provide the students with an opportunity to develop a complete project by applying the principles of Software Engineering, Project Management and the industrial experience gained during their internships.

2. The major project is spread across a period of two semesters giving students ample time to realize a complete project with documentation or transform their ideas of startups into reality. The requirement analysis and designing part of the project must be completed in the 5th semester.

3. The students may be provided support in preparing project proposals, startup incubation and awareness about various government initiatives to promote startups. At

least one expert lecture on the concepts of startup and government initiatives to promote startups must be arranged in this semester.

4. The project guide must help students to identify their major project works and make use of project management best practices in execution of project activities.

5. A project work may be carried out by a team of 3 to 5 students with a well-defined role of each student within the team

Suggested Distribution of Marks:

1. Internal Assessment-

Sr. No.	Project Component	Marks Allotted
1	Synopsis and Project Title Selection	08
2	Initiative in Performing Project Tasks	12
3	Attendance and Punctuality	08
4	Outcome of the Completed Stages of the Project	12
Total		40

2. External Assessment-

Sr. No.	Project Component	Marks Allotted
1	Project Demonstration	24
2	Project Presentation	24
3	Viva	12
Total		60

DETAILED CONTENTS
FOR
THIRD YEAR
(6th Semester)

Course Code	:	IEPC302
Course Title	:	Logic Controllers & Distributed Control System
Numbers of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	Nil
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Logic Controller, its Programming & applications.
- Supervisory Control and Data Acquisition.
- Distributed Control System.

Course Content

1. Basics of PLC:

- 1.1 Basic Concept of Relay
- 1.2 Limitations of Relay Based Logic Circuits
- 1.3 Introduction to Programmable Logic Controller
- 1.4 Advantages of PLC Over Relay Wired System
- 1.5 Areas of Application of PLC
- 1.6 Name of Some PLC Manufacturers

2. Programmable Logic Controllers:

- 2.1 Block Diagram of PLC
- 2.2 Classification of PLC:
Unitary (Shoe Box Type) & Modular (Rack Type)
- 2.3 Basic Parts/Components of PLC
- 2.4 Operation of PLC
- 2.5 I/O Modules- AI, AO, DI & DO
- 2.6 Power Supply Requirement
- 2.7 Memories in PLC

3. Programming of PLC:

- 3.1 Introduction to Various Programming Languages Used in PLC Programming.
- 3.2 Description of Ladder Logic Programming of PLC:
 - 3.2.1 Concept of Rung & Power Lines
 - 3.2.2 Symbols used in PLC Programming for NO Input, NC Input, Output Coil etc.
 - 3.2.3 Basic Instructions Used in Ladder Logic Programming:-
 - 3.2.3.1 Bit Instructions- Examine If Closed, Examine IF Open, Output Energize, Output Latch, Output Unlatch & One Shot.

- 3.2.3.2 Timer Instructions- On Delay Timer, Off Delay Timer & Retentive Timer On
- 3.2.3.3 Counter Instructions- Up Counter, Down Counter & Reset.
- 3.2.3.4 Comparison Instructions- Equal, Not Equal, Greater Than, Greater Than Equal, Less Than, Less Than Equal & Limit.
- 3.3 Basic Concept of Implementation of Latch & Unlatch in Rung of any Ladder Diagram.

4. Ladder Logic Programming:

Design a Ladder Logic Program for following processes after writing general description- Schematic Diagram, I/O Assumptions, I/O Tag Allocation & Ladder Logic Program with Detailed Description:-

- 4.1 Door Bell Operation
- 4.2 Switching On/Off Light
- 4.3 Seven Segment Display
- 4.4 Star-Delta Starter
- 4.5 Oven Control
- 4.6 Tank Level Control
- 4.7 Bottling Plant
- 4.8 Traffic Light Control
- 4.9 Elevator Control

5. SCADA & DCS:

- 5.1 Benefits of SCADA
- 5.2 SCADA- Hardware & Software
- 5.3 Functions of SCADA System
- 5.4 Applications of SCADA
- 5.5 Introduction to DCS
- 5.6 Hierarchical DCS Structure
- 5.7 Elements of DCS
- 5.8 Advantages & Disadvantages of DCS
- 5.9 Applications of DCS.
- 5.10 Comparison of PLC with DCS.

Reference Books:

1. Programmable Logic Controller; Vijay R. Jadhav; Khana Publishers.
2. Programmable Logic Controllers & Industrial Automation; M.Mitra& SS Gupta; Penram International
3. PLC & SCADA; Rajesh Mehra; University Science Press
4. Process Control; Surekha Bhanot; Oxford.
5. Process Control Instrumentation Technology; Curtis D. Johnson; Pearson

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the different components of the PLC and SCADA.

CO-2: To understand basics of PLC programming (i.e. Ladder Language).

CO-3: To purpose ladder program for small industrial applications.

CO-4: To identify the components of DCS.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	08	10
2	12	10
3	16	15
4	16	15
5	12	10
Total	64	60

Course Code	:	IEPC304
Course Title	:	Logic Controllers & Distributed Control System Lab
Numbers of Credits	:	1 (L: 0, DCS: 0 , P:2)
Prerequisites	:	Nil
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Logic Controller, its Programming & applications.
- Supervisory Control and Data Acquisition.
- Distributed Control System.

List of Practicals:

Sr. No.	Practicals
1	To simulate PLC Program for Door Bell Operation & Switching On/Off of Lights.
2	To simulate PLC Program for 7-Segment Display.
3	To simulate PLC Program for Star-Delta Starter.
4	To simulate PLC Program for Oven Control.
5	To simulate PLC Program for Tank Level Control.
6	To simulate PLC Program for Bottling Plant.
7	To simulate PLC Program for Traffic Light Control.
8	To simulate PLC Program for Elevator Control.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: The selection of hardware & software in PLC Based automation.

CO-2: To understand about PLC ladder logic programs.

CO-3: About various PLC applications in industries.

Course Code	:	IEPC306
Course Title	:	Automation, Utilities & its Applications
Numbers of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	Basic knowledge of Digital Electronics/ Microprocessors/ Industrial Instrumentation/ Process Control
Course Category	:	Program Core Course

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Automation & its components.
- Robotics.
- Industry 4.0

Course Content

1. Introduction to Automation:

- 1.1 Basic Concept of Automation
- 1.2 Advantages of Automation
- 1.3 Limitations of Automation
- 1.4 Aim of Automation
- 1.5 Types of Automation or Areas of Automation
- 1.6 Basic Components or Elements of industrial Automation

2. Servo & Stepper Motors:

- 2.1 Introduction to Servo Motor
- 2.2 Basic Concept of Servomechanism.
- 2.3 Basics of Servo Motor Control
- 2.4 Applications of Servo Motors.
- 2.5 Basic Working Principle of Stepper Motor
- 2.6 Applications of Stepper Motors.

3. Electric Drives:

- 3.1 Introduction to Electric Drives.
- 3.2 Features of AC Drives
- 3.3 Concept of Variable Frequency Drive (VFD)
- 3.4 Need of VFD
- 3.5 VFD Types
- 3.6 Generalized VFD System (Block Diagram of VFD)
- 3.7 Basic Front Panel Controls of VFD
- 3.8 Typical Wiring Diagram of VFD
- 3.9 Operation of VFD through PLC

3.10 Applications of VFD

4. Robotics:

- 4.1 Concept to Robotics
- 4.2 Functions of Robot
- 4.3 Advantages & Disadvantages of Robot
- 4.4 Basic Elements of a Robot
- 4.5 Applications of Robotics

5. Industry 4.0:

- 5.1 Introduction of Industry 4.0
- 5.2 Role of Industry 4.0 in Digital Manufacturing
- 5.3 Advantages of Industry 4.0
- 5.4 Industry 4.0 Technologies
- 5.5 Concept of Smart Factories

Reference Books:

1. Advanced Industrial Automation & its Applications; Ravindra Sharma; Trinity Publishers.
2. Robotics & Industrial Automation; R.K. Rajput; S. Chand Publishers
3. Programmable Logic Controller; Vijay R. Jadhav; Khanna Publishers

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To understand the classical and latest Industry 4.0 model of industrial automation.

CO-2: To identify the components of Electric Drives.

CO-3: To identify the components of robotics.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	10	10
2	11	10
3	18	15
4	15	15
5	10	10
Total	64	60

Course Code	:	HS302
Course Title	:	Entrepreneurship and Start-ups
Numbers of Credits	:	4 (L: 4, DCS: 0, P: 0)
Prerequisites	:	None
Course Category	:	HS

Course Objectives:

The aim of this course is to help the student to attain the following:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

Course Content

1. Introduction to Entrepreneurship and Start-ups:

- 1.1 Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation.
- 1.2 Types of Business Structures, Similarities/differences between entrepreneurs and managers.

2. Business Ideas and their implementation:

- 2.1 Discovering ideas and visualizing the business.
- 2.2 Activity map.
- 2.3 Business Plan

3. Idea to Start-up:

- 3.1 Market Analysis – Identifying the target market.
- 3.2 Competition evaluation and Strategy Development.
- 3.3 Marketing and accounting.
- 3.4 Risk analysis

4. Management:

- 4.1 Company's Organization Structure.
- 4.2 Recruitment and management of talent.
- 4.3 Financial organization and management

5. Financing and Protection of Ideas:

- 5.1 Financing methods available for start-ups in India

5.2 Communication of Ideas to potential investors – Investor Pitch

5.3 Patenting and Licenses

6. Exit Strategies:

6.1 Exit strategies for Entrepreneurs

6.2 Bankruptcy

6.3 Succession and Harvesting Strategy

Reference Books :

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company by Steve Blank and Bob Dorf, K & S Ranch, ISBN – 978-0984999392
2. The Lean Startup: How Today's Entrepreneurs use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Penguin UK, ISBN - 978-0670921607
3. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky, Headline Book Publishing, ISBN – 978-0755388974
4. The Innovator's Dilemma: The Revolutionary Book that will Change the Way You do Business by C.M. Christensen, Harvard business, ISBN: 978-142219602

Suggested Software / Learning Website:

- a. <https://www.fundable.com/learn/resources/guides/startup>
- b. <https://corporatefinanceinstitute.com/resources/accounting/corporate-structure/>
- c. <https://www.finder.com/small-business-finance-tips>
- d. <https://profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

Course Outcome:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

CO-1. Understanding the dynamic role of entrepreneurship and small businesses.

CO-2. Organizing and Managing a Small Business.

CO-3. Financial Planning and Control.

CO-4. Forms of Ownership for Small Business.

CO-5. Strategic Marketing Planning.

CO-6. New Product or Service Development.

CO-7. Business Plan Creation.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	12	9
2	10	9
3	12	12
4	12	10
5	10	12
6	08	8
Total	64	60

Course Code	:	AU302
Course Title	:	Indian Constitution
Numbers of Credits	:	0 (L: 2, DCS: 0, P: 0)
Prerequisites	:	Nil
Course Category	:	Audit Course

Course Objectives:

The aim of this course is to help the student to attain the following :

1. To realize the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
2. To identify the importance of fundamental rights as well as fundamental duties.
3. To understand the functioning of Union, State and Local Governments in Indian federal system.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedures.

Course Content

Unit 1 – The Constitution – Introduction

- 1.1 History of making of the Indian Constitution.
- 1.2 Meaning and importance of the Constitution.
- 1.3 Salient features and Preamble of Indian Constitution.
- 1.4 Fundamental rights- meaning and limitations.
- 1.5 Directive principles of state policy and Fundamental duties -their enforcement & their relevance.

Unit 2 – Union Government

- 2.1 Structure of Union Government.
- 2.2 Union Executive - President, Vice-president, Prime Minister, Council of Ministers.
- 2.3 Union Legislature- Parliament and Parliamentary proceedings.
- 2.4 Union Judiciary-Supreme Court of India – composition and powers and function.

Unit 3 – State & Local Governments

- 3.1 Structure of State Government.
- 3.2 State Executive- Governor, Chief Minister, Council of Ministers.
- 3.3 State Legislature- State Legislative Assembly and State Legislative Council.
- 3.4 State Judiciary- High Court.
- 3.5 Local Government- Panchayat Raj System with Special Reference to 73rd and Urban Local Self Government with Special Reference to 74th Amendment.

Unit 4 – Election Provisions, Emergency Provisions, Amendment of the Constitution

4.1 Election Commission of India-composition, powers and functions and electoral process.

4.2 Types of emergency-grounds, procedure, duration and effects.

4.3 Amendment of the constitution- meaning, procedure and limitations

Reference Books:

1. Introduction to the Constitution of India by M.V. Pylee, 4th Edition, Vikas publication, 2005.
2. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008.
3. The Constitution of India by B. L. Fadia, Sahitya Bhawan, New Edition, 2017.
4. Introduction to the constitution of India by Durga Das Basu, (Student Edition), 19th edition, Prentice-Hall EEE, 2008.

Course Outcome:

At the end of the course the student should be able to:

CO-1: Understand and explain the significance of Indian Constitution as the fundamental law of the land.

CO-2: Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.

CO-3: Analyze the Indian political system, the powers and functions of the Union, State and Local Governments in detail.

CO-4: Understand Electoral Process, Emergency provisions and Amendment procedure.

Suggested Distribution of Marks:

Topic /Unit No.	Time Allowed (In Hrs.)	Marks Allotted
1	08	15
2	08	15
3	10	21
4	06	09
Total	32	60

Course Code	:	PR302
Course Title	:	Major Project
Numbers of Credits	:	3 (L: 0, DCS: 2 , P:6)
Prerequisites	:	PR301 (Major Project)
Course Category	:	Project

Course Learning Objectives:

Project work inculcates skills like problem-solving, creative thinking, time management, planning, teamwork, leadership, presentation, report-writing, communication etc. The objective of this course is to encourage the students to solve some real problem of some organization or start on their own startup ideas and transform it into reality by the time they complete their diploma.

Course Outcomes:

After completing this course the students will be able to :

CO-1. Apply basic software engineering processes in developing a complete project.

CO-2. Conceive, incubate and present a potential startup idea.

CO-3. Design, develop, test and implement a complete project.

CO-4. Present the work carried out in the project in front of reviewers.

Guidelines for Major Project:

1. Major projects should be based on real/ live problems of the Industry/ Govt./ NGO/ MSME/ Rural Sector or an innovative idea having the potential of a Startup. Main objective of the major project is to provide the students with an opportunity to develop a complete project by applying the principles of Software Engineering, Project Management and the industrial experience gained during their internships.

2. The major project is spread across a period of two semesters giving students ample time to realize a complete project with documentation or transform their ideas of startups into reality. The requirement analysis and designing part of the project must have been completed in the 5th semester. The implementation, testing and documentation part of the project is to be carried out in the 6th semester.

3. The project guide must help students in selecting the appropriate tools and technologies for project implementation and the progress of the students must be monitored on a regular basis.

4. The students must properly document the project work as per the software engineering documentation standards. A project report has to be prepared by each student as per the standard format prescribed by the concerned department

Suggested Distribution of Marks:

1. Internal Assessment-

Sr. No.	Project Component	Marks Allotted
1	Initiative in Performing Project Tasks	12
2	Attendance and Punctuality	08
3	Final Outcome as per Project Objectives	12
4	Report Writing	08
Total		40

2. External Assessment -

Sr. No.	Project Component	Marks Allotted
1	Project Demonstration	24
2	Project Presentation	12
3	Project Report	12
4	Viva	12
Total		60

Course Code	:	SE302
Course Title	:	Seminar
Numbers of Credits	:	1 (L: 0, DCS: 0, P: 2)
Prerequisites	:	Nil
Course Category	:	Seminar

Course Learning Objectives:

1. To provide a platform for the students to share their ideas about some emerging topic in the field of information technology with their peers.
2. To improve the public speaking skills of the students.

Course Outcomes:

After completing this course the students will be able to :

CO-1. Prepare a presentation about the topic of their choice.

CO-2. Present their ideas/ thoughts to the audience.

CO-3. Demonstrate their skill in handling audience queries

Guidelines:

1. The students should be assigned emerging topics in the field of their interests for their seminars.
2. A seminar schedule should be prepared for the entire semester and conveyed to the students.
3. The students have to prepare at least 30 slides presentation for their seminar.
4. Each student has to individually present the seminar in front of his/ her classmates and faculty.
5. A proper arrangement for presentation may be done with a multimedia projector and a computer system.
6. A student may be allotted time of 15 minutes for presentation and 5 minutes for Q&A session.
7. The students in the audience may ask the questions on the seminar topic from the presenter after the seminar.

Suggested Distribution of Marks (Internal Assessment):

Sr. No.	Seminar Component	Marks (%)
1	Seminar Topic Relevance	10
2	Execution of Seminar	40
3	Quality of Presentation	10
4	Attendance and Punctuality	10
5	Exhibition of Public Speaking Skill	10
6	Adherence of Time	10
7	Engagement of Audience	10
Total		100

Guidelines w.r.t Massive Open Online Courses (MOOCs)

1. A student may opt for a MOOC mode course as open elective in 5th semester after due approval of the Principal as per the recommendations of respective Head of the Department.
2. The student opting for the open elective under MOOC shall apply for the same on the prescribed proforma and may take the course only after due recommendation from the concerned HOD and approval from the Principal of the institute.
3. The MOOC course/Subject opted by the student should preferably be offered by Swayam, IITBX, Spoken Tutorials, mookIT etc. of minimum 12 weeks duration carrying 3 credits.
4. The MOOC course opted by the student must have the provisions of continuous evaluation and examination at the end of the course.
5. The certificate issued by the MOOC provider, after successful completion of a MOOC Course/Subject clearly showing the result and credits earned is to be submitted by the student to the institute for further submission to Himachal Pradesh Takniki Shiksha Board Dharamshala well in time.
6. The details of credits earned and the marks obtained by the students are to be submitted by the institute to the Himachal Pradesh Takniki Shiksha Board Dharamshala. The credits and grades are to be reflected in the Detailed Marks Certificate (DMC) of 5th semester.

Guidelines w.r.t Open Elective

1. The students can opt only for that open elective course which is offered by other than their respective department.
2. Open Elective will be offered by each Department subject to the availability of the infrastructure, faculty and required relevant facilities.
3. The Courses/Subjects will be offered as per the criteria fixed by the Institution.
4. Institute shall ensure that Open Elective offered to the students should be such that he/she has not studied the same in earlier semester as open elective/core subjects.
5. The contents of open elective offered by different Departments/Branches are available with the curricula of respective Departments/Branches.

Annexure-B

OPEN ELECTIVES CURRICULUM

FOR

DIPLOMA PROGRAMME

3rd Year (5th & 6th Semester)

**FOR THE STATE OF HIMACHAL
PRADESH**



N-2022

Implemented w.e.f. Session 2022-23

Prepared by:-

Composite Curriculum Development Centre

Directorate of Technical Education,

Vocational & Industrial Training, Sundernagar (H.P.)

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OPEN ELECTIVE COURSES (OE)

Sr. No.	Name of Branch offers the Open Elective	Course Code	Name of Subject	Credit (3)			Semester
				L	P	DCS	
1.	Applied Science	ASOE301	Life Skills for Professional & Personal Life(LSPPL)	3	0	1	V
		ASOE303	Industrial Water Treatment	3	0	1	V
		ASOE302	Technical communication	3	0	1	VI
		ASOE304	Composites Science & Technology	3	0	1	VI
2.	Architecture Assistantship	AROE301	Vastu-Shastra	3	0	1	V
		AROE302	Architecture Photography	3	0	1	VI
		AROE304	Sustainable Development	3	0	1	VI
3.	Automobile Engineering	AEOE 301	Vehicular Systems	3	0	1	V
		AEOE 302	Automotive Pollution and Control	3	0	1	VI
		AEOE 304	Vehicle Body Engineering	3	0	1	VI
4.	Civil Engineering	CEOE301	Project Management	3	0	1	V
		CEOE302	Engineering Geology	3	0	1	VI
		CEOE304	Disaster Management	3	0	1	VI
5.	Computer Engineering	COOE301	Introduction to e - Governance	3	0	1	V
		COOE302	Introduction to E-Commerce	3	0	1	VI
		COOE304	Computer Hardware and Peripherals	3	0	1	VI
6.	Electrical Engineering	EEOE301	Illumination Practices	3	0	1	V
		EEOE302	Energy Efficiency And Audit	3	0	1	VI
		EEOE304	Electric Traction	3	0	1	VI
7.	Electrical and Electronics Engineering	EEEOE301	Powering Building: Strategies for Electrification	3	0	1	V
		EEEOE302	Nanotechnology	3	0	1	VI
		EEEOE304	Industrial Drives	3	0	1	VI
8.	Electronics and Communication Engineering	ECOE301	PLC & Automation	3	0	1	V
		ECOE302	Satellite and Cellular Communication	3	0	1	VI
		ECOE304	Optical Fibre Technology	3	0	1	VI
9.	Information Technology	ITOE301	Cyber Laws & Ethics	3	0	1	V
		ITOE302	Fundamentals of Blockchain Technology	3	0	1	VI
		ITOE304	Multimedia Applications	3	0	1	VI
10.	Instrumentation Engineering	IEOE301	Power Plant Instrumentation	3	0	1	V
		IEOE302	Automation Solution	3	0	1	VI
		IEOE304	Computer aided Instrumentation	3	0	1	VI
11.	Mechanical Engineering	MEOE301	Renewable Energy Technologies	3	0	1	V
		MEOE302	Installation testing and Maintenance	3	0	1	VI
		MEOE304	Productio Planning and Control	3	0	1	VI

12.	Computer Engineering & Internet of Things (IoT)	IoTOE301	Software Project Management	3	0	1	V
		IoTOE302	Data Warehousing and Data Mining	3	0	1	VI
		IoTOE304	Wireless Sensor Network	3	0	1	VI
13.	Mechatronics	MAOE301	Industrial Mechatronics	3	0	1	V
		MAOE302	Robotics And Applications	3	0	1	VI
		MAOE304	Product Design	3	0	1	VI
14.	Agriculture Engineering	AGEOE301	Fertiliser Technology	3	0	1	V
		AGEOE302	Industrial Safety	3	0	1	VI
		AGEOE304	Organic and Natural Farming Practices	3	0	1	VI
15.	Electrical Engineering and Electrical Vehicle Technology	EEVOE 301	Automotive Fuel and Lubricants	3	0	1	V
		EEVOE 302	Automotive Power Train	3	0	1	VI
		EEVOE 303	Basics of Management	3	0	1	VI
16.	Mechanical Engineering (Tool and Die)	METOE301	Non- conventional Energy Systems	3	0	1	V
		METOE302	Energy Management	3	0	1	VI
		METOE304	Fundamental of Mechatronics	3	0	1	VI
17.	Mechanical Engineering (Refrigeration and Air Conditioning)	ME(RAC)OE301	Basics of 3D Printing	3	0	1	V
		ME(RAC)OE302	Quantitative Techniques for Engineers	3	0	1	VI
		ME(RAC)OE304	Solar Thermal Technologies	3	0	1	VI

Note: - *“List of Open Electives may be updated according to the advancement in the concerned Course/Technology in the future”.*

Course Code	:	ASOE301
Course Title	:	Life Skills for Professional and Personal Life (LSPPL)
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Life skills prepare students to meet the demands of everyday professional and personal life, besides helping them in appropriately placed. The course aims to develop basic awareness among the students about the significance and useful tips on life skills for their professional growth and facilitate them in developing all-round personality. Hard or technical skills help securing a basic position in one's life and career, whereas, life and soft skills ensure a person retain it, climb further, reach a pinnacle, achieve excellence and derive fulfilment and supreme joy. Life skills comprise of pleasant and appealing personality traits such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills to name a few. The life skills aims to shape youth's attitudes and beliefs in a positive manner so that they contribute to Self-reliant Bharat (Atamnirbhar Bharat) by making productive life choices and at the same time enable them manage their physical, mental and emotional wellbeing.

The course will enable students:

1. To apply the concepts of self-awareness, self-esteem and self-confidence in their professional and personal lives.
2. To manage their time effectively.
3. To display ethics in their professional and personal lives.
4. To communicate assertively.
5. To build inter-personal communication skills to promote their mental and emotional well-being.
6. To demonstrate positive attitudes and actions for healthy and meaningful social relationships and team working.
7. To live an emotionally healthy life.
8. To demonstrate a balance in their cognitive, physical and social lives, including working in teams.

Unit 1: Life Skills, Soft Skills & Interpersonal Skills:

1. Definition of Life Skills and Soft Skills
2. Significance of Life Skills and Soft Skills in Personal and Professional life
3. Types of Soft skills and Life skills, Ways to develop Soft Skills and Life Skills.
4. Concept of Interpersonal Skills and tips to improve Interpersonal Skills
5. Meaning of Team dynamics and Tips for improving Team dynamics

Unit 2. Communication Skills

1. Meaning of Communication Skills
2. Significance and Characteristics of Assertive Communication,
3. Techniques of Assertive Communication
4. Tips to develop Assertive Communication

Unit 3.Life Skills

(A) Self Awareness:

1. Self Introspection

- (a) Meaning of Self awareness :Introspection, Self Reflection and Insight
- (b) Strategies to improve self awareness
- (c) Importance of counseling and coaching

2. Stress Management

- (a) Meaning of Stress
- (b) Factors causing positive and negative types of stress
- (c) Effects of Stress on mind and body.
- (d) Stress Management techniques

3. Emotional Intelligence:

- (a) Meaning and Significance of EI
- (b) Strategies to develop and enhance Emotional Intelligence

4. Self-Esteem

- (a) Concept, Meaning and Significance of Self-Esteem
- (b) Types of Self-Esteem
- (c) Characteristics of people with High and Low Self -Esteem
- (d) Steps and Tips for improving Self-Esteem

(B) Social Awareness:

1. Meaning and Techniques of social awareness and social skills

2. Empathy:

- (a) Meaning and types of Empathy
- (b) Benefits of Empathy
- (c) Steps for developing Empathy

3. Compassion:

- (a) Meaning and Benefits of Compassion
- (b) Steps to practice Compassion.

4. Body Language:

- (a) Elements of Body Language
- (b) Develop Positive Body language that helps in building positive relationships
- (c) Avoiding Negative Body Language

(C) Thinking Skills:

1. Positive Thinking

- (a) Meaning and Benefits of Positive Thinking
- (b) Tips to develop positive attitude and practice Positive Thinking

(Students can choose any three activities to be written in their Home Assignment

Notebook: 1. Gratitude Journal 2. Preparing your Strength's list. 3. Silver Linings in difficult situations 4. Strengths spotting activity of any four people who inspires and motivates you)

2. Listening Skills:

- (a) Concept, Significance and Process of Listening Skills
- (b) Kinds of Listening
- (c) Factors hindering effective Listening
- (d) Tips for Active and Empathetic Listening

3 Resilience:

- (a) Meaning and Types of Resilience
- (b) Case studies of Resilience

(Students should undertake Minimum Two case studies of Resilience)

Unit 4. Time Management Skills

1. Concept and Significance of Time Management.
2. Benefits of Time Management,
3. Tools and techniques of Time Management
4. How to overcome procrastination and avoid time-wasters

(Student should prepare Daily ‘To-do’ list /Timeboxing to hone up their time management skills . The main wasters should be identified daily and also steps to overcome them. Home Assignment Notebook should be used for these tasks.

Unit 5. Human Values and Ethics

1. Meaning of Human values, Morals and Ethics
2. What is Value and types of values
3. Human Dignity and Humility: Meaning of Human Dignity and Fundamental rights of a person, Meaning of Humility, Significance of humility, Developing and cultivating humility

Course outcomes:

At the end of the course the student will be able to:

CO1	Build and reflect self-confidence and high self-esteem in their behavior and conduct.
CO2	Demonstrate life skills in their professional and personal lives.
CO3	Communicate assertively and make effective presentations.
CO3	Manage time effectively
CO4	Display positive attitude and resilience in their behavior and conduct
CO5	Demonstrate positive interpersonal skills and work effectively in a Team, as a leader and a member.
CO6	Listen actively and empathetically
CO7	Manage adverse circumstances with resilience
CO8	Display emotionally intelligent behavior and create stress free environment
CO9	Demonstrate harmony in their physical, cognitive, personal, social behavior and conduct
CO10	Exhibit and apply social and emotional abilities to climb the ladder of success in personal and professional lives

Reference Books:

1. <https://esoftskills.com/soft-skills-vs-life-skills/#:~:text=Soft%20skills%20primarily%20focus%20on,day%2Dto%2Dday%20living>
2. Soft Skills & Employability Skills. Sabina Pillai&Agn Fernandez.Cambridge University Press.

3. Soft Skills. K. Alex. S. Chand
4. Positivity-Away of life by Manika Ghosh , Published by Orient Blackswan Pvt. Ltd.
5. Clear, J. (2018). Atomic habits: An easy & proven way to build good habits & break bad ones. Penguin.
6. Klaus, Peggy, Jane Rohman & Molly Hamaker. "The Hard Truth about Soft Skills", London: HarperCollins E-books, 2007
7. <https://www.coursera.org/articles/interpersonal-skills>
8. <https://www.indeed.com/career-advice/resumes-cover-letters/interpersonal-skills>
9. <https://www.understood.org/en/articles/4-types-of-social-cues>
10. <https://www.bhf.org.uk/information-support/heart-matters-magazine/wellbeing/how-to-talk-about-health-problems/active-listening>
11. <https://www.scienceofpeople.com/mirroring/>
12. <https://www.apa.org/monitor/2021/11/feature-cultivating-empathy>
13. <https://www.helpguide.org/articles/relationships-communication/empathy.htm>
14. <https://www.verywellmind.com/what-is-compassion-5207366>
15. <https://library.xtensio.com/noise-analysis>
16. <https://hbr.org/2016/06/the-secrets-of-great-teamwork>
17. <https://blog.vantagecircle.com/team-dynamics/>
18. <https://www.indeed.com/career-advice/career-development/how-to-improve-interpersonal-skills>
19. <https://positivepsychology.com/self-awareness-matters-how-you-can-be-more-self-aware/>
20. Peale, Norman Vincent. The Power of Positive Thinking. RHUK, 2016.
21. <https://www.rajeevelt.com/life-skills-teaching-learning-beneficial-holistic-development-child-education/rajeev-ranjan/>
22. https://www.mirecc.va.gov/cihvisn2/Documents/Patient_Education_Handouts/Assertive_Communication_Version_3.pdf
23. <https://positivepsychology.com/assertive-communication/#benefits>
24. <https://www.berkeleywellbeing.com/assertive-communication.html>
25. <https://www.choosingtherapy.com/assertive-communication/>
26. <https://www.executive-impressions.com/blog/why-assertive-communication-important-new-leaders>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted(Hrs)	Marks Allotted(%)
1	13	15
2	09	15
3	26	40
4	8	15
5	8	15
Total	64	100

Course Code	:	ASOE303
Course Title	:	Industrial Water Treatment
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE: At the End of the Chapter Students will be able

- (a) To Understand Water Quality Standard, sources and Classification of pollutants.
- (b) To Understand coagulation-precipitation, neutralization used in chemical treatment technology.
- (c) To Understand membrane based processes used for water treatment.
- (d) To Understand specific treatment used for industrial waste water.
- (e) To Understand the use of modern water treatment technology.

UNIT I

Introduction to water resource management issues, access to safe drinking water, river pollution, water quality standards, sources and classification of pollutants.

UNIT II

Chemical Treatment Technology: aeration, chemical coagulation-precipitation, neutralization, chemical oxidation, adsorption, ion-exchange, And advanced oxidation, disinfection of water

UNIT III

Water treatment by membrane technology: Membrane-based processes, membrane modules, micro, ultra, nano, reverse osmosis, membrane distillation in water treatment. Forward osmosis,

UNIT IV

Industry-specific treatment of water: Coke oven wastewater treatment, Pharmaceutical wastewater treatment, tannery wastewater treatment, petroleum refinery wastewater treatment, pulp and paper industry wastewater treatment

UNIT V

Nanotechnology in water treatment, Hybrid Water Treatment Technologies: Chemical-biological, biological-membrane, membrane-c chemical hybrid treatment technologies in water treatment, sustainable water treatment, ethics, compliance of regulations

Course outcomes:

At the end of the course, the student will be able to:

CO1	Learn different sources of energy and basic terminology
CO2	Identify characteristic properties of fuels and analyze fuel processing equipment
CO3	Compare performances and select type of fuel processing equipment

Reference Books:

1. Industrial Water Treatment Process Technology, P. Pal, Elsevier Science
2. Groundwater Arsenic Remediation: Treatment Technology and Scale Up, P.Pal, Elsevier Science

Suggested Reference Books:

1. Wastewater Treatment, Disposal, Reuse, Eddy and Metcalf

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs)	Marks Allotted(%)
1	10	10
2	14	20
3	14	20
4	13	25
5	13	25
Total	64	100

Course Code	:	ASOE302
Course Title	:	Technical Communication
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

This course will help diploma holders to hone up their technical communication skills to enable them enter the technical workforce with greater confidence and desired skill-sets. People who can communicate effectively, using a variety of media, tend to be successful in their professional lives. People with weak communication skills are not able to get appropriate placements, and they generally do not get opportunity to work on challenging projects, which adversely affect their growth and promotions. Technical communication is indispensable for successful any career, whether as an engineer, web developer, programmer or any other professional in technical field. An enhanced awareness about the significance of communication, skills will facilitate an all-round development of personality.

Course Objectives:

The course will enable students to:

1. Use various facets of Technical Communications.
2. Apply different aspects and dimensions of technical writing in the professional settings.
3. Make effective presentations to diverse types of audiences with enhanced confidence.
4. Create and develop a vast know-how of technical communication and its applications at workplace.
5. Bring effectiveness in situations like problem-solving, resolving conflicts and team-working etc.
6. Speak flawlessly and with confidence.
7. To handle a variety of social and business situations and display professional behavior.

DETAILED CONTENTS

Unit 1: Fundamentals of Technical Communication

1. Language as a tool of Communication
2. Features of Technical Communication
3. Distinction between General and Technical Communication
4. Channels of Communication at workplace: Downward, Upward, Lateral or Horizontal, Diagonal, Grapevine, Consensus
5. Barriers to Communication and overcoming barriers

Unit 2. Technical Writing

1. Types of Technical writing
2. Drafting skills: Agenda and Minutes of Meetings, Official and Business Correspondence
3. Different formats of Report writing
4. Basics of Grammar: Spotting errors in sentences (Noun, Pronoun, Verb, Adverb, Adjective, Preposition, Conjunction, Article, Modals, Tenses, Punctuation)
5. Resume Writing and Covering letter

(Students should prepare a Resume and a Covering letter as part of Home Assignment)

Unit 3. Presentation Skills

1. Concept and Significance of Presentation skills
2. Steps of a Effective Presentation
3. Elements of Effective Presentation skills, including public speaking Clarity of substance; Emotion, Humour, Overcoming Fear, Confident speaking, Audience Analysis and Retention of audience interest
4. How to improve Presentation Skills

Unit 4. Speaking skills

1. What are Speaking Skills and Characteristics of a Good Speech
2. What is Panel Discussion and its procedure
3. Job Interview Skills: What to do Before, After and During Interview
4. Body Language Examples and their Meanings-Positive and Negative. Body language for interviews
5. Difference between Etiquettes and Manners ,Table Etiquettes , Business Etiquettes, Telephone Etiquettes, Dressing Etiquettes and Workplace Etiquettes, How to get along with opposite Gender
6. What are the elements of Voice Modulation (Quality, Pitch, Rhythm, Volume, Pace; Intonation; Pronunciation; Articulation; stress & accent);Tips for better Voice modulation

(Mock Interview should be undertaken in collaboration with subject experts from respective branches to give students practical exposure of facing an interview.)

Course Outcomes

At the end of the course, the student will be able to:

CO1	Adapt, accept and adjust to the physical and emotional changes in one's own self and influence others positively.
CO2	Classify the correct usage of English grammar in writing and speaking.
CO3	Develop various written communication strategies of resume writing and official correspondence
CO4	Demonstrate the use of verbal and non-verbal communication in academic and non-academic platforms.
CO5	Demonstrate appropriate communication behavior to enhance self-representation and interpersonal skills through pleasing manners and charming personality

Reference Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta

- Sharma, Oxford Univ. Press, 2007, New Delhi.
2. <https://www.skillsyouneed.com/quiz/343479>
 3. <https://www.indeed.com/career-advice/career-development/project-management-report>
 4. <https://whatfix.com/blog/technical-writing-examples/>
 5. <https://virtualspeech.com/blog/technical-presentation>
 6. Csikszentmihalyi, Mihaly. Flow: The Psychology of Optimal Experience. Harper Perennial Modern Classics, 2018.
 7. Canfield, Jack et al. Chicken Soup for the Unsinkable Soul, Backlist LLC, 2012.
 8. <https://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreportwriting>

SUGGESTED DISTRIBUTION OF MARKS:

Topic No.	Time Allotted(Hrs)	Marks Allotted(%)
1	14	20
2	25	40
3	10	15
4	15	25
Total	64	100

Course Code	:	ASOE304
Course Title	:	Composites Science &Technology
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Why use composites? The greatest advantage of composite materials is strength and stiffness combined with lightness. By choosing an appropriate combination of reinforcement and matrix material, manufacturers can produce properties that exactly fit the requirements for a particular structure for a particular purpose

1. Introduction:

Definition – Classification and characteristics of Composite materials. terminology used in fiber science, Advantages and application of composites. Introduction to composite materials: General characteristics of reinforcement- classification.

2 Polymer matrix composites:

Thermoplastic and thermosetting resins; Commonly used matrix reinforcement system; Fibre, Flake and particulate reinforced composites, Reinforcements used in PMC's- glass, carbon, aramids, boron, Roving's, yarns, fabrics, etc.; Thermoset matrices for aerospace components- polyesters, epoxies, phenolics, vinyl esters, cyanate esters, etc.;

3 Specialty composites:

Composites for satellites and advanced launch vehicles, Design considerations PMC- for structural composites, Silicon carbide composites, design, processing and properties Carbon-Carbon composites: Matrix precursors, Manufacturing considerations, Nanocomposites: Nano particle dispersion in polymer matrix, Polymer- nanoclay composites and polymer-carbon nanotubes composites.

4 Manufacturing techniques:

Hand lay-up, Filament winding, Pultrusion, Resin transfer molding, Processing science of reactive polymer composites, Process steps for production, Selection of processing conditions toolings, Equipments, Carbon-carbon composites, Processing, Thermal and mechanical properties, Quality control.

5 Testing of composites:

Raw material testing, Property evaluation at laminate level, NDT techniques.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Explain the advantages and applications of composite materials.
CO2	Describe the properties of various reinforcements of composite materials.
CO3	Summarize the manufacture and application of speciality composites.

Reference Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007. References: 1. Hand Book of Composite Materials-ed-Lubin. 2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	15	25
3	12	20
4	15	25
5	8	10
Total	64	100

AROE301-Vastu-Shastra

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination (h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVE:

1. To know about various theories related to building design based on Vastu Shastra.
2. To acquaint with various principles and concepts of Design based on Vaastu Shastra.

UNIT	COURSE CONTENT
I	<p>General: -</p> <p>Various Directions and their importance and uses along with the various terms used to refer these directions in Vaastu Shastra</p> <p>Various effects of Vastu Shastra in buildings or towns along with suitable examples.</p> <p>Position of the various usable spaces like, drawing hall, kitchen, master bed room, children bed, guest bed room, store, pooja room, dining hall, car porch etc in a residential building</p> <p>Location of septic tank, water source/ overhead water tanks, main entrance gate, Electric meter etc in a residential building.</p> <p>Vastu based planning of the individual rooms in a residential building, shapes of doors and windows and other openings in a residential building.</p> <p>Use of the various colours with reference to the different directions as per Vastu Shastra. Remedies as per Vastu Shastra in existing Buildings not designed as per Vastu Shastra.</p>
II	<p>Site Selection & Approach Roads</p> <p>Shapes of various plots and their good or ill effects as per Vastu Shastra.</p> <p>Position of various approach road around a plot and their effects as per Vastu Shastra, Most suitable access road as per Vastu shastra, Access roads to be avoided as per Vastu Shastra</p> <p>Planning and positioning of the main entrance gate of the various plots facing South, West, East, North, NE, SE, SW & NW.</p>
III	<p>General Guidelines and Principles to be followed in planning of a residential building following Vastu Shastra tips</p> <p>A three bed room house planning considering all the important concepts and principles of Vastu Shastra based planning like position of various rooms in a residential building, main entrance, location of septic tank and soak pit and other important spaces of a residential building.</p>

COURSE OUTCOMES

By the end of the course, the students are expected to learn

- i. The various aspects of Vastu Shastra which are in practice and are beneficial to the society.
- ii. The basic techniques of Vastu Shastra to make people healthy and happy by using the Vastu tips.
- iii. The problem solving related to ill effects of existing buildings.

BOOKS AND REFERENCES

1. The Journey of Vastu Shastra: Lets have More Money, Happiness and Growth in LifeBy: - Abhishek Goel.
2. Ancient Science of Vastu By:- Vishwakarma Prakash.
3. The Miracles of Vastu shastra By:- Shanku Shiva Dass.
4. Vastu Shastra in modern Context By:- Anand Bhardwaj.
5. The need of Vastu Shastra By:- Pratul Chanra Dass.

NOTE:

- A site visit may be arranged for the students to develop a real time problem solving approach w.r.t. Vastu Shastra.
- Students may develop the plans of a residential building based on the concept of Vastu Shastra.

Suggested Distribution of Marks		
Unit	Time Allotted(Hrs)	Marks Allotted (%)
I	32	50
II	16	25
III	16	25
TOTAL	64	100

AROE302-Architecture Photography

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination(h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVES:

1. To familiarize students with the basic skills of photography for use in architecture, landscape design, interior design both as a tool of documentation and aesthetic interpretation.
2. To develop understanding about the photography equipment and its uses.

UNIT	COURSE CONTENT
I	Nature, history and scope of photography. Various applications of photography. Creative composition in photography. Architectural photography and its role in documentation and creative design process (Basic introduction to the principles of design)
II	General introduction to the art of photography; concept of color; concepts of lighting, distance, visual angle, Frames; media.
III	UNDERSTANDING THE TOOLS Various types of cameras and films. Components of SLR, DSLR and Mirror less Cameras. Various types of lenses i.e. Macro, Wide angle, portrait and telephoto lenses for full frame and crop sensor cameras and their uses/applications. Other camera accessories.
IV	CREATING EXPRESSION Field assignments in groups of photography, interior and landscape photography work - both in color and black and white mediums. To document and interpret as aesthetic expression - various subjects of photography such as buildings, landscapes and interiors Basic introduction to the photo editing software like Photoshop, light room etc.

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to

- i. Understand the basics of photography.
- ii. Understand the basic skills of photography for use in architecture, and related fields like, landscape design interior design both as a tool of documentation and aesthetic interpretation.
- iii. Develop a flair for creativity and aesthetics.

BOOKS AND REFERENCES

1. Architectural Photography, 1976

2. Photographers equipment book, 1984 by Brusselle Michael
3. Architectural Photography by Michael G. Harris

NOTE:

- Detailed teaching program to be made and circulated to the students at the commencement of the semester.
- Photography lab shall be setup comprising of the latest cameras and lenses mentioned above.
- Study Tour/Visit shall be arranged by the subject teacher of any nearby project for practical exposure of photography.

Suggested Distribution of Marks		
Unit	Time Allotted (Hrs.)	Marks Allotted (%)
I	18	30
II	12	15
III	18	30
IV	16	25
Total	64	100

AROE304-Sustainable Development

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination (h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVE:

1. Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
2. Know the history of the Sustainable Development idea.

UNIT	COURSE CONTENT
I	Introduction to Sustainable Development: Glimpse into History and Current practices - Broad introduction to SD - its importance, need, impact and implications; definition coined; evolution of SD perspectives (MDGs AND SDGs) over the years; recent debates; 1987 Brundtland Commission and outcome; later UN summits (Rio summit, etc.) and outcome.
II	Ecosystem & Sustainability: Fundamentals of ecology - types of ecosystems & interrelationships, factors influencing sustainability of ecosystems, ecosystem restoration - developmental needs. Introduction to sustainability & its factors, requirements for sustainability: food security and agriculture, renewable resources - water and energy, non-renewable resources, factors and trade-offs, sustainability conflicts, a conceptual framework for linking sustainability and sustainable development.
III	Gauging Sustainable Development - Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.
IV	Case Studies & Projects on Rural Sustainable Development (Indian village perspectives) - Village resources (broad perspectives); current challenges and thematic areas; village social hierarchy; village economy; needs of present and future generation; conflicts - sustainability and rural culture & tradition; road to achieving sustainable development goals - bridging conflicts and way forward

COURSE OUTCOMES

Upon completion of the course students will be able to:

- i. Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
- ii. Understand the embedment of sustainability issues in environmental, societal, and economic systems, and the relevance of the conditions, interrelations, and dynamics of

- these systems.
- iii. Get sensitise and aware about the dire need of sustainability in the contemporary world.

BOOKS AND REFERENCES

- 1. Sustainable Building, Design Manual –Vol-1,2. – TERI Press.**
- 2. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>**

NOTE:

- A site visit may be arranged for the students to understand the concerns of sustainable development w.r.t to rural environment.

Suggested Distribution of Marks		
Unit	Time Allotted(Hrs)	Marks Allotted (%)
I	8	10
II	14	20
III	24	40
IV	18	30
TOTAL	64	100

Course Code	:	AEOE 301
Course Title	:	Vehicular Systems
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To introduce internal combustion engine
- To explain different components of internal combustion engine
- To explain working of different parts of transmission system
- To describe construction of different automotive chassis components
- To analyse braking systems of automobiles.

Course Content:

Unit I Introduction

Types of automobiles, different layouts of vehicle, chassis, frame and body, Spark Ignition (SI) & Compression Ignition (CI) engines.

Unit II Automotive Engine Parts

Cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms.

Unit III Transmission Systems

Clutch-types and construction of single plate clutch, propeller shaft, slip joints, universal joints, Differential, and rear axle.

Unit IV Brakes and Suspension Systems

Requirements, leaf spring, coil spring. Types of brakes, mechanical and hydraulic braking systems, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system.

Unit V Safety and Comfort Systems

Passive Safety Systems – Airbags, Seatbelts, Crumple Zones, Active Safety Systems – Automatic Driver Assist Systems (ADAS), Antilock Braking System, Reverse parking system, Anti-collision system, Traction control system, Comfort Systems – Cruise control system, Heating, ventilation and Air-conditioning system (HVAC), Autonomous Driving Cars – Level of Driving Automation.(Basic definitions and functions only)

Text books:

1. Automobile Engineering-R. B. Gupta, Satya Prakashan.
2. Automobile engineering-Kirpal Singh. Vol I and II.

References:

1. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill Book Co.
2. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005

4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric,
5. Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
6. Bosch “Automotive Handbook”, Robert Bosch GmbH, Germany, 2008, Eighthth Edition.

Course Outcomes: At the end of the course the student should be able to:

CO1	Distinguish the different types of automobiles and chassis.
CO2	Interpret the various types of engines.
CO3	Select the appropriate transmission systems.
CO4	Compare the braking and suspension systems.
CO5	To have information about various safety systems.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	AEOE 302
Course Title	:	Automotive Pollution and Control
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To describe emissions from SI and CI engines, measure and control the same.
- To identify sources of noise, measure and control the same.
- To enumerate emission control techniques.

Course Content:

Unit I: Emissions from SI and CI Engines: Emission formation in SI and CI engines – factors influencing emission, effect of pollution on environment and human health.

Unit II: Emission Testing: Emission test cycles, constant volume sampling method, non-dispersive infrared (NDIR) analyzer, flame ionization detectors (FID), chemical luminescence analyzer, smoke meters, and gas chromatograph.

Unit III: Emission Control Techniques: Air fuel ratio (A/F) control, crank case emission control, fuel evaporation & control, EGR, SCR, catalytic converters, Particulate traps. Effect of engine combustion on human body, engine modification and emission technologies.

Unit IV: Noise and Noise Control: Introduction to sound, noise measurements, control of air borne and structure borne noise- use of absorber, criteria for the selection of materials.

Unit V: Emission Norms: Emission norms - Euro & Bharat norms, effect of fuel properties and additives, emissions from alternate fuels.

Text Books:

1. Pundir B P, “Engine Emissions: Fundamentals and Advances in Control”, Alpha Science International Ltd, 2017.
2. Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Matthew Harrison, Butterworth-Heinemann, Burlington, 2011.
3. XuWang ,“Vehicle Noise and Vibration Refinement”, Woodhead Publishing; 1st edition, 2010.

References:

1. James D. Halderman, “Automotive Fuel and Emissions Control Systems”, 4th Edition, Prentice Hall, Pearson Education, 2016.
2. Gang Sheng, “Vehicle Noise, vibration and Sound quality”, SAE International 2012.

Course Outcomes: At the end of the course the student should be able to:

CO1	Identify the sources of vehicle emission, properties of various types of fuel and additives in control of emission.
CO2	Apply the emission standard test methods and procedure in accordance to driving conditions for different vehicles.
CO3	Evaluate different pre-combustion and post combustion methods involving in emission control.
CO4	Understand the sources of vehicle noise in vehicle refinement along with control measures.
CO5	Understand the emission norms.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	AEOE 304
Course Title	:	Vehicle Body Engineering
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand different types of chassis.
- To gain knowledge about different types of vehicle body.
- To understand ergonomics of an automobile.
- To describe the various materials used in vehicle body engineering.
- To understand the painting process in Automobiles.

Detailed Contents:

Unit – I: Introduction: Classification of automobiles on different basis, Types of vehicle bodies, requirements of automobile body, constructional details.

Unit – II: Car body details: Types: Saloon, hatchback, convertibles, Limousine, Estate Van, racing and sports car, etc. Carbody construction types – frame and unitary, various body panels and their constructional details.

Unit- III: Bus body details: Types: Mini bus, single and double Decker, split level and articulated bus, Bus body lay out, Floor height, Engine location, Entrance and exit location, Seating dimensions, Constructional details: Frame construction, Types of metal section used, Conventional and integral type construction.

Unit - IV: Commercial vehicle details: Types of commercial vehicles. Commercial vehicle body details, flat platform, drop side, fixed side, tipper body, tanker body, tractor trailer.

Unit- V: Body materials, trim and mechanisms: Carbon fibers, plastics, timber, GRP; ferrous and non-ferrous materials used in vehicle. Corrosion and anticorrosion methods. Paint and painting process, Corrosion, Anticorrosion methods, Body trim items, Body mechanisms.

Course Outcomes: At the end of the course the student should be able to:

CO1	Understand the fundamentals of various automotive body construction details
CO2	Identify different aspects of car body and bus body, types, commercial vehicle.
CO3	Describe the materials used in body building, tools used, body repairs
CO4	Analyse vehicle body for different load conditions
CO5	Understand various body designs according to load.

Suggested Readings/Books:

1. J Powloski, "Vehicle Body Engineering", Business Books Ltd., London.
2. Kirpal Singh, "Automobile Engineering Vol-1", Standard Publishers distributors
3. Braithwaite J.B., "Vehicle Body building and drawing ", Heinemann Educational Books Ltd., London.
4. Sydney F. Page "Body Engineering" Chapman & Hill Ltd., London,
5. John Fenton, "Handbook of Automotive Body and Systems Design", Wiley.
6. Heinz Hezler "Advance vehicle Technology"

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	CEOE301
Course Title	:	Project Management
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

- To develop the idea of project plan, from defining and confirming the project goals and objectives,
- Identifying tasks and how goals will be achieved.
- To develop an understanding of key project management skills and strategies.

Course Content:

UNIT-I: Concept of a project:

Classification of projects- importance of project management. The project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work break down structure.

UNIT-II: Capital budgeting process:

Planning Analysis- Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections:

Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting:

Non discounting and discounting methods- payback period- Accounting rate of return-net present value- Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects.

UNIT-V: Project administration:

Progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation.

Suggested Learning Resources

- Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
- Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson – McGraw Hill

- Project management - David I Cleland - McGraw Hill International Edition, 1999
- Project Management – Gopala Krishnan – McMillan India Ltd.
- Project Management-Harry-Maylor-Pearson Publication

Course outcomes:

At the end of the course, the student will be able to:

- Understand the importance of projects and its phases.
- Analyze projects from marketing, operational and financial perspectives.
- Evaluate projects based on discount and non-discount methods.
- Develop network diagrams for planning and execution of a given project.
- Apply crashing procedures for time and cost optimization.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	12	20
2	13	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	CEOE 302
Course Title	:	Engineering Geology
Number of Credits	:	3(L:3, P: 0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

The course should enable the students to:

- Understand the origin and formation of earth and various geological processes.
- Learn about types of rocks and minerals.
- Acquire knowledge of various terminologies in structural geology.
- Know about various methods of geological investigations.

Unit I: Introduction.

- Introduction and branches of Geology,
- Importance of Engineering Geology,
- Scope of engineering geology: Geology in construction jobs, Geology in water resource development, Geology in town and regional planning.

Unit II: The Earth

- A brief account of theory of origin of Earth. Size, Shape, mass, density and atmosphere of Earth.
- Internal structure and chemical composition of Earth.

Unit II: General Geology

- Geological work of atmosphere (rock Weathering) types and effect.
- Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition. Resulting Features and Importance in Engineering.

Unit III: Study of rocks

- Types of rocks (Igneous, Sedimentary & Metamorphic rocks): Their composition and engineering importance.
- Engineering properties of rocks as material for construction: building stones, properties and important building stones.
- Building stone as road material, quality of aggregate, common road aggregate.

Unit IV: Structural Geology

- Dip and strike, apparent dip and true dip.
- Folds, elements of fold, types of fold, causes of folding.
- Fault terminology, classification of faults. Significance of faults.

Unit V: Geological investigations

- Introduction and objective of geological investigations
- Methods of geological investigations,
- Geophysical investigations, Seismic method of investigation, Gravitational method, Acoustic methods.

References:

- K.M Bangar, Standard Publishers Distributors.

- Prabin Singh, Katson Books.
- G.B Mahapatra, CBS Publishers & Distributors
- Dr. D S Arora M C Publishers

Course Outcomes:

After completing this course, student will be able to:

- Recognize the fundamentals of the Earth, earth's dynamic actions and their importance.
- Identify and classify rocks and minerals.
- Describe types and processes of weathering and erosion and other geological processes.
- Understand Structural Geology.
- Know about various methods of geological investigations

Topic NO.	Time Allotted (Hrs.)	Marks Allotted (%)
UNIT-I	12	20
UNIT-II	13	20
UNIT-III	13	20
UNIT-IV	13	20
UNIT-V	13	20
Total	64	100

Course Code	:	CEOE304
Course Title	:	Disaster Management
Number of Credits	:	3(L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organizations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course Content:

Unit – I: Understanding Disaster

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity

– Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

- Geological Disasters (earthquakes, landslides, tsunami, mining);
- Hydro-Meteorological Disasters (Floods, cyclones, lightning, thunderstorms, hailstorms, avalanches, droughts, cold and heat waves)
- Biological Disasters (epidemics, pest attacks, forest fire);
- Technological Disasters (chemical, industrial, radiological, nuclear) and
- Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
- Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework

- Disaster Management Cycle – Paradigm Shift in Disaster Management.
- Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation, and Micro zonation,
- Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development.
- Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency
- Operation Centre – Incident Command System – Relief and Rehabilitation
- Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early
- Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit– IV: Disaster Management in India

- Disaster Profile of India – Mega Disasters of India and Lessons Learnt.
- Disaster Management Act 2005 – Institutional and Financial Mechanism,
- National Policy on Disaster Management, National Guidelines and Plans on Disaster Management.
- Role of Government (local, state, and national), Non-Government and Inter Governmental Agencies.

Unit– V: Applications of Science and Technology for Disaster Management

- Geo-informatics in Disaster Management (RS, GIS, GPS, and RS).
- Disaster Communication System (Early Warning and Its Dissemination).
- Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions,
- Structural and Non-Structural Mitigation of Disasters
- S&T Institutions for Disaster Management in India

Suggested Learning Resources

- Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
- Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
- Alexander, David, Natural Disasters, Kluwer Academic London
- Ghosh, G. K., Disaster Management, A P H Publishing Corporation
- Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

Course Outcomes:

After completing this course, student will be:

- Acquainted with basic information on various types of disasters
- Knowing the precautions and awareness regarding various disasters
- Decide first action to be taken under various disasters
- Familiarized with organization in India which are dealing with disasters
- Able to select IT tools to help in disaster management.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	8	12
2	16	24
3	16	24
4	12	20
5	12	20
Total	64	100

Course Code	:	COOE301
Course Title	:	Introduction to e - Governance
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

To cover the concepts of e-Governance and to understand how technologies and business models shape the contours of government for improving citizen services and bringing in transparency.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Understand the different models of E-governance.
CO 2	Describe the e-governance projects at Union and State Govt. level.
CO 3	Understand the benefits and reasons for the introduction of e-governance at the local level.
CO 4	Realize the issues and challenges of e-governance.

DETAILED CONTENTS

UNIT 1: 12 Hours

Exposure to emerging trends in ICT for development; Understanding of design and implementation of e-Government projects, e-governance lifecycle.

UNIT 2:12 Hours

Need for Government Process Re-engineering (GPR); National e-Governance Plan(NeGP) for India; SMART Governments & Thumb Rules

UNIT 3:16 Hours

Architecture and models of e-Governance, including Public Private Partnership (PPP); Need for Innovation and Change Management in eGovernance; Critical Success Factors; Major issue including corruption, resistance for change, e-Security and Cyber laws

UNIT 4:16 Hours

Focusing on Indian initiatives and their impact on citizens; Sharing of case studies to highlight best practices in managing e-Governance projects in Indian context. Visits to local e-governance sites(CSC, eSeva, Post Office, Passport Seva Kendra, etc) as part of Tutorials.

UNIT 5:8 Hours

Mini Projects by students in groups – primarily evaluation of various e-governance project

Reference Books:

1. Managing Transformation –Objectives to Outcomes. J Satyanarayana, Prentice Hall India
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
3. e-Government -The Science of the Possible. J Satyanarayana, Prentice Hall, India
4. <http://www.csi-sigegov.org/publications.php>
5. <https://negd.gov.in>
6. <https://www.nisg.org/case-studies-on-e-governance-in-india>

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	18
2	12	18
3	16	25
4	16	25
5	8	14
Total	64	100

Course Code	: COOE302
Course Title	: Introduction to E-Commerce
Number of Credits	: 3 (L:3; DCS:1; P:0)
Prerequisites	: NIL
Course Category	: Open Elective

Course Learning Objectives:

The course introduces students to the basic concepts and evolution of e-commerce, including its advantages, challenges, and impact on traditional business models. This includes the detailed study of various e-commerce business models, such as B2C (Business-to-Consumer), B2B (Business-to-Business), C2C (Consumer-to-Consumer), and others. This course will equip students with the knowledge and skills needed to navigate the dynamic and ever-changing landscape of online business effectively.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Understand the concept of E-commerce
CO 2	Analyze various E-commerce business models
CO 3	Categorize advantages and disadvantages of different online payment options
CO 4	Assess e-commerce strategies and applications

COURSE CONTENTS

UNIT-I: Introduction to E-Commerce.....14 Hours

An Overview of Electronic Commerce, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Cyber Laws. E-Commerce Technologies: Different types of Networking for E–Commerce, Internet, Intranet & Extranet, EDI Systems. WAP, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement for E – Commerce.

UNIT-II: Business Models of E – Commerce..... 14 Hours

Business Models of e –commerce: Model Based on transaction type, Model Based on Transaction Party - B2B, B2C, C2B, C2C, E – Governance.

UNIT-III: Electronic Data Interchange..... 12 Hours

Electronic Data Interchange (EDI): Benefits, EDI working concepts, Applications, EDI Model, Protocols (UN EDI FACT Data Encryption (DES / RSA), EDI implementation difficulties.

UNIT-IV: Electronic Payment Systems..... 12 Hours

Electronic Payment Systems, Electronic Cash, Smart Cards and Electronic Payment Systems, Credit Card Based Electronic Payment Systems, Risks in Electronic Payment Systems.

UNIT-V: Security issues in E – Commerce..... 12 Hours

Risk in E – Commerce, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Reference Books:

1. Bhaskar Bharat: Electronic Commerce - Technologies & Applications. TMH
2. E – Commerce: Strategy Technologies & Applications, Tata McGraw Hill.
3. Murthy: E – Commerce, Himalaya Publishing.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	25
2	14	25
3	12	18
4	12	18
5	12	14
Total	64	100

Course Code	:	COOE304
Course Title	:	Computer Hardware and Peripherals
Number of Credits	:	3 (L:3; DCS:1; P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

This course is designed to acquaint students with knowledge of computer hardware, peripherals and networking devices. After completing this course, the students will be able to identify various hardware devices, prepare the specification of required computer hardware for home / office use and perform basic troubleshooting.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Identify and understand various hardware and network devices.
CO 2	Understand different internet connectivity technologies.
CO 3	Identify different hardware/networking faults and their possible solutions.

Course Contents

UNIT-I Computer Hardware Devices 14 Hours

PC components, Processor types and their features, Processor specification, Overview of motherboards, Bus system –data I/O bus, Address bus, Internal Data bus, Comparing processor performance, BIOS, BIOS setup menus, Limitation of BIOS, UEFI, overview of Mobile devices hardware.

UNIT-II Input/ Output Devices and Memory20 Hours

Objective of I/O Devices, Types of input devices, Different printing devices and their use, Display types– LCD, LED, Plasma, OLED, HDTV, Data projector; Video connector types – VGA, DVI, HDMI, S-Video Characteristics of display devices – Resolution, refresh rate, response time, color quality, USB port. Memory basics –ROM, RAM, Types of RAM, Memory Module –Registered Modules, SDR DIMM, DDR DIMM, DDR2 DIMM, DDR3 DIMM, DDR4 DIMM, Concept of cache –internal cache, External Cache (L1, L2, L3 cache).

UNIT-III Storage Devices14 Hours

Type of storage devices, Benefits and features of storage devices, Principle and operation of HDD, Basic HDD components, HDD cables and connectors, Optical Storage –CD/DVD construction technology, DVD format and standards, Concept of HD-DVD, Optical drive performance specifications –data transfer rate, drive speed, access time; Flash and removable devices –USB flash drive, SSD, Flash card readers; Concept of cloud-based storage.

UNIT-IV Networking Devices16 Hours

Different types of networking devices –NIC, Repeaters, Switch, Hub, router, gateways, bridge, modem, Access point, Bluetooth, Firewall. Internet connectivity technologies –Dial-up, ISDN, broadband, Wi-Max, leased line, Networking cables and their comparison, Networking tools.

Reference Books:

1. CompTIA A+ Certification Guide, Mark Edward Soper et al., Pearson Publisher.
2. The Complete PC Upgrade and Maintenance Guide, Mark Minasi, John Willey & Sons Inc.
3. Upgrading and Repairing PCs, Scott Mueller, Que Publication

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	20	35
3	14	20
4	16	25
Total	64	100

Course Code	:	EEOE301
Course Title	:	Illumination Practices
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design illumination schemes and associated electrification of buildings.

Course contents:

Unit – I Fundamentals of illumination

Basic illumination, Terminology, Laws of illumination, Polar curves (definition only), Measurement of illumination Lighting calculation methods (brief introduction only)

Unit – II Types of lamps

Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp.

Types of other lamps: Mercury vapour lamp, HPMV lamp, Mercury iodide lamp, Sodium vapour lamp, Halogen Lamps, Ultraviolet Lamps, Neon Lamps, Neon Sign Tubes. Metal halides, HID and Arc lamps, LED lamps, CFL, Lasers.

Selection Criteria for lamps.

Unit– III Illumination Control and Dimmer Circuits

Purpose of lighting control and Dimmer circuits.

Working principle and operation of Dimmer circuits.

Transformer and their types, Dimmer Transformer, Auto transformer dimmer, two winding transformer dimmer

Electronic Dimmer: Brief introduction and applications (only).

Unit– IV Illumination for Interior Applications

Standard for various locations of Interior Illumination.

Design considerations for interior location of residences, Commercial & Industrial premises. Illumination schemes for different interior locations of Residential, Commercial & industrial unit.

Unit– V Illumination for Interior Applications

Factory Lighting, Street Lighting (Latest Technology), Flood Lighting, Railway Lighting, Agriculture and Horticulture lighting, Health Care Centres / Hospitals, Decorating Purposes, Stage Lighting.

References:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths
5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Select relevant lamps for various applications considering illumination levels
- b) Select the lighting accessories required for selected wiring scheme.
- c) Design relevant illumination schemes for interior applications.
- d) Design Illumination schemes for various applications
- e) Design Illumination schemes for various outdoor applications.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	14
5	12	12
Total	64	60

Course Code	:	EEOE302
Course Title	:	Energy Efficiency And Audit
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Undertake energy efficiency measures and energy audit.

Course Contents:

Unit – I Introduction to Energy Efficiency

Energy Scenario: Energy demand and supply, National scenario. Energy Efficiency and Energy Conservation concepts, Indian Electricity Act 2001; relevant clauses of energy conservation BEE and its Roles; Star Labelling: Need and its benefits.

Unit – II Pumping Systems, Fans and Blowers

Factors affecting pump performance; Efficient Pumping system operation; Energy conservation opportunities in Pumping systems; Energy Conservation opportunities in Fan and blowers, Tips for energy saving in fans and blowers.

Unit –III Energy Conservation in Lighting System

Replacing Lamp sources; using energy efficient luminaries Using light controlled gears; Installation of separate transformer/servo stabilizer for lighting, Innovative measures of energy savings in lighting.

Unit– IV Energy Efficient Electrical Machines

Need for energy conservation in induction motor and transformer, Energy efficient motor; significant features, advantages and Limitations.

Energy efficient transformers, amorphous core transformers; epoxy Resin cast transformer/Dry type of transformer, Technical losses; causes and measure to reduce losses, Commercial losses: pilferage, causes and remedies.

Unit– V Energy Audit of Electrical Systems

Energy audit (definition as per Energy Conservation Act), Energy audit instruments and their use, Questionnaire for energy audit projects, Energy flow diagram (Sankey diagram), Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

Reference Books:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978-93-86173-683).
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN:978-

0195606539

4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkateshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta, V. K., Principles of Power System, S. Chand and Co. New Delhi, 2016, ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria and Sons, New Delhi ISBN-13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Undertake energy efficiency activities
- Use energy efficient pumps, compressors and blowers
- Use energy efficient Air Compressors and DG sets
- Use energy efficient Lighting Systems
- Apply energy efficient electrical machines.
- Use Co-generation and relevant tariff for reducing losses in facilities.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	14
5	12	12
Total	64	60

Course Code	:	EEOE304
Course Title	:	Electric Traction
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- ❖ Maintain electric traction systems.

Course contents:

Unit – I Basics of Traction

General description of Electrical Traction system in India.
 Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive
 Problems associated with AC traction System and remedies for it.

Unit – II Power Supply Arrangements

Constituents of supply system: -
 Substation: layout, list of equipment and their functions
 Feeding post: list of equipment and their functions
 Brief introduction to - Feeding and sectioning Arrangements, Sectioning and paralleling post, Sub sectioning and Paralleling post, Sub sectioning post, Elementary section.

Unit– III Overhead Equipment

Different types of overhead equipments
 Different types of OHE Centenary Construction.
 OHE Supporting Structure, Cantilever assembly diagram
 Brief introduction to - Trolley collector, Bow collector, Pantograph Collector
 Brief introduction to pantograph.

Unit– IV Electric Locomotive

Classification and Nomenclature of Electric Locomotive
 Block diagram of AC locomotive
 Power Circuit of AC Locomotive

Unit– V Traction Motors and Train Lighting

Desirable characteristics of traction motor.
 Types of motors used for traction with their characteristics and features
 Control of motors used for traction and methods to control
 Requirements of braking, brief introduction to different types of braking

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book

- Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
 3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
 4. Partab H., Dhanpat Rai and Co, Modern Electric Traction

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements.
- c) Maintain the function of the overhead equipment for electric traction

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	12
5	12	14
Total	64	60

Course Code	:	EEEEOE301
Course Title	:	Powering Building : Strategies for Electrification
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

Course contents:

Unit-1: Electrical Safety & Prevention Techniques

Definition of Safety, Hazard, accident, major accident hazard, responsibility, authority, accountability, Monitoring. Need of Safety, I.E. Rules & Statutory regulations for safety of persons & equipment in electrical installation, causes of electrical accidents, severity of shock, Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration, Precautions to be taken to avoid fire due to electrical faults, various measures to prevent electrical accidents, types and operation of fire extinguishers.

Unit – II: Electrical Wiring Components & Accessories

PVC Cable: Constructional features, types, and rating of PVC wiring.

Classification of switches according to working such as single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch.

Types of different switches such as surface switch, flush switch, and pull switch, rotary switch etc. Various types of holders and their utilization

Types of sockets like two pin, three-pin, multi pin sockets, two-pin and three-pin plug.

Accessories such as Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber, Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.

Classification of electrical accessories- controlling, holding, safety, outlet, BIS symbols of following electrical accessories.

Unit-III: Electrical Power Protection Components & Accessories

Fuse: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material, types of fuses: Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse.

Miniature circuit Breaker (MCB): Construction working principle rating and uses in electrical circuit.

Earth Leakage Circuit Breaker (ELCB): Construction, working Principle rating and uses in electrical circuit.

Earthing: System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance, Electrical Engineering Curriculum Structure 172 Methods of earthing as per IS 3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing.

Unit– IV Electrical Wiring System & its Various Methods

Wiring System: Factors determining the selection of wiring methods, IS: 732-1983 wiring rules, various wiring methods

PVC casing-capping wiring: Basics fundamentals of casing -capping wiring, casing- capping wiring accessories advantages, and limitations.

Conduit Wiring: Conduit wiring its types of conduits, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring,

Modular Wiring: Basics fundamentals of modular wiring, modular wiring accessories advantages, and limitations.

Comparison of various wiring systems, General BIS rules for domestic installations.

Unit– V Estimating & Costing of Powering/Wiring System

Estimating & Costing of Domestic Powering/Wiring System: Standard practices as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate.

Estimating & Costing Industrial Powering/ Wiring Sysyem: relevant IE rules and standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the lighting load (3-phase supply system).

Estimating & Costing of Service Line: Service line connections estimate for domestic and Industrial loads (overhead and Under- ground connections) from pole to energy meter.

Estimating & Costing of Earthing System: IS specifications regarding earthing, types of earthing, List of materials required for earthing, Design of earth wire/strip and electrode for domestic and industrial installation.

References:

1. Raina, K.B. and S.K. Bhattacharya, Electrical Design Estimating and Costing, New Age International Ltd., New Delhi, ISBN 978-81-224-0363-3
2. Allagappan, N. S.Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, DhanpatRai and Co. New Delhi, ISBN: 1234567150995

4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons, New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. **E-REFERENCES:-**

- (i) <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- (ii) <http://www.electrical4u.com>, assessed on 18th January 2016
- (iii) <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016
- (iv) <http://www.electricaltechnology.org/2015/09>, assessed on 30 Jan 2016
- (v) www.slideshare.net/bawaparam/made-by-param assessed on 30 Jan 2016
- (vi) www.electricaltechnology.org/2013/09/electrical-wiring.html assessed on 16 March 2016.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Select accessories, wires, cables and wiring systems for electrification.
2. Design electrical wiring installation system for residential unit.
3. Design proper illumination scheme for residential unit.
4. Prepare wiring layouts on wiring board.
5. Locate and diagnose faults in electrical wiring installation.
6. Do proper earthing for building electrification

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	8	8
2	14	13
3	14	13
4	14	13
5	14	13
Total	64	60

Course Code	:	EEEEOE302
Course Title	:	Nanotechnology
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To provide basic knowledge of nanoscience & nanotechnology.
- To make students familiar with nanoelectronic devices
- To make students familiar with Applications of nanomaterials.

Unit-I : Introduction to Nanoscience, nanoscale, nanoparticles

Unit-II : Nanotechnology: History, Top down and Bottom up approaches with fabrication and future scope of nanotechnology.

Unit-III : Properties of nanomaterials: Electronic, magnetic, optical, chemical and mechanical properties.

Unit-IV : Nanoelectronics Devices: Computer, Memory, Integrated Circuit , CMOS Technology, Optoelectronic Devices.

Unit-V : Applications of nanomaterials and Nanotechnology: Nanostructured materials in memory and electronic devices and for magnetic recording, sensors and interfaces, Medicine, Energy, Electronics, Environment protection, Agriculture etc.

References:

1. Michael Köhler, Wolfgang Fritzsche, Nanotechnology An Introduction to Nanostructuring Techniques, Approved in Academic Council held on 25.10.2021 Wiley, 2nd edition, (2008).
2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition (2011).
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley, (2003).
4. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg (2017).
5. Guozhong Cao and Ying Wang, World Scientific Series in Nanoscience and Nanotechnology: Volume 2 , Nanostructures and Nanomaterials, Synthesis, Properties, and Applications, 2nd Edition (2011).

E-references:

1. NPTEL course contents links
2. <https://nanohub.org/groups/education>

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Students will be able to learn basics of nanotechnology.
2. Students will learn the difference in semiconductor devices with nanoelectronics devices
3. Applications of nanotechnology in their respective fields as well as in interdisciplinary science and engineering.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	08	10
2	12	12
3	14	14
4	14	12
5	16	12
Total	64	60

Course Code	:	EEEEOE304
Course Title	:	Industrial Drives
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric AC and DC Drives

Unit – I Electric Drives

Need of Electric Drives, Functional Block diagrams of an electric drives.

DC Motors, Motor Rating

- a. Series, Shunt and compound DC motors.
- b. Universal motor
- c. Permanent magnet motor
- d. DC servo motor
- e. Moving coil motor
- f. Torque motor.

Starting and Braking of DC Motors

Brushless DC Motors for servo applications.

Maintenance procedure.

Unit – II AC Motors

Single phase AC Motors

- a) Resistance split phase motors
- b) Capacitor run motors
- c) Capacitor start motors
- d) Shaded pole motors

Three phase Induction Motors

- a) Squirrel cage Induction motor
- b) Slip ring Induction Motor
- c) Starting methods of Induction Motor
- d) Braking methods of Induction Motor

Determination of Motor Rating

Maintenance procedure.

Unit– III DC Drives

Single phase SCR Drives

- a) Half wave converter
- b) Full wave converter
- c) Semi converter
- d) Dual converter

Three Phase SCR Drives

- a) Half wave converter
- b) Full wave converter
- c) Semi converter
- d) Dual converter

Reversible SCR Drives.

Speed control methods of DC series Motor

Chopper Controlled DC Drives

Solar and battery powered vehicles

Maintenance procedure.

Unit– IV AC Drives

Starting and Braking of Induction motors.

Stator voltage control

Variable Frequency Control

Voltage Source Inverter Control

Current Source Inverter Control

Rotor Resistance Control

Slip Power Recovery

Solar powered pump drives

Maintenance procedure for AC drives

Sequences of stages & drives required in each stage for following applications:

- a) Textile mills
- b) Steel rolling mills
- c) Paper mills
- d) Sugar mills

Unit– V Advanced Techniques of Motor Control

Microcontroller/ Microprocessor based control for drives

Phase locked loop control of DC motor.

AC/DC motor drive using Microcomputer control

AC/DC motor drive using Microcontroller control.

Synchronous Motor drives.

Ratings & specifications of stepper motor.

Stepper motor drives employing microcontroller (No programming)

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978- 93-86173-294)
2. Saxena, S.B Lal ; Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353
3. Theraja, B. L. ; Theraja, A. K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ram nagar, New Delhi, ISBN : 9788121924405
4. Mittle, V.N. ; Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 9780070593572
5. Sen P.C., Power Electronics, Mcgraw-Hill Publishing Company Limited, New Delhi. ISBN: 9780074624005
6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi. ISBN :9788173194283
7. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw- Hill

- Publishing Company Limited, New Delhi.ISBN:9780070701991
8. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.
 9. Deshpande M.V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452
 10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978-0470213995

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Select relevant DC motor for various electric drive applications.
2. Select relevant AC motor for various electric drive applications.
3. Maintain DC Drives.
4. Maintain AC Drives.
5. Maintain microprocessor/micro controlled electric motors

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	15	15
3	15	15
4	12	10
5	10	10
Total	64	60

Course Code	:	ECEOE301
Course Title	:	PLC & Automation
Number of Credits	:	3 (L:3,P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objective:

1	Understand automation technologies and identify advantages, limitations and applications of the same
2	Develop ability to recognize, articulate and solve industrial problems using automation technologies
3	To understand the generic architecture and constituent components of a Programmable Logic Controller.

Course Content

Unit I : Introduction

1. Introduction to Automation
 - 1.1 Definition
 - 1.2 Role of Automation
 - 1.3 Industrial Applications
 - 1.4 History of Automation

Unit II: Automation Components

- 2.1 Relays: Concept of relays, Relay wiring for logic gates
- 2.2 Switches and its types
- 2.3 Sensors:
Working principal of Optical Sensors, Capacitive Sensors, Inductive Sensors, Ultrasonic Sensors, Fluid flow Industrial Sensors, Angular displacement (Potentiometers, Encoders, tachometers), Linear Position (LVDT), Forces and Moments (Strain gages, Piezoelectric), Liquids and Gases (Pressure, Venturi valves, Magnetic and Ultrasonic flow meter, Pilot Tubes), Temperature (RTDs, Thermocouples, Thermisters), Light (LDR).
- 2.4 Concept of Control Actuators, Different types) Control Actuators (Solenoids, Valves, Hydraulics, Pneumatics

Unit III: PLC (Programmable Logic controller)

- 3.1 Introduction, Advantages of PLC control Panel, Architecture of PLC, - Functions of various Blocks of PLC, Working principle of PLC, Memory types , Different types of Input/Output circuits
- 3.2 Concept of inputs and outputs:Concept of Digital inputs and outputs, Concept of Analog inputs and outputs

- 3.3 Concept of sink and source input/ output cards
- 3.4 Programming Methods, Programming devices, Programming with PLC
- 3.5 Basic Instructions - NO and NC contacts
- 3.6 Boolean gates - symbols and truth tables
- 3.7 Introduction to Ladder Logic programming
- 3.8 Concept of latching and unlatching
- 3.9 Timers and counters
- 3.10 Maintenance and Trouble Shooting of PLC
- 3.11 Selection of PLC
- 3.12 Applications

Unit IV: Programing Instructions

User and Bit Functions, Timer and Counters, Input / Output, Compare Compute/math Instructions, Move and Logical Instructions

Course Outcomes:

CO1	Identify different types of Automation systems.
CO2	Understand the basics of PLC programming
CO3	Understand the different parameters of PLC.
CO4	Design different process control applications through ladder logic

SUGGESTED LEARNING RESOURCES:

1. Introduction to Transducers by Arun K. Ghosh, PHI Learning
2. Transducers Engineering by S. Vijayachitra , PHI Learning
3. Programmable Logic Controller Jadhav, V. R. Khanna publishers, New Delhi
4. PLCs & SCADA Theory and Practice, Rajesh Mehra , Vikrant Vij,Laxmi Publications Private Limited.
5. PLC and Automation, Mahesh S. Patil , Rahul K. Sarawale, Nirali Prakashan

Suggested Distribution of Marks (For Paper Setters and Students)

Topic /Unit	Time (In Hrs.)	Marks Allotted
1	06	03
2	22	18
3	24	24
4	14	15
Total	64	60

Course Code	:	ECEOE302
Course Title	:	Satellite and Cellular Communication
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objective:

1	Understand the basics of satellite Communication and its Applications.
2	To understand the design of cellular systems.
3	To understand the evolution of Communication Generations

Course Content

Unit 1: Introduction to Satellite Communication

- 1.1 Evolution and growth of communication satellite. Need for satellite communication.
- 1.2 Advantages of satellite communication
- 1.3 Active & Passive satellite
- 1.4 Orbital aspects and their effects on satellite communications.

Unit 2: Satellite Applications

- 2.1 INTELSAT Series, INSAT, VSAT
- 2.2 Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO
- 2.3 Satellite Navigational System. GPS Position Location Principles
- 2.4 Differential GPS, Direct Broadcast satellites (DBS/DTH).

Unit 3: Cellular Communication Concepts

- 3.1 Introduction of cellular communication, Formation of Cell, frequency reuse concept.
- 3.2. Classification of Cells, Umbrella cell concept.
- 3.3 Channel assignment strategies.
- 3.4 Handoff, Hard and Soft handoff, Handoff strategies.
- 3.5 Interference, Co channel and Adjacent channel interference.
- 3.6 Estimation of cellular system capacity.
- 3.7 Cellular system capacity improving techniques; Cell splitting, Sectoring, Microcell zone concept.

Unit 4: Evolution of Communication Generations:

- 4.1 2.5G TDMA evolution path, GPRS technology,
- 4.2 EDGE technology, 2.5G CDMA technology,
- 4.3 Need of 3G and 4G mobile networks,
- 4.4 Introduction to CDMA 2000 technology. Comparison between GSM and CDMA technologies.
- 4.4 LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

Course Outcomes:

CO1	Analyze the satellite orbits
CO2	Design various satellite application
CO3	To understand the design of a cellular system
CO4	Illustrate the generations of telecommunication systems in wireless network

SUGGESTED LEARNING RESOURCES:

1. Dennis Roddy —Satellite Communication, 4th Edition, Mc Graw Hill International, 2006.
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication,2nd Edition, Wiley Publications,2002
3. Wireless Communications and Networking, by William Stallings.
4. Wireless Communications, Principles and Practice, by Theodore S.Rappaport.

Suggested Distribution of Marks (For Paper Setters and Students)

Topic /Unit	Time (In Hrs.)	Marks Allotted
1	10	09
2	18	18
3	16	15
4	20	18
Total	64	60

Course Code	:	ECEOE304
Course Title	:	Optical Fibre Technology
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

1	To provide a comprehensive understanding of the fundamental principles of optical fibre technology.
2	To develop an understanding of optical fibre characteristics and the factors that affect them.
3	To introduce the students to the design of fibre optic communication systems and their applications.
4	To familiarize the students with the use of fibre optic sensors in various fields.
5	To introduce the students to the basics of optical amplifiers and their applications.

COURSE CONTENT: -

1. Introduction to Optical Fibre

Technology 1.1 Introduction to Optical Fibres ,

1.2 Types of Optical Fibres on the basis of refractive index profile & on the basis of modes, 1.3 Advantages and Limitations of Optical Fibres

2. Optical Fibre Characteristics

2.1 Attenuation and Dispersion in Optical Fibres, 2.2 Numerical Aperture and Acceptance Angle 2.3 Optical Fibre Modes

3. Fibre Optic Communication Systems

3.1 Working principle of Optical Sources (LED, LASER DIODE),
3.2 Working principle of Detectors (PIN TYPE, AVALANCHE TYPE)
3.3 Block diagram of Fibre Optic Transmitters and Receivers
3.4 Modulation Techniques (ASK, FSK)
3.5 Multiplexing Techniques (TDM, WDM)

4. Fibre Optic Sensors

4.1 Types of Fibre Optic Sensors
4.2 Principle of Operation of fabry-perot interferometer (fpi) sensor & fiber optic gyroscope (fog) sensor

5. Optical Amplifiers

5.1 Types of Optical Amplifiers
5.2 Working principle of Erbium-doped Fibre Amplifiers
5.3 Working principle of Semiconductor Optical Amplifiers (SOA)

6. Fibre Optic Networks

6.1 Classification of optical networks

6.2 Hybrid Fibre-Coaxial (HFC)

Network 6.3 Passive Optical

Network (PON)

6.4 SONET/SDH

6.5 OTDR method of testing network.

Course Outcomes:

CO1	Understand the principles of optical fibre technology
CO2	Analyze and design optical fibre networks
CO3	Apply optical fibre sensors for various applications
CO4	Troubleshoot optical fibre systems

SUGGESTED LEARNING RESOURCES

1. G. Keiser, Optical Fiber Communication, Tata McGraw Hill, 2013.
2. J. M. Senior, Optical Fiber Communications, Pearson Education, 2010.
3. G. P. Agrawal, Fiber Optic Communication Systems, John Wiley & Sons, 2002.

SUGGESTED DISTRIBUTION OF MARKS (For Paper Setter & Students)

UNIT	Time in Hours	Percentage Distribution of Marks
1	8	07
2	12	12
3	20	20
4	8	07
5	8	07
6	8	07
Total	64	60

Course Code	:	ITOE301
Course Title	:	Cyber Laws & Ethics
Number of Credits (Teaching Load)	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

In the age of the internet, our lives are increasingly dependent on online shopping, banking, and socializing. We store personal information on our computers and in the cloud. Hence, in modern society, cybersecurity and data protection are major challenges to combat. This introductory course is designed to create an awareness among the students about various challenges pertaining to the cyberworld and legal frameworks to deal with a new set of challenges arising thereof.

Course Outcomes

After completing this course the students will be :

- CO-1. Conversant with the basic terminology of the cyberworld.
- CO-2. Having thorough knowledge about cyber ethics and code.
- CO-3. Having awareness about the legal framework to combat cybercrimes.
- CO-4. Having awareness about IPRs and their protection.

Course Content

Unit-1 : Cyber Ethics & Etiquettes 15 Marks

History of the Internet, Major Applications of the Internet - Email, WWW, Social Media, Online Payment, Online Gaming; Digital Footprints, Cyberworld, Digital Society and Netizen, Net Etiquettes, Cyber Ethics; Impact of the Internet on Society, Impact of Digital Technologies on Health, Government Guidelines and Digital Media Ethics Code

Unit-2 : Basics of Cybersecurity 15 Marks

Need for Cybersecurity, Challenges in Cybersecurity; Cybersecurity Framework; Cybercrime - Hacking, Phishing, Fraud Emails, Identity Theft, Ransomware, Cyber Stalking/ Harassment, Cyberbullying, Pornography, Cyber Terrorism, Cyber Defamation; Combatting and Preventing Cyber Crime; Prevention from Cybercrime using self-regulation; National Cyber Security Strategy

Unit-3 : Intellectual Property Rights 15 Marks

Data Protection, Right to Privacy and Data Protection, Intellectual Property Right (IPR), Copyright, Patent, Trademark; Scopes of Copyrights, Patents and Trademark; Violation of IPR -

Plagiarism, Copyright Infringement, Trademark Infringement;

Unit-4 : Cyber Laws in India **15 Marks**

Major Provisions for Cybercrime under Indian Penal Code (IPC), Indian IT Act-2000 (Sections 65, 66, 67, 69); Digital Personal Data Protection Act 2023, Intellectual Property Rights, Patent Law, Copyright Law, Digital Signatures

Reference Books

1. Information Security and Cyber Laws, Sarika Gupta, Khanna Publishing House
2. Intellectual Property Rights by Dr. S.K. Singh, Central Law Agency
3. Cyber Law-Law Of Information Technology & Internet by Anirudh Rastogi, LexisNexis
4. Acts, Laws and Standards (IT Act, ISO27001 Standard, IPR and Copyright Laws)
5. GoI website <https://www.indiacode.nic.in>

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Cyber Ethics & Etiquettes	16 Hrs	15
Unit 2 : Basics of Cybersecurity	16 Hrs	15
Unit-3 : Intellectual Property Right	16 Hrs	15
Unit-4 : Cyber Laws in India	16 Hrs	15
Total	64 Hrs	60

Course Code	:	ITOE302
Course Title	:	Fundamentals of Blockchain Technology
Number of Credits (Teaching Load)	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

Contracts and transactions are at the heart of our modern society. Their paper-based and digital records define the most important structures of our administrative, economic, legal, political, and social systems by setting associated regulatory boundaries. They govern interactions among nations, public and private organizations, communities, and individuals worldwide. This is why they are frequently subject to digital abuse and fraud, which is why cybersecurity is more important than ever in the digital age. Blockchain technology promises to play a crucial role in this context since it might be as disruptive for data integrity and recording as the Internet has been for data access and exchange. This course is meant to expose the students to Blockchain technology and its applications.

Course Outcomes

After completing this course the students will be :

- CO-1. Conversant with the basic terminology of Blockchain technology.
- CO-2. Having knowledge about various application areas of Blockchain.
- CO-3. Having an understanding of distributed computing and cryptography.

Course Content

Unit-1 : Introduction to Blockchain 15 Marks

Centralized, Decentralized and Distributed Systems; P2P Systems, Concept of Trust in Distributed Computing, Evolution of Blockchain, Importance of Blockchain Technology, Blockchain Structure, Characteristics of Blockchain - Distributed Consensus, Cryptography, Immutability; Applications of Blockchain, Blockchain Types - Public, Private and Consortium

Unit-2 : Blockchain Components 15 Marks

Elements of a Blockchain, Nodes in Blockchain, Concept of Distributed Ledger, Consensus Algorithms - PoW and PoS, Structure of a Block, Blockchain Transactions, Cryptography, Plaintext and Ciphertext, Symmetric and Asymmetric Ciphers, Public/ Private Key Cryptography, Encryption and Decryption, Hashing, Challenges in Blockchain - Double Spending, Sybil Attack; Hyperledger

Unit-3 : Cryptocurrency **15 Marks**

Concept of Money, Properties of Money, Currency, Fiat Currency, Cryptocurrency, Advantages and Disadvantages of Cryptocurrency, Bitcoin, History of Bitcoin, Ethereum, Ethereum Concepts - Ether and Gas; Cryptocurrency Wallets, Concept of Cryptocurrency Mining

Unit-4 : Other Applications of Blockchain **15 Marks**

Smart Contracts, Non Fungible Tokens, Web 3.0, Digital Assets, Web 3.0, Application of Blockchain in e-Governance, Land Record, Digital Certificates, Insurance, Supply Chain, Identity Management, E-Voting, IoT

Reference Books

1. Ethereum: The Insider Guide to Blockchain Technology, Cryptocurrency and Mining
Ethereum by Richard Ozer, Createspace Independent Publication
2. Blockchain for Beginners by Kurt Dugan, CRB Publishing
3. The Basics of Bitcoins and Blockchains by Antony Lewis, Two Rivers Distribution
4. Distributed Ledger Technology: The Science of the Blockchain by R.P. Wattenhofer,
Inverted Forest Publishing

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Introduction to Blockchain	16 Hrs	15
Unit 2 : Blockchain Components	16 Hrs	15
Unit-3 : Cryptocurrency	16 Hrs	15
Unit-4 : Other Applications of Blockchain	16 Hrs	15
Total	64 Hrs	60

Course Code	:	ITOE304
Course Title	:	Multimedia Applications
Number of Credits (Teaching Load)	:	3 (L : 3, DCS : 1, P : 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

The objective of this course is to introduce students to the domain of Multimedia applications, which entails the technologies underlying digital images, videos and audio contents and interactive media.

Course Outcomes

After completing this course the students will be able to :

CO-1. Understand the basic terminology associated with multimedia technologies.

CO-2. Explain various applications of multimedia technology.

CO-3. Understand the basic multimedia compression techniques.

Course Content

Unit 1 : Introduction to Multimedia 15 Marks

Multimedia, Multimedia Elements, Multimedia Hardware - GPU, Digital Camera, Scanner, Projector, Printer, MIDI Synthesizer, Light Pen, Touch Screen, Microphone, Speakers; Multimedia Software - Raster Graphics and Vector Graphics Editing Software, Audio and Video Editing Software, Multimedia Authoring, Video and Audio Data Compression Techniques – Lossy and Lossless

Unit 2 : Multimedia Applications 15 Marks

Video on Demand, Video Streaming, Multimedia Conferencing, Interactive Television, Educational Applications, Social Media, Healthcare, Augmented Reality, Virtual Reality, Visual Effects (VFX), Modelling and Simulation, Marketing, Business Presentations

Unit 3 : Computer Graphics 15 Marks

Raster and Vector Graphics, Basic Terminology - Coordinate System, Pixel, Bitmap, Resolution, Dot Pitch, Color Depth, Aspect Ratio, Gamut, Color Models - RGB, CMYK, HSL; Aliasing, 2D Transformations - Translation, Rotation and Scaling; Vector Graphics Primitives, Shapes, Anchor Points, Bezier Curves, Combining Shapes - Union, Intersection, Exclusion and Minus; Stroke and Fill, Features of Adobe Illustrator, Features of Adobe Photoshop and Adobe Illustrator

Unit 4 : Digital Audio & Video 15 Marks

Characteristics of Audio - Frequency, Amplitude, Envelope; Digitization of Sound, Sampling

and Quantization, Synthetic Sound, MIDI, Digital Video, Basic Principles of Animation, Animation Terminology - Timeline Frames, Keyframes, Layers, Tweening, 2D and 3D Animation, Introduction to different MPEG standards - MPEG-1, MPEG-2, MP3, AAC.

Reference Books & Online Resources

1. Elements of Multimedia by Sreeparna Banerjee, CRC Press
2. Fundamentals of Multimedia by Ze-Nian Li et al., Springer
3. Multimedia Foundations by Vic Costello, Routledge Publication
4. Online Tutorials on Adobe Photoshop and Illustrator

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Introduction to Multimedia	16 Hrs	15
Unit 2 : Multimedia Applications	16 Hrs	15
Unit 3 : Computer Graphics	16 Hrs	15
Unit 4 : Digital Audio & Video	16 Hrs	15
Total	64 Hrs	60

Course Code	:	IEOE301
Course Title	:	Power Plant Instrumentation
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts, equipments or systems used in Power Plant based on Instrumentation or Process Control.

COURSE CONTENT

UNIT-I: Power Generation

- 1.1 Renewable & Non-Renewable Sources of Electricity.
- 1.2 Concept of Power Generation- Schematic Block Diagram of Hydro, Thermal, Nuclear, Solar & Wind Power Plant.
- 1.3 Importance of Instrumentation in Power Plants.

UNIT-II: Essential Process Parameter Measurement Concepts in Power Plants

- 2.1 Measurement of Temperature.
- 2.2 Measurement of Pressure.
- 2.3 Measurement of Flow. 2.4 Measurement of Level.
- 2.5 Measurement of Vibration.

UNIT-III: Process Control/Instrumentation in Water Treatment

- 3.1 Process Control/Instrumentation in Pre Water Treatment.
- 3.2 Process Control/ Instrumentation in DM Water Treatment Plant.
- 3.3 Instrumentation in Effluent Treatment Plant.
- 3.4 Instrumentation in Sewage Treatment Plant.

UNIT-IV: Important Control Loops in Steam Generation

- 4.1 Introduction to Steam Generator (Boiler).
- 4.2 Boiler Feed Water Control.
- 4.3 Boiler Air/Fuel Ratio Control.
- 4.4 Boiler Combustion Control.
- 4.5 Boiler Drum Level Control.
- 4.6 Boiler Steam Temperature Control. 4.7 Boiler Deaerator Control.
- 4.8 Boiler Superheating Control.

UNIT-V: Turbine – Monitoring & Control

- 5.1 Introduction to Turbine.
- 5.2 Turbine – Steam Pressure Monitoring & Control.

5.3 Turbine – Temperature Monitoring & Control.

5.4 Turbine – Vibration Monitoring & Control.

5.5 Turbine – Speed Monitoring & Control.

Reference Books:

1. Power Plant Engineering; P. K. Nag; TMH Publishers.
2. Power Plant Engineering; R. K. Rajput; Laxmi Publications.
3. Power Plant Instrumentation; K. Krishnaswamy; PHI.
4. Boiler Control Systems Engineering; G.F. Gilman; ISA Publication.
5. Instrument Engineer’s Handbook; Bela G Liptak; CRC Press.

Course Outcome:

At the end of the course, the student will be able to:

CO-1: Learn the concept of power generation

CO-2: Need of Instrumentation in Power Plants

CO-3: Various Control or Process Control Methodology

CO-4: Importance of Instrumentation in Smooth Power Plant Operation.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time (in Hours)	Marks Allotted
1	12	12
2	10	6
3	12	12
4	18	18
5	12	12
Total	64	60

Course Code	:	IEOE302
Course Title	:	Automation Solutions
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts of Automation, PLC, DCS & Robotics.

COURSE CONTENT

UNIT-I: Overview of Automation

- 1.1 Idea on PID.
- 1.2 Idea on a close loop system with real example of different instrument needed.

UNIT-II: Programmable Logic Controller

- 2.1 Introduction to PLCs, Areas of applications.
- 2.2 Architecture of a typical PLC, operation of PLC.
- 2.3 Difference between PLC and Hardware system, Relay logic and Ladder Logic.
- 2.4 Programming of PLCs, systematic solution finding.
- 2.5 Programming languages, PLC Programmers, PC interface.
- 2.6 Function block diagram, ladder diagram, instruction list, structured text.
- 2.7 Sequential function chart, logic control systems, timers, counters.
- 2.8 Commissioning and operational safety of a PLC, data transmission interface and communication in the field area.
- 2.9 Guidelines and standards.

UNIT-III: Distributed Control System:

- 3.1 Features of DCS.
- 3.2 PLC and DCS – a comparative study.
- 3.3 Architecture of a Typical DCS system.
- 3.4 Advantage & Disadvantage of DCS.
- 3.5 Hardware arrangement of DCS for a complete close loop system for analog as well as digital control.
- 3.6 Concept of graphic panel, control panel, tuning panel, alarm panel etc.

UNIT-IV: Concept of Robotics

- 4.1 Definition of Robot and Robotics, functional components of Robot.
- 4.2 Different types of robot joints, workplace, work volume, work envelop degree of freedom of robot.
- 4.3 Common types of configuration used in major linkage or arm. 4.4 Description of Cartesian coordinate robot.

4.5 Robot Sensors: internal (joint position, speed sensor, acceleration, force, torque), external tactile, proximity, long range).

4.6 Robot application- loading unloading, material handling etc.

Reference Books:

1. Process Control Instrumentation Technology; Curtis D. Johnson; PHI.
2. Process Control Principles and Applications; Surekha Bhanot; Oxford.
3. PID Controllers: Theory, Design and Tuning; Karl J. Aström and Tore Hägglund; Instrument Society of America.
4. Instrument Engineer's Handbook; Bela G Liptak; CRC Press.
5. Programmable Logic Controller; Vijay R. Jadhav; Khana Publishers.
6. Programmable Logic Controllers; Weib & Reis; PHI
7. Robotic Technology and Flexible Automation; S R Deb & S Deb; TMH
8. Robotics Engineering; Klafter, Chmielewski & Negin; PHI

Course Outcome:

At the end of the course, the student will be able to:

CO-1: Understand the basic concept of Automation.

CO-2: Understand about PID Controller.

CO-3: Enhance knowledge about PLC.

CO-4: Enhance knowledge about DCS

CO-5: Understand about Robotics.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time (in Hours)	Marks Allotted
1	10	12
2	20	18
3	17	15
4	17	15
Total	64	60

Course Code	:	IEOE304
Course Title	:	Computer Aided Instrumentation
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts of Computer/PC Based Instrumentation.

COURSE CONTENT

UNIT-I: Introduction:

- 1.1 General structure of PC based instrumentation.
- 1.2 Advantages and disadvantages of computer based instrumentation.
- 1.3 Comparison with other systems.

UNIT-II: Buses & Other Interfaces:

- 2.1 Introduction.
- 2.2 Expansion Buses- ISA bus, EISA bus, PCI bus.
- 2.3 Serial Interface- RS232, RS422 & RS 485.
- 2.4 Universal Serial Bus (USB). 2.5 GPIB.

UNIT-III: Computers in Process Control:

Programmable controller, Data logging, Supervisory control, Computer based controller.

UNIT-IV: Linear Circuit and Signal Conditioning:

Op-Amps, Instrumentation Amplifiers and Signal Conditioning, Multiplexer and De-Multiplexer, ADC and DAC.

UNIT-V: Parallel Port

Introduction to parallel port, Standard Parallel, Enhanced parallel port, Enhanced Capabilities port.

UNIT-VI: Use of Instrumentation Software Package:

Basic use of:

1. LabVIEW. 2. MATLAB. 3. MULTISIM.

Reference Books:

1. PC Based Instrumentation; N. Mathivanan; PHI.
2. Advanced Instrumentation & Computer I/O Design; Patrick H. Garrett; Wiley.
3. PC Based Instrumentation & Control; Mike Tooley; Routledge.
4. PC Interfacing for Data Acquisition & Process Control; Sanjay Gupta; ISA.
5. Virtual Instrumentation using LabVIEW; Jovitha Jerome; PHI.

Course Outcome:

At the end of the course, the student will be able to:

CO-1: Know Bus Standard.

CO-2: Know about Serial & Parallel Port, USB.

CO-3: Know about Linear Circuits & Signal Conditioning.

CO-4: Know about various controllers of Process Control.

CO-5: Know the basics of LabVIEW, MATLAB & MULTISIM.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
1	6	6
2	14	15
3	11	9
4	14	12
5	10	9
6	9	9
Total	64	60

Course Code	:	MEOE301
Course Title	:	Renewable Energy Technologies
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

- To understand present and future scenario of world energy use.
- To understand fundamentals of solar energy systems.
- To understand basics of wind energy.
- To understand bio energy and its usage in different ways.
- To identify different available non-conventional energy sources.

Course Content:

UNIT-I: (12Hrs)

Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilization; Renewable Energy Scenario in India and around the World; Potentials; Achievements/Applications; Economics of renewable energy systems.

Unit-II: (13Hrs)

Solar energy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation; Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

Unit-III (13Hrs)

Wind Energy: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance; Site Selection; Details of Wind Turbine Generator; Safety and Environmental Aspects.

Unit-IV: (13Hrs)

Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Biodiesel; Cogeneration; Biomass Applications.

Unit-V: (13Hrs)

Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi (ed. 2018)
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
3. Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey

- & Sons, New York
8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

Course outcomes: At the end of the course, the student will be able to:

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods of solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio-energy generations from various Bio-wastes.
CO5	Identify suitable energy sources for allocation.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	MEOE302
Course Title	:	Installation Testing and Maintenance
Number of Credits	:	3(L:3, DCS:1, P:0)
Pre requisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To explain the concept of testing, repair and maintenance
- To comprehend the procedure for erection and commissioning of machines.
- To provide adequate information, confidence and experience to handle any issue or problem related to mechanical equipment during operations
- To understand the inspection schedules and activities and maintenance requirements to be able to contribute to better and more efficient mechanical equipment and lesser repair costs

Course Content:

UNIT-I:

(12Hrs)

Introduction: Necessity of testing, repair and maintenance; manpower planning and materials management.

Execution and Commissioning of Machines (Installation): Location, layout and positioning of machines; Foundation - types of foundation. Brief description of following:- Foundation plan, Foundation bolts, erection and leveling, grouting, vibration damping.

Unit-II:

(19Hrs)

Inspection, Servicing, Repair & Overhauling of machines and equipment : Inspection of various machines and equipment; Servicing of various machines and equipment; Repair of various machines and equipment; Overhauling of various machines and equipment.

Maintenance planning & stages of maintenance: Maintenance planning; Various stages of maintenance; Maintenance schedules.

Unit III:

(14Hrs)

Reliability Centred Maintenance (Introduction only): Reliability; Availability; Maintainability

Overhauling: Frequent failure of common parts, their causes & remedial measures.; Overhauling schedule and procedure.; Repair and maintenance of Parts which require frequent maintenance to avoid downtime.; Fault diagnosis and action against fault.

Unit-IV:

(19Hrs)

Maintenance: Meaning of maintenance; advantages & disadvantages; Types of maintenance:- Preventive, predictive & breakdown maintenance.; Maintenance organization.; Centralized maintenance & decentralized maintenance.

Storage of parts: Storage of parts used frequently for replacement and parts which are not easily available in local market.; History cards of different machines.; Machines repair/replacement decision.

Reference Books:

1. Industrial Maintenance by HP Garg; S. Chand and Company.
2. Plant Maintenance Engineering by RK Jain; Khanna Publishers.
3. A Text book of Reability and Maintenance Engineering by Dr. A Manna, Prentice Hall of India.
4. Installation, Servicing and Maintenance by SN Bhattacharya; S. Chand and Company.
5. Installation, Maintenance, Servicing by AR Basu; M Dutta and Co., Calcutta. 115
6. Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt., Ltd., New Delhi.

Course out comes:

At the end of the course, the student will be able to:

CO1	Understand the principles and objectives of Maintenance Engineering
CO2	Describe the various categories of maintenance.
CO3	Discuss various condition monitoring techniques
CO4	Understanding of international standards for safety and operational adherence

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	19	18
3	14	12
4	19	18
Total	64	60

Course Code	:	MEOE304
Course Title	:	Production Planning and Control
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

1. To analyze different planning activities needed during the operations stage of a manufacturing or a service industry.
2. To apply productivity techniques for achieving continuous improvement.
3. To critically analyze existing methods of doing the job and evolve efficient and economical methods.
4. To understand the applications of material handling equipment.

Course Content:

UNIT-I: (15Hrs)

Introduction: Types of production. - Job, batch and mass production; Concept of planning, scheduling, routing, dispatching and follow up; Break even analysis

Plant Location and Layout: Factors affecting the site selection of plant; Factors affecting plant layout; Types of layout - Process, product, combination and fixed position.

Unit-II: (13Hrs)

Inventory Control: Material purchasing; store keeping; functions and duties of store department; Definition of inventory; Types of inventory; ABC analysis; Procurement cost; carrying charges; lead-time; reorder point; Economic ordering quantity; simple direct numerical problems; Concept of JIT

Unit-III: (12Hrs)

Inspection and Quality Control(Problems omitted): Inspection needs; types of inspection; stages of inspection; Statistical quality control; Process capability; Control charts for variables – X and R chart; control chart for fraction defectives (P chart); control chart for number of defects (C chart).

Unit-IV: (13Hrs)

Material Handling: Principles of material handling; Hoisting equipment - Fork lift truck, cranes; Conveying equipment - Package conveyor, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, belt conveyors, and pneumatic conveyors.

Repair and maintenance: Objectives and importance of maintenance; Different types of maintenance; Nature of maintenance problem; Range of maintenance activities; Procedure of preventive maintenance; Schedules of preventive maintenance; Advantages of preventive maintenance

Unit-V: (11Hrs)

Cost estimation and control(Problems omitted): Functions of cost estimation; Estimation procedure; Elements of cost; ladder of costs; Depreciation-concept and methods of calculating depreciation; Overhead expanses; Cost control - capital cost control (planning and scheduling) operating cost control.

Reference Books:

1. Industrial Engineering and Management by T.R. Banga and SC Sharma; Khanna Publishers, Delhi
2. Industrial Engineering and Management by O.P. Khanna; Dhanpat Rai and Sons, New Delhi
3. Production Management by C.L. Mahajan; Satya Parkashan Company Limited, New Delhi
4. Mechanical Costing, Estimation and Project Planning by CK Singh; Standard Publishers, New Delhi
5. A Text Book of Reliability and Maintenance Engineering by A Manna, Prentice Hall of India

Course outcomes

At the end of the course, the student will be able to:

CO1	Explain Break even analysis to determine safe production levels and costing of industrial products.
CO2	Demonstrate the knowledge of selection of location for the new plant & optimizing the layout within the plant for smooth production.
CO3	Apply productivity techniques for continuous improvement in different functionalities of an industry.
CO4	Ability to apply the concept of inventory and supply chain management.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	15	15
2	13	12
3	12	11
4	13	12
5	11	10
Total	64	60

Course Code	:	IoTOE301
Course Title	:	Software Project Management
Number of Credits (Teaching)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

Software project management is an art and discipline of planning and supervising software projects. It will inculcate the students with the procedure of managing, allocating and timing resources to develop computer software that fulfills requirements.

Course Outcomes

After the course completion, the students would be able to:

- CO-1. Understand the basics of the software project management techniques.
- CO-2. Learn the feasible solution and optimum solution for the resource management.
- CO-3. Learn the time estimation and critical path for project.
- CO-4. Learnt about the application of probability techniques in the decision making.

Course Content

Unit 1: Introduction

14 Hours

Project - Programs, Subprojects and Portfolios. Software Project - Application Development, Process & Systems Reengineering Services, System Integration Services. Software Project Management Fundamentals, People, Process, and Product, PMI Processes, Software project phases, Organizational structures, Project charter, Statement of Work (SOW).

Unit 2: Project Planning

12 Hours

Development lifecycle models - Waterfall Model, V-Shaped Model, Iterative Model, Spiral Model, Agile Model. Matching lifecycles to projects, Project plans, Work Breakdown Structures (WBS).

Unit 3: Managing Goals, Time, and Costs

14 Hours

Formalizing the Project Goals. Techniques to Assess Value and Risks. Building a WBS, WBS Decomposition Styles, WBS Construction Methodologies. Estimation - Effort, Duration, and Resources. Budgeting and Accounting - Project Costs, Cost Element Structures, Determining the Project Costs, Determining the Project Costs.

Unit 4: Managing People and Organizing Communication

14 Hours

Managing People- Define Staff Requirements, Selection of Staff, Managing Staff, Management Styles. Project Organization Structures – Hierarchical, Matricial Organizations, RACI Matrix, Agile Teams. Managing Communication - Planning a Communication Strategy, Communication Styles. Meetings - Managing Meetings, Types of Meetings, Planning Poker.

Unit 5: Risk, Change and Configuration Management**10 Hours**

Risk management, Change control, Microsoft Project Management software, Configuration management process, configuration management audit.

Reference Books & Online Resources:

1. M. Cottrell and B. Hughes, Rajib Mall, "Software Project Management", McGraw-Hill, 6/e, 2019.
2. Kathy Schwalbe, "Information Technology Project Management", Cengage Learning, 7/e, 2013.
3. Adolfo Villafiorita, "Introduction to Software Project Management", CRC Press, Taylor & Francis Group, 2014.
4. D. J. Henry, "Software Project Management – A Real-World Guide to Success", Addison-Wesley, 2003.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	12 Hrs	18
Unit 3	14 Hrs	24
Unit 4	14 Hrs	20
Unit 5	10 Hrs	18
Total	64	100

Course Code	:	IoTOE302
Course Title	:	Data Warehousing and Data Mining
Number of Credits (Teaching Load)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

This course will introduce the concepts of data warehousing and data mining, which gives a complete description about the principles, uses, architectures, applications, design and implementation of data mining and data warehousing concepts.

Course Outcomes

After completing this course, the students will be able to:

- CO-1 Identify the scope and necessity of Data Warehousing Data Mining.
- CO-2 Understand the basic architecture of Data Warehousing.
- CO-3 Understand various tools of Data Mining and their techniques.
- CO-4 Understand the various trends and application of Data Mining

Course Content

Unit 1: Introduction to Data Warehousing ----- 14 Hours

Data Warehouse, OLTP, OLAP, comparison of OLTP and OLAP systems, three-tier data warehouse architecture, Data Warehouse Models: Enterprise warehouse, Data mart, Virtual warehouse, Types of OLAP Servers: Relational OLAP (ROLAP), Multidimensional OLAP (MOLAP), Hybrid OLAP (HOLAP).

Unit 2: Multidimensional Data Models ----- 10Hours

Multidimensional database, data cube, concept hierarchy, OLAP Operations: Roll-up, Drill-down, Slice and dice, Pivot (rotate), Schemas for multidimensional databases: Stars, Snowflakes, and Fact Constellations.

Unit 3: Data Mining & KDD Process ----- 14 Hours

Data Mining, Importance of data mining, KDD process: Data preprocessing, Data cleaning, Data integration, Data selection, Data transformation, Data mining, Pattern evaluation, Knowledge presentation. Classification of data mining systems, Technologies used in data mining, Major issues in Data Mining.

Unit 4: Building Data Warehouse ----- **14 Hours**

ETL process, Top-down approach, Bottom-up approach, Steps for Data warehouse design: choosing a business process to model, choosing the grain of the business process, choosing the dimensions, choosing the measures, Recommended approach for data warehouse development.

Unit 5: Applications & Trends in Data Mining ----- **12 Hours**

Data Mining Applications: Data Mining for Financial Data Analysis, Retails and Telecommunication Industries, Science and Engineering, Intrusion Detection and Protection, Recommendation System, Recent trends in data mining.

Reference Books & Online Resources

1. “Data Mining & Warehousing”, by Ikvinderpal Singh, Khanna Book Publishing Ltd.
2. “Data Mining, Data Warehousing”, by Parteek Bhatia, Cambridge University Press.
3. “Data Warehousing, Data Mining & OLAP”, by Alex Berson and S. Smith, TMH
4. “Data Mining – Concepts & Techniques” by Jiawei Han and Micheline Kamber, Elsevier.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	10 Hrs	18
Unit 3	14 Hrs	24
Unit 4	14 Hrs	20
Unit 5	12 Hrs	18
Total	64	100

Course Code	:	IoTOE304
Course Title	:	Wireless Sensor Network
Number of Credits (Teaching Load)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

This is one of the fundamental courses meant to understand the important concepts related to Wireless Sensor Networks

Course Outcomes

After the course completion, the students would be able to:

- CO-1. To understand the basics of Wireless sensor Networks.
- CO-2. To learn about the Architecture of WSN.
- CO-3. To understand the concept of Networking in WSN
- CO-4. To learn security requirements for WSNs.

Course Content

Unit 1: Introduction to Wireless Sensor Network (WSN) ----- 14 Hours

Wireless Network, Sensors, Wireless Sensor Network (WSN), Adhoc Network, Difference between Adhoc Networks and Wireless Sensor Network, Characteristics of WSN, advantages & disadvantages of WSN, Design challenges for WSN, Applications of Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Types of Wireless Sensor Networks.

Unit 2: Network Architecture for Wireless Sensor Networks ----- 14 Hours

Sensor Node, Sensor Node Structure, Components of Sensor Node, Network Architecture of WSNs – Flat Architecture and Hierarchical Architecture, Classifications of Wireless Sensor Networks, Protocol Stack for Wireless Sensor Networks, Optimization Goals and Figures of Merit.

Unit 3: WSN Networking Concepts and Protocols----- 14 Hours

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC and B-MAC Protocol, WSN Communication technologies - IEEE 802.15.4, NFC, BLE and ZigBee. Internet wo WSN Communication, WSN Routing Protocols Energy-Efficient Routing, Geographic Routing.

Unit 4: Infrastructure Establishment ----- **10 Hours**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit 5: Sensor Network Security ----- **12 Hours**

Network Security, Issues and challenges in Sensor Network Security, Security requirements – Availability, Confidentiality, Eavesdropping, Node Compromise, Authenticity, Packet Injection, Integrity, Freshness- Packet Replaying, Timestamp.

Reference Books & Online Resources:

1. Anna Forster, "Introduction to Wireless Sensor Networks", John Wiley & Sons, Inc., Publication 2016.
2. Sudip Misra, M. S. Obaidat, "Principles of Wireless Sensor Networks", Cambridge University Press
3. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks - A Networking Perspective", John Wiley & Sons, Inc., Publication
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	14 Hrs	24
Unit 3	14 Hrs	20
Unit 4	10 Hrs	16
Unit 5	12 Hrs	20
Total	64	100

Course Code	MAOE301
Course Title	Industrial Mechatronics
Number of Credits	3 (L:3, DCS:1, P:0)
Prerequisites	Engineering Mechanics
Course Category	Open Elective

Course Content:

UNIT-I (14Hrs)

Introduction to Mechatronics: What is mechatronics, The design process Systems, Measurement systems, Control systems, Programmable logic controller, Examples of mechatronic systems.

UNIT-II (11Hrs)

Sensors and signal Conditioning: Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers. Microprocessors, Microcontrollers. PID Controllers and PLCs.

UNIT-III (13Hrs)

Hydraulic Systems: Flow, Pressure and Direction Control Valves. Actuators, Supporting Elements, Hydraulic Power Packs, Pumps. Design of Hydraulic circuits.

UNIT-IV (13Hrs)

Pneumatic System: Production, Distribution and conditioning of compressed air. System Components and Graphic representations. Design of Systems

UNIT-V (13Hrs)

System models: Mathematical models, Mechanical system building blocks, Electrical system building blocks, Fluid system building blocks, Thermal system building blocks

References:

1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton Pearson Education 2019
2. Analysis and design of Dynamic Systems Cochin, Era and Cadwallender, AddisonWesley,1997
3. Mechatronics Engineering Tomkinson, D. And Horne, J. Longman McGraw Hill,1996
4. Mechatronics Bolton, W Pearson
5. Fundamental of mechatronic M. Jouaneh Cengage Learning ISBN –978-1111569020
6. Mechatronics – An Integrated Approach Clarence W. de Silva CRC Press ISBN –978-0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

https://youtu.be/Ro_tFv1iH6g

<https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/>

<https://science.howstuffworks.com/robot.htm>

Course outcomes:

At the end of the course, the student will be able to:

CO1	Ability to find creative solutions to real life problems using concurrent interdisciplinary approach to engineering design.
CO2	Ability to develop and program advanced manufacturing systems such as CNC machines, rapid prototyping systems and industrial robotics.
CO3	Ability to select appropriate sensors, actuators and control systems depending on application requirement in the domains such as industrial automation, process control, automotive electronics and MEMS.
CO4	Ability to simulate, analyze and design complex interdisciplinary technology systems with embedded software and hardware.

Suggested Distribution of Marks		
Name of Topic /Unit	Time Allotted(Hrs)	Marks Allotted (%)
1	14	20
2	11	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	MAOE302
Course Title	Robotics and Applications
Number of Credits	3 (L: 3, DCS:1, P:0)
Prerequisites	Mechatronics and instrumentation
Course Category	Open Elective

Course Content:

UNIT-I (08Hrs)

Introduction: Robot definition, need, robot terminology, robot motion, robot classification based on physical configuration, advantages and limitations of robot.

UNIT-II (22Hrs)

Basic Elements of Robots: Basic structure, classification of robotic systems- accordingly to types of system, according to control loop, according to structure of manipulator (Cartesian, cylindrical, spherical and articulated). Degree of freedom. End effectors- types, working principle and applications Drives- types and application with working principle.

Sensing Devices- optical sensor, proximity sensor- LVDT, Force sensor (strain gauges and piezoelectric), RTD and thermocouple. Motion encoders, Selection Criteria for Robot.

UNIT-III (10Hrs)

Robot controls: Purpose, level of controls; Device controller Work cell controller; Servo and Non-servo control systems – types, basic principle and block diagrams; Working, advantages, limit at ions of some control system; Adaptive control; Computed Torque Technique; New minimum time control; Resolved motion Control

UNIT-IV (12Hrs)

Robot Programming: Need and function of robot programming, Methods; Manual Teaching Lead through Programming languages (VAN, RAIL); Types, features and applications of various programming language

UNIT-V (12Hrs)

Robotic Applications: Material transfer, Machine loading and unloading, painting, packaging, inspection and welding.

Reference:

1. Robotics for Engineers Yoram Koren; McGraw Hill Publisher
2. CAD/CAM/CIM by P. Radhakrishnan and S. Subramaniam; Wiley Eastern Publishers, New Delhi
3. Robotics by K S Fu, R. C. Gonzalez and C S G Lee
4. Robotic Engineering by Richard K Lafter
5. Robot Reliability and Safety by B.S. Dhillon
6. Industrial Robotics by M.P. Groovers et al.

Course Outcome:

At the end of the course, the student will be able to:

CO1	Understand the basic concept of robot motion and physical configuration
CO2	Learn the basic structure of robotic system & degree of freedom.
CO3	Use of different types of drives, commissioning of drives and application
CO4	Use different types of industrial sensor to make a live project

Suggested Distribution of Marks		
Name of Topic /Unit	Time Allotted(Hrs)	Marks Allotted (%)
1	08	10
2	22	30
3	10	15
4	12	25
5	12	20
Total	64	100

Course Code	:	MAOE304
Course Title	:	Product Design
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

- To acquire the basic concepts of product design and development process
- To understand the engineering and scientific process in executing a design from concept to finished product
- To study the key reasons for design or redesign.

Course Content:

UNIT-I

(12Hrs)

Definition of a product; Types of product; Levels of product; Product-market mix; New product development (NPD) process ; Idea generation methods; Creativity; Creative attitude; Creative de-sign process; Morphological analysis; Analysis of interconnected decision areas; Brainstorming.

Unit-II:

(12 Hrs)

Product lifecycle; The challenges of Product development; Product analysis; Product characteristics; Economic considerations; Production and Marketing aspects; Characteristics of successful Product development; Phases of a generic product development process; Customer need identification; Product development practices and industry-product strategies.

Unit-III:

(12Hrs)

Product design; Design by evolution; Design by innovation; Design by imitation; Factors affecting product design; Standards of performance and environmental factors; Decision making and iteration; Morphology of design(different phases);Role of aesthetics in design.

Unit-IV:

(16 Hrs)

Introduction to optimization in design; Economic factors in design; Design for safety and reliability ;Role of computers in design; Modeling and Simulation; The role of models in engineering design; Mathematical modeling; Similitude and scale models; Concurrent design; Six sigma and de-sign for six sigma; Introduction to optimization in design; Economic factors and financial feasibility in design; Design for manufacturing; Rapid Prototyping (RP); Application of RP in product design; Product Development versus Design.

Unit-V:

(12 Hrs)

Design of simple products dealing with various aspects of product development; Design starting from need till the manufacture of the product,

Reference Books:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw–Hill edition.
2. Engineering Design –George E. Dieter.
3. An Introduction to Engineering Design methods Vijay Gupta.
4. Merie Crawford : New Product management, McGraw-Hill Irwin.
5. Chitale A K and Gupta R C, “Product Design and Manufacturing”, Prentice Hall of India, 2005.
6. Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New Product Development, Pearson education.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand the basic concepts of product design and development process.
CO2	Illustrate the methods to define the customer needs.
CO3	Describe an engineering design and development process.
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5	Apply modeling and embodiment principles in product design and development process.

Suggested Distribution of Marks

Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	12	20
3	12	20
4	16	30
5	12	10
Total	64	100

Course Code	:	AGEOE301
Course Title	:	Fertiliser Technology
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Indian economy dominated by agriculture sector, it is therefore vital for technologists to understand each fertilizer product, its flow sheet diagram for industrial production. For this, student should have skills for arranging treatment, reaction, raw materials for variety of fertilizers including Nitrogenous, Phosphate, Potassic and Bio fertiliser is essential. Hence the course is designed to achieve this objective.

1. Introduction:

Objective, scope and outcome of the course

2. Nitrogenous Fertilisers

Macro and Micro Nutrients, Fertilisers Grades, Various Fertilisers and their demand and production in India, Methods of production of Nitrogenous Fertilisers: Ammonium sulphate, Ammonium nitrate, Urea, Calcium ammonium nitrate, Ammonium chloride. Characteristics, specifications, storage and handling of Nitrogenous Fertilisers.

3. Phosphate Fertiliser

Raw materials; Phosphate rock, Sulphur; Pyrites etc. applications, Processes for the production of Sulphuric and Phosphoric acids. Phosphate Fertilisers –Methods of production of single superphosphate and triple superphosphate. Characteristics and applications.

4. Potassic Fertiliser

Methods of production of Potassium chloride and its application. Potassium schoenite their characteristics and specifications. Complex and NPK Fertilisers Methods of production and applications of Ammonium phosphate sulphate, Diammonium phosphate and various grades of NPK Fertilisers produced in the country.

5. Miscellaneous Fertilisers

Mixed Fertilisers and granulated mixtures; Bio Fertilisers: Need and importance, Vermi-compost preparation and precautions, Method of production of Bio fertiliser using kitchen waste. Initiatives and Scheme of Centre and state Government towards bio fertiliser.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Use the proper micronutrients to improve fertility of soil.
CO2	Use relevant fertilizer on the basis of soil .
CO3	Select the relevant manufacturing process for the Phosphatic fertilisers.
CO4	Select the relevant manufacturing process for the Potassic fertilisers.
CO5	Select proper nutrients to produce Bio fertiliser.

Reference Books:

1. Fertilizer Technology and management by Brahma Mishra, Willy Publication.
2. Fertilizer: A Text Book by Ranjan Kumar Basak, Kalynai Publishers.
3. Handbook of Fertilisers - Their Sources, Make-Up Effects and Use by A. F. Gustafson, Read Books
4. Fertilisers and Their Use, 4Th Edition by FAO, Scientific Publishers
5. The Chemistry and Technology of fertilizer by Sauchelli, Reinhold Publication Corp. New York.
6. Bio fertilizers in Agriculture by Rao,N S Subba, Oxford and IBH Publications Co. New Delhi
7. Hand Book fertilizer Technology, Editorial board, The fertilizers association of India, New Delhi

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	4	5
2	16	25
3	12	20
4	16	25
5	16	25
Total	64	100

Course Code	:	AGEOE302
Course Title	:	Industrial Safety
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

To impart knowledge on safety engineering fundamentals and safety management practices.

1. Introduction:

Evolution of modern safety concepts – Fire prevention – Mechanical hazard Boilers, Pressure vessels, Electrical Exposure.

2. Chemical Hazards

Chemical exposure – Toxic materials – Ionizing Radiation and Non-Ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

3. Environmental Control

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

4. Hazard Analysis

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment

5. Safety Regulations

Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety – case studies

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understands the need for safety in various Industrial sectors
CO2	Complete knowledge about various hazards in industries.
CO3	Create and develop innovations in safety.
CO4	Capable of handling various challenges in Industry regarding safety
CO5	Understand the various safety regulations

Reference Books:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. Safety Manual, “EDEL Engineering Consultancy”, 2000.
3. David L.Goetsch, “Occupational Safety and Health for Technologists”, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.
4. Industrial Safety & Environment by Anupama Prashar , S.K. Kataria & Sons

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	10	15
2	12	20
3	12	20
4	12	20
5	18	25
Total	64	100

Course Code	:	AGEOE304
Course Title	:	Organic and Natural Farm Practices
Number of Credits	:	03 (L:03, P:00, DCS:1)
Course Category	:	Open Elective

RATIONALE

- To enable the students to learn concept, principles and need of Organic farming.
- To impart the knowledge of selection of Crop, Seed, Soil nutrient management, Harvest management.

1. Introduction

Concept, Philosophies, Principles and Need of organic farming.

2. Package of Practices for organic Farming

Selection of Crop, Seed selection and Treatment, Soil Sampling, Weed Management & Irrigation Management.

3. Soil Nutrient Management

Establishment of Organic Nutrient Production Unit (Manures, Compost and Bio fertilizer) Integrated Pest and Disease Management under Organic Farming including Integrated Pest.

4. Management

Bio pesticides and their Multiplication, Production of Bio and Herbal Pesticides at household/Farm Level.

5. Harvest and Post-Harvest Management

Branding of rural products, FSSAI, marketing and packaging of organic produce. Undertake Business of Organic Farming, Various Current Government schemes related to organic farming & Process of Certification.

Course outcomes:

After completing this course student will be:

CO1	Understand concept, principles and need of Organic farming.
CO2	Distinguish suitable climate for different crops.
CO3	Undertake business of organic farming.
CO4	Understand various Government schemes related to Organic farming and process of certification.

Reference Books:

1. Principles of Organic Farming by P.L. Maliwal Scientific Publishers.
2. Principles of Organic Farming by S.R. Reddy Kalyani Publisher.
3. ABC of Organic Farming by Amitava Rakshit and H B Singh Jain Brothers.
4. Farming System and Sustainable Agriculture by S.R. Reddy Kalyani Publisher.
5. Basics of Organic Farming by Bansal M. CBS Publishers And Distributors Pvt. Ltd.

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	10	15
2	12	20
3	12	20
4	12	20
5	18	25
Total	64	100

Course Code	:	EEVOE 301
Course Title	:	Automotive Fuel and Lubricants
Number of Credits	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the role of various fuel and lubricants
- To understand the properties of various fuel and lubricants
- To understand the testing procedure of various fuel and lubricants

Unit I REFINERY OF FUELS AND LUBRICANTS

Introduction to Structure of petroleum, refining Process-Distillation, cracking processes, Catalytic reforming, alkylation, isomerisation and polymerization, finishing process- blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants

Unit II_ : THEORY OF LUBRICATION

Engine friction: Introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elastic hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system

Unit III:-LUBRICANTS

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease- lubricants for gearbox, brake, differential and steering systems

Unit IV:-

PROPERTIES AND TESTING OF FUELS

Properties and testing of fuels- density, calorific value, cetane and octane number, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, cloud and pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion. Test on used lubricants. Biofuel-properties and testing.

Unit V:- Combustion and Fuel Rating

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane

rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating , fuel requirements

Text Books:

1. Ganesan.V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi
2. Kirpal Singh, “Automobile Engineering Vol-II”, Standard Publishers distributors
3. Mathur.M.L.,Sharma.R.P.“Acoursein internal combustionengines”,Dhanpatraipublication,2003

On completion of this course, a learner should be able to-

CO1	Identify the fuels and lubricants for automotive applications
CO2	Understand the properties of fuels & lubricants and their testing
CO3	Analyze the behavior of fuel and lubricants
CO4	Evaluate the properties and uses of fuel and lubricants
CO5	To understand the combustion process in IC engine

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	EEVOE 302
Course Title	:	Automotive Power Train
Number of Credit	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To introduce the various layout of vehicle chassis, engine types.
- To expose the need, constructional details and working principle of various clutches. To envisage the working of manual transmission systems.
- To explicate the operating principle of various automatic transmission systems.
- To relate the importance of driveline components, wheels and tyres.

Unit I Introduction: Layout with reference to power plant. IC Engine operation - classifications and working principle. E – Vehicle layout, operation, advantages and limitations.

Unit II Clutch: Requirements of Transmission system. Purpose and requirement of clutch. Principle of friction clutches. Principle and operation of single plate coil spring and multiplate clutches. Introduction to Electromagnetic clutch.

Unit III Gear Box: Purpose and requirement of gear box. Construction and working principle of sliding mesh and constant mesh gear boxes. Construction and working principle of synchromesh gear box. Introduction to Automated Manual Transmission. Comparison between conventional and Automated Manual Transmission.

Unit IV Automatic Transmission Construction and working principle of Fluid Coupling, advantages and limitations. Construction and working principle of Torque Converter. Multistage and Polyphase Torque converter. Principle of CVT, advantages and limitations.

Unit V Final Drive and Differential: Forces and Torque reaction on rear axle. Propeller shaft, Universal joints. Final Drive and its types. Construction and working principle of Differential. Introduction to Limited Slip Differential. Types of wheels and tyres.

Text Books

1. Rajput R.K., “A Textbook Of Automobile Engineering”, Laxmi Publications; Second edition, 2017.
2. K.Newton, W.Steeds and T.K. Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India 2004.
3. William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, 10th Edition, McGrawHill Education, 2017. REFERENCES: 1. David A Crolla, “Automotive Engineering: Powertrain, Chassis System and Vehicle Body”, Butterworth-Heinemann, 2009. 2. Ramalingam K.K, “Automobile Engineering”, Sci-Tec Book, 2005. 3. Heinz Heisler, “Advanced Vehicle Technology”, Butterworth-

Heinemann, 2002.

4. “Bosch Automotive Handbook”, 10th Edition, Robert Bosch GmbH, 2018.

On completion of this course, a learner should be able to:

CO1	Visualize the power flow of various vehicle layouts.
CO2	Understand the working principle the various positive engagement clutches.
CO3	Appraise upon the constructional details and working principle of the manual transmission systems
CO4	Compare and contrast between various automatic transmission systems
CO5	Summarize the significant driveline components, wheels and tyres

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	EEVOE 303
Course Title	:	Basics of Management
Number of Credits	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the basics of management.
- To understand self-management.
- To understand the leadership and motivation.
- To understand the Legal Environment and Business
- To understand the concept of total quality management.

Unit 1: Introduction to Management: Definitions and concept of Management, Functions of management- planning, organizing, staffing, coordinating and controlling, Various areas of management, Structure of an Organization.

Unit 2: Self-Management and Development: Life Long Learning Skills, Concept of Personality Development, Ethics and Moral values, Concept of Physical Development; Significance of health, hygiene, body gestures, Time Management Concept and its importance, Intellectual Development: Reading skills, speaking, listening skills, writing skills (Note taking, rough draft, revision, editing and final drafting), Concept of Critical Thinking and Problem Solving (approaches, steps and cases).

Unit 3: Leadership and Motivation: Meaning, importance , types of leadership and qualities of a good leader. Concept and importance of motivation-drives and incentives, types of motivation.

Unit 4: Legal Environment and Business:

- a) Various labour laws and its necessity. Salient features of Income Tax Act – computation of income tax on salary income, Sales and Excise Tax Act-VAT& Excise duty and Factory Act. 1948.
- b) Labour Welfare Schemes including wage payment-types, system of wage payment and incentives.
- c) Intellectual Property Rights(IPR)- Concepts, infringements and remedies related to patents, copy rights, trademarks and designs.
- d) Accident and Safety- Meaning and concept of accident and safety, causes, safety precautions and various measures after accidents

Unit– 5 Total Quality Management: Meaning and concept of Total Quality Management, various factors/measures to achieve TQM in an organization. Standards and Codes-National & International.

List of Books:

1. Principles of Management by Philip Kotler TEE Publication
2. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi.
3. Financial Management by MY Khan and PK Jain, Tata McGraw Hill Publishing Co:: 7, West Patel Nagar , New Delhi.
4. Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.

On completion of this course, a learner should be able to:

CO1	To understand the basics of management
CO2	To understand self-management
CO3	To understand the leadership and motivation.
CO4	To understand the Legal Environment and Business
CO5	To understand the concept of total quality management.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	METOE301
Course Title	:	Non Conventional Energy Systems
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	OE

Course Learning Objectives: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the renewable energy technology equipment.
- To create awareness among the students about the different types of non-conventional energy resources and emphasize its importance.

Course Contents:

Unit – I (12 Hrs)

Ocean Energy Technologies:

Ocean energy map of India and its implications; Specification, Construction and working of the following ocean energy technologies:

- Tidal power technologies
- Wave power technologies
- Ocean Thermal Energy Conversion (OTEC) technologies

Unit – II (13 Hrs)

Solar PV and Concentrated Solar Power Plants

- Solar Map of India: Solar PV
- Concentrated Solar Power (CSP) plants, construction and working of Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
- Solar Photovoltaic (PV) power plant: components layout, construction, working.

Unit – III (13 Hrs)

Large Wind Power Plants

Wind Map of India: Wind power density in watts per square meter, Lift and drag principle; long path theory, Geared type wind power plants: components, layout and working, Direct drive type wind power plants: components, layout and working.

Unit– IV (13 Hrs)

Small Wind Turbines

- Horizontal axis small wind turbine: direct drive type, components and working.
- Horizontal axis small wind turbine: geared type, components and working.
- Vertical axis small wind turbine: direct drive and geared, components and working.
- Types of towers and installation of small wind turbines on roof tops and open fields.

Unit– V (13 Hrs)

Biomass-based Power Plants

- Types of fuel used for Biomass power plants: Solid, Liquid and gaseous fuels
- Layout of a Bio-chemical based (e.g. biogas) power plant.

- Layout of a Thermo-chemical based (e.g. Municipal waste) power plant.
- Layout of a Agro-chemical based (e.g. bio-diesel) power plant.

Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
2. Neill, Simon P.; Hashemi, M. Reza: Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea, Academic Press, ISBN:978-0-12-810448-4
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
6. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
7. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
8. Kothari, D.P. et aL: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
9. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Maintain ocean thermal energy technologies
- Maintain the optimised working of solar PV and CS power plants.
- Maintain the optimised working of large wind power plants
- Maintain the optimised working of small wind turbines.
- Maintain the optimised working of biomass-based power plants

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	METOE302
Course Title	:	Energy Management
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	OE

Course Learning Objectives:

This subject will make the students to learn the following identified competency through various teaching learning experiences:

- To have knowledge about the basic concepts of energy management.
- To apply Energy management concepts while managing the energy intensive utilities.

Course Contents:

Unit – I (12 Hrs)

Energy Sources:

Brief overview of present energy scenario in India, brief overview of share (in %age) of various energy sources in present energy scenario in India , Basic concept and importance of Energy Management.

Unit – II (13 Hrs)

Energy Conservation:

Energy Conservation and its Need Energy Conservation opportunities & energy conversation strategies in domestic sectors; Energy conversation measures in office; Methods/Technologies for Energy Savings in Heating, Ventilating systems and Air Conditioners (HVAC Systems); Energy conversation at macro level

Unit – III (13 Hrs)

Energy Conservation in Industrial Sector:

Introduction; Industrial energy efficiency; Energy saving potential in Industries: Methods/Technologies for energy savings in Furnaces, Ovens, Fans and blowers;
Case studies of energy conservation in Industrial processes

Unit – IV (15 Hrs)

Energy Conservation in Agriculture sector:

Introduction; Energy conservation opportunities in pumps used in agriculture sector; Energy conservation techniques in agriculture sector

Energy Audit:

Need of Energy Audit, Types of Energy Audit: Preliminary Audit, General or Mini audit, and Comprehensive Audit, Energy audit team, Energy Audit methodologies/Procedure.

Unit – V (11 Hrs)

Energy and Environment:

Environment and social concerns related to energy utilization, Environment impact assessment and its need.

RECOMMENDED BOOKS

1. Energy Management by Dr. Umesh Rathore, KATON Publication New Delhi
2. Energy Management by Dr. Sanjeev Singh & Dr. Umesh Rathore, KATON Publication New Delhi
3. Economic Loading of Power Plant and Electric System by M. J. Steinberg and T. H. Smith, John Willey

4. Generation Distribution and Utilization of Electrical Energy by C L Vadhawa, New Age Publication.
5. Study the World Energy Report
6. Study the Energy Audit Reports
7. Manuals of B. E. E (Bureau of Energy Efficiency)

Course outcomes

At the end of the course, the student will be able to:

CO1	Understand the fundamentals of energy scenario, energy management, electric energy and economic aspects.
CO2	Understand importance of Energy Conservation in Industrial Sector.
CO3	Understand importance of energy conservation in industrial and agriculture sector.
CO4	Understand needs and type of energy audits.
CO5	Understand Environment and social concerns related to energy utilization.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	13	13
3	13	13
4	15	14
5	11	10
Total	64	60

Course Code	:	METOE304
Course Title	:	Fundamental of Mechatronics
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites (Course code)	:	None
Course Category	:	OE

Course Content:

Unit1–Introduction to Mechatronics (12 Hrs)

- Introduction to System Concepts, Analysis and Design
- Mechatronics basic definitions; systems and components;
- Systems with mixed disciplines
- Electronics Fundamentals Review

Unit2– Elements in Mechatronics (13 Hrs)

- Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers
- Microprocessors, Microcontrollers
- PID Controllers and PLCs

Unit3–Drives (13 Hrs)

- Stepper Motors, Servo Drives
- Linear Motion bearings, cams
- Systems controlled by camshafts, electronic cams
- Tool magazines and indexing mechanisms.

Unit4–Hydraulic Systems (13 Hrs)

- Flow, Pressure and Direction Control Valves
- Actuators, Supporting Elements, Hydraulic Power Packs, Pumps
- Design of Hydraulic circuits

Unit5–Pneumatic System (13 Hrs)

- Production, Distribution and conditioning of compressed air
- System Components and Graphic representations
- Design of Systems

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	Analysis and design of Dynamic Systems	Cochin, Eraand Cadwallender	Addison Wesley,1997

2.	Mechatronics Engineering	Tomkinson, D. And Horne, J. Longman	Mc Graw Hill,1996
3.	Mechatronics	Bolton, W	Pearson
4.	Fundamental of mechatronic	M. Jouaneh	Cengage Learning ISBN-978- 1111569020
5.	Mechatronics- An Integrated Approach	Clarence W. deSilva	CRC Press ISBN-978- 0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://youtu.be/Ro_tFv1iH6g
2. <https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/>
3. <https://science.howstuffworks.com/robot.htm>
4. <https://howtomechatronics.com/>

At the end of the course, the student will be able to:

CO1	Identify the basic systems and components of mechatronics
CO2	Understand the applications and use of Microprocessors, Microcontrollers and PLCs
CO3	Explain Various kind of drives used in Mechatronics
CO4	Explain System Components and Graphic representations of Pneumatic Systems
CO5	Explain Flow, Pressure and Direction Control Valves used in Hydraulic Systems

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	ME(RAC)OE-301
Course Title	:	Basics of 3D Printing
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- Understand the fundamentals of various Additive Manufacturing Technologies. Understand the method of manufacturing of liquid based techniques.
- Understand the method of manufacturing of solid based techniques.
- Understand the method of manufacturing of powder based techniques.

Course Content:

UNIT-I

(14 Hrs)

Introduction and Basic Principles

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and traditional Machining, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Post processing, RP data formats, Classification of 3D Printing Processes.

UNIT-II

(16 Hrs)

Liquid based Systems

Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages, and disadvantages.

Solid ground curing (SGC): Models and specifications, process, working principle, applications, advantages, and disadvantages.

UNIT-III

(18 Hrs)

Solid Based Systems

Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages.

Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages.

UNIT-IV**(16 Hrs)****Powder Based Systems**

Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages.

Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Reference Books:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
2. D.T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer, 2001
3. Terry Wohlers, “ Wholers Report 2000”, Wohlers Associates, 2000
4. Paul F. Jacobs, “ Rapid Prototyping and Manufacturing”–, ASME Press, 1996
5. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Course Outcomes

At the end of the course, the student will be able to:

CO1	Understand the fundamentals of Additive Manufacturing Technologies for engineering applications.
CO2	Understand the methodology to manufacture the products using SLA and SGC technologies and study their applications , advantages.
CO3	Understand the methodology to manufacture the products using LOM and FDM technologies and study their applications , advantages.
CO4	Understand the methodology to manufacture the products using SLS and 3D Printing technologies and study their applications , advantages.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	14
2	16	14
3	18	16
4	16	16
Total	64	60

Course Code	:	ME(RAC)OE-302
Course Title	:	Quantitative Techniques for Engineers
Number of Credits	:	3 (L:3, DCS:1 ,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- Understand the basics of statistics.
- Formulate and solve problems on Linear programming.
- Formulate and solve problems on Transportation, and assignment.
- Formulate and solve problems on critical path methods and cost estimation in crashing activities.

Course Content:

UNIT-I (14 Hrs)

Statistics (Simple Numericals)

Mean, Median, Mode, Standard derivation and variance, Averages – Simple average, weighted moving average, Root-Mean Square, Errors – Absolute errors, relative error, percentage errors.

UNIT-II (16 Hrs)

Linear Programming (Simple Numericals)

Introduction, Requirement of LP, Basic Assumptions, Formulation of LP, General Statement of LP, Solution techniques of LP: Graphical Methods, Analytical Methods: Simplex, Introduction of Primal and Dual Problems.

UNIT-III (18 Hrs)

Transportation and Assignment (Simple Numericals)

Transportation Problems definition, Linear form, Solution methods: Northwest corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method (MODI method). Assignment Problems-Hungarian method.

UNIT-IV**(16 Hrs)****Project Management (Simple Numericals)**

Introduction to PERT and CPM, Critical Path calculation, float calculation and its importance. Crashing of activities.

Reference Books:

1. Industrial Engineering and Management, O.P .Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi–110002.
2. Operations Research: An Introduction by Hamdy Taha, Pearson Education Inc
3. Operations Research: Principles and Practice by Pradeep PrabhakarPai, Oxford Higher Education, Oxford University press
4. Operations Research: Principles and Practice by Ravindran Phillips and Solberg by Wiley India Edition,
5. Operations Research by P Mariappan, Pearson
6. Operations Research by A M Natarajan, P Balasubramani, A Tamilarasi, Pearson Education Inc
7. Operations Research by H N Wagner, Prentice hall.
8. Optimization in Operations Research by Ronald Rardin, Pearson Education Inc.
9. Operations Research by R. Paneerselvam, Prentice Hall of India Pvt. Ltd.
10. Quantitative Techniques in Management by N D Vohra, Tata McGraw-Hill.

Course Outcomes:-

At the end of the course, the student will be able to:

CO1	Understand and apply basics of statistics.
CO2	Make use of LP techniques for optimization.
CO3	Evaluate and solve transportation and assignment problems.
CO4	Solve Project management problems.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	14
2	16	14
3	18	16
4	16	16
Total	64	60

Course Code	:	ME(RAC)OE-304
Course Title	:	Solar Thermal Technologies
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the functioning of various solar thermal collectors.
- To understand the functioning of solar water heating systems.
- To study the various types and configurations of solar space conditioning systems.
- To study the applications of solar thermal technologies in various fields .

Course Content:

UNIT-I (16 Hrs)

Solar Collectors

Introduction, Need of solar collectors, Principle, construction, Working and applications of various Collectors: Flat plate- Water, Air - Evacuated tube, Concentrated –Point Focus, Line Focus and Fresnel lens, Comparison of flat plate and concentrated collectors.

UNIT-II (14 Hrs)

Solar Water Heating Systems

Integral Collector Storage System - Thermosyphon System - Open Loop, Drain Down, Drain Back, Antifreeze Systems - Refrigerant Solar Water Heaters - Solar Heated Pools.

UNIT-III (16 Hrs)

Solar Space Conditioning Systems

Liquid Type Solar Heating System With and Without Storage - Heat Storage Configurations – Heat Delivery Methods - Air-Type Solar Heating Systems, Solar Refrigeration and Air Conditioning

UNIT-IV**(18 Hrs)****Other Solar Technologies**

Principles, Construction, Working and applications of various solar thermal technologies: Solar Cooking, Solar Drying, Distillation, Desalination, Solar Ponds, Solar thermal power generation.

Reference Books:

1. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process - 4 th Edition (2013), John Wiley and Sons, New York, ISBN: 978-0-470-87366-3, Solar Energy Laboratory, University of Wisconsin-Madison, pp. 944.
2. H P Garg, M Dayal, G Furlan, Physics and Technology of Solar Energy- Volume I: Solar Thermal Applications, Springer, 2007.
3. Sukhatme S.P. J K Nayak, Solar Energy, Tata McGraw Hills P Co., ISBN: 9789352607112, 4 th Edition, 2017, pp. 568.
4. Charles Christopher Newton - Concentrated Solar Thermal Energy- Published by VDM Verlag, 2008.
5. H.P.Garg, S.C.Mullick, A.K.Bhargava, D.Reidal, Solar Thermal Energy Storage Springer, 2005.

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Explain the technical and physical principles of different solar collectors.
CO2	Measure and evaluate different solar water heating technology through knowledge of the physical function of the devices.
CO3	Measure and evaluate different solar space conditioning technology through knowledge of the physical function of the devices.
CO4	Describe the spectrum of possible solar thermal technologies to assist industrial processing or power production.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	16	14
2	14	12
3	16	16
4	18	18
Total	64	60