

DIRECTORATE OF TECHNICAL EDUCATION,  
KAHILIPARA, GUWAHATI-19



**DIPLOMA PROGRAMME IN**  
**MECHANICAL ENGINEERING**  
**NEW SYLLABUS**

M | OCTOBER,2018

# **FIFTH SEMESTER**

# **MECHANICAL ENGINEERING**

M | OCTOBER,2018



# 1: Course Title:THERMAL ENGINEERING-I

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<b>Subject Title</b>	:	<b>Thermal Engineering-I</b>		
<b>Subject Code</b>	:	<b>Me-501</b>		
<b>Hours Per Week</b>	:	<b>03</b>		
<b>Hours Per Semester</b>	:	<b>45</b>		
<b>Class Test</b>	:	<b>03</b>		
<b>Full marks(Theory)</b>	:	<b>70</b>		
<b>Sessional Marks</b>	:	<b>30</b>		
<b>Class hours</b>		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>1</b>	<b>3</b>

**Pre Requisite:** Applied Physics Thermodynamics

**Aim of the subject :**The aim of the subject is to know about steam generators, Steam Nozzles, Steam turbines, Condensers , cooling towers and nuclear power plant and their related elements, and a brief knowledge about laws of heat transfer.

## Outcome Based OBJECTIVES

**On the completion of the course the students should be able to:**

1. Identify the components of a steam generator or boiler
2. Calculate the draught in chimney of a steam generator
3. Solve problems on steam turbines using velocity diagram
4. Explain the working principle of steam condensers and cooling towers
5. Know about the nuclear power plant
6. Know the basics of heat transfer.

## COURSE CONTENTS



## 1.0 Steam generators

- 1.1 Steam boiler- function of boiler -classification of boilers
- 1.2 Low pressure boilers- Sketch and working of Cochran and Babcock and Wilcox boiler
- 1.3 High pressure boilers- Sketch and working of Lamont and Benson boiler
- 1.4 Comparison of water tube and fire tube boilers.
- 1.5 Boiler mountings- Pressure gauge, water level indicator, fusible plug, blow off valve, stop valve, safety valve
- 1.6 Boiler accessories - feed pump, economizer, super heater and air pre-heater
- 1.7 Boiler fuels, burning equipment and ash handling
- 1.8 Chimney draught and measurement
- 1.9 Feed water treatment
- 1.10 Boiler performance, Boiler acts, dry inspection and hydraulic test

## 2.0 Steam nozzles

- 2.1 Introduction -Types of stem nozzles
- 2.2 Flow of steam through nozzle
- 2.3 Friction in a nozzle

## 3.0 Steam turbine

- 3.1 Classification of steam turbines with examples and their working
- 3.2 Turbine components
- 3.3 Working principle with line diagram of a simple De-Laval turbine - velocity diagram of impulse turbine
- 3.4 Expression for work done, axial thrust, diagram efficiency, stage efficiency, nozzle efficiency.
- 3.5 Methods of reducing rotor speed by compounding (velocity compounding, pressure compounding & pressure - velocity compounding)



- 3.6 Working principle with line diagram of a Parson's Reaction turbine - velocity diagram of reaction turbine
- 3.7 Losses in steam turbine
- 3.8 Governing of turbine
- 3.9 Simple problems on single stage impulse turbines (without blade friction) and reaction turbines

#### **4.0 Steam condensers and Cooling towers**

- 4.1 Function of condenser
- 4.2 Elements of steam condensing plant
- 4.3 Types of Condenser-Jet Condenser and Surface Condenser
- 4.4 Vacuum in condenser and its measurement
- 4.5 Cooling tower

#### **5.0 Nuclear power plant**

- 5.1 Elements of nuclear power plant
- 5.2 Nuclear reactor, fuels, moderators, coolants and control
- 5.3 Classification of nuclear power station

#### **6.0 Heat transfer**

- 6.1 Fourier's law of heat conduction
- 6.2 Newton law of cooling- Stefan-Boltzmann law of radiation
- 6.3 Heat transfer by conduction through slab and composite wall
- 6.4 Simple problems on above (conduction only)

#### **REFERENCES**

1. "Fundamental of thermodynamics" by Richard E Snatag, Claus Borgnakke, Gordon J Vanwylen, Wiley Student edition, 6<sup>th</sup> Ed.,
2. " Basic and applied thermodynamics" by P.K.Nag ,Tata McGraw hill, New Delhi 2009

3. “Heat engines (Vol-I & Vol-II)” by Patel and Karmachandani

4. “Thermal Engineering “by R.S.Khurmi

5. “Thermal Engineering” by P.L. Balaney

6. “Thermodynamics applied to heat engines” by Lewitt.

7. “Heat engines” by Pandya and shah

8. “A course in Thermodynamics & Heat Engines” Kothandaraman, Khajuria & Arora,  
Dhanpat Rai & Sons

Table Of Specification for Thermal Engineering -I																	
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total
			K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	
	45																97
1	14	Steam Generators	3	3	0	6	3	3	0	0	6	0	6	6	6	18	30
2	5	Steam Nozzles	2	0	0	2	2	0	0	0	2	0	3	3	0	6	10
3	14	Steam Turbines	3	3	0	6	0	3	3	0	6	0	6	6	6	18	30
3	6	Steam condensers and cooling towers	2	1	0	3	2	2	0	0	4	0	3	3	0	6	13
5	4	Nuclear Power Plant	1	2	0	3	1	2	0	0	3	0	0	3	0	3	9
6	2	Heat Transfer	2	0	0	2	0	2	1	0	3	0	0	0	0	8	5

Annexure -I Thermal Engineering -I								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total
1	Steam Generators	14	31.11	6	12	6	6	30
2	Steam Nozzles	5	11.11	4	3	3	0	10
3	Steam Turbines	14	31.11	3	12	9	6	30
4	Steam condensers and cooling towers	6	13.33	4	6	3	0	13
5	Nuclear Power Plant	4	8.89	2	4	3	0	9
6	Heat Transfer	2	4.44	2	2	1	0	5

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# 1: Course Title: Thermal Engineering Laboratory – I

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## **Outcome Based Objectives:**

After performing the experiment the students will be able to

1. Identify the components of a fire tube and water tube boiler specially Cochran, Lancashire, Babcock and Wilcox
2. Determine experimentally the flash point of a liquid fuel oil
3. Determine the dryness fraction of steam by Throttling Calorimeter
4. Identify the components of a steam engine

## **Course Contents:**

1. Study of Cochran, Lancashire, Babcock and Wilcox Boiler
  - 1.1. Observe the models of boiler in laboratory and make neat sketches labeling all the parts on it.
  - 1.2. List all the mountings and accessories of boiler and explain their functions and location in boiler.
  - 1.3. Using throttling calorimeter determine the dryness fraction of steam.
2. Fuels and Lubricants.
  - 2.1. Determine the flash point and fire points of fuels and lubricant using apparatus available in laboratory.
3. Analyse the flue gas using Orsat's apparatus.

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## 2: Course Title: INDUSTRIAL ENGINEERING

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<b>Subject Title</b>	<b>:INDUSTRIAL ENGINEERING</b>		
<b>Subject Code</b>	<b>:</b>	<b>Me-502</b>	
<b>Hours Per Week</b>	<b>:</b>	<b>03</b>	
<b>Hours Per Semester</b>	<b>:</b>	<b>45</b>	
<b>Class Test hrs</b>	<b>:</b>	<b>03</b>	
<b>Total hours</b>	<b>:</b>	<b>48</b>	
<b>Full marks(Theory)</b>	<b>:</b>	<b>70</b>	
<b>Sessional Marks</b>	<b>:</b>	<b>30</b>	
<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>
	<b>3</b>	<b>0</b>	<b>0</b>

**Pre Requisites: None**

**Aim of the Subject:** The aim of the subject is to know the method of work study and its related techniques, to understand job evaluation , wage system, inspection procedure & quality Control , network analysis and various maintenance systems in Industry.

### CO \_\_\_\_OUTCOME BASED OBJECTIVES

After studying the course the students will be able to

1. Explain the principle of work study(Method and Time study)
2. Illustrate the job evaluation and merit rating
3. Know the wage system in industry
4. Know the inspection procedure and maintenance system
5. Apply the network analysis as an effective tool of management



## COURSE CONTENTS

Contribution of work study to productivity

### 1.0 Method Study

Meaning and purpose.

Process chart, Symbols, types.

Operation process chart ; method of Construction.

Flow process chart, its elements and Relationship.

Flow diagrams.

Other tools for method analysis.

Analysing the charts and methods by questioning process.

Decisions for improving the Methods.

Purpose, basic procedures.

Work measurement : Meaning and purpose.

Time study equipment-stop watch, study board, time study forms.

Making time study, checking the methods, breakdown of the job- recording-selection of elements-measurement of time.

Time study-rating-average rating-normal performances, factors affecting performances, rating scales, rating factors.

Allowance to be considered in determining standard time- determination of standard time.

Predetermined motion time standard, Standard data, uses of the standard data.

Work sampling , work sampling procedure- purpose-collection of data- determination of the results.

### 2.0 Job Evaluation & Merit Rating

Job evaluation- definition, objectives and procedure, Job analysis, job description and Job specification.

Methods of Job Evaluation- Ranking, classification, factors comparison and point rating methods.

Merit Rating- definition and objectives

Methods of merit rating- rating scale, check list and employee comparison methods, advantages and disadvantages of merit rating.

### 3.0 Wage Systems.



Wages- definition, types- wage differentials- reasons, Methods of wage payments, Types of incentives, standard wage plans- Halsey, Weir, Emersons, Rowan's Gantt's task and Bonus systems- Taylor's piece rate system, Merric's piece rate system- Numerical problems on the above plans, Incentives to the supervisor and executives.

#### 4.0 Inspection and Statistical quality control

##### Inspection

Introduction- meaning of the term quality, quality of design, quality conformance & quality assurance- quality & cost relationship, reliability, Inspection- definition- objectives of inspection- methods of inspection- floor or patrolling inspection & centralized inspection- merits demerits- kinds of inspection- trial run inspection- first piece inspection- pilot piece inspection- operation inspection- sample inspection, notional inspection-final inspection- working inspection.

Review of statistical terms- Quality control- measurable & non-measurable.

Variation in manufacture- assignable causes- chance causes- inspection.

Causes- variables- attributes- tally sheet frequency table histogram- frequency polygon- Normal curve- properties of normal curve.

Average and grand average- their significance determination of upper and lower control limits of X and R using statistical tables, construction of X and R charts for a group of samples.

Analysis of control charts- process out of control, and in control.

Thumb rules for analysis- shifts, runs, trends, erratic fluctuations.

Control charts for attributes- fraction defective- percent defective- P, NP, 100p charts- significance- characteristics of X and R charts- calculation of P from data- control limits- process 'in control' and 'out of control' –differences between P, NP and 100P charts.

Sampling procedure lot, Meaning of the term- lot- lot quality, lot size, sample size and acceptance number- lot sampling.

Probability of acceptance- producer's risk- consumer's risk LTPD, AOQ and AOQL.

Single sampling plan- Parameters that affect the lot size and sample size and acceptance number- effect of sample size and acceptance number on probability of acceptance (Pa)- 'OC' curves of a single sampling plan- Variables involved in double sampling plan- Calculation of Pa. A B C standard.

Problems using tables.

#### 5.0 Network Analysis.

Definition- Network Techniques- PERT, CPM, RAMS, PEP, COPAC, MAP, RPSM, LCS, MOSS, PCS, GERT.



Terms used in Network Planning- Event, Activity, Classification of Activity, Critical Path, Duration, Total project time, EST, EFT, LFT, LST, Float or slack, Total float, Free float, Independent float.

Network diagram or Arrow diagram- Construction, critical path, calculation of project duration.

Simple problem on CP and Project duration.

## REFERENCE BOOKS

1. Work Study- by I.L.O.
2. Industrial Engineering and Management Science- by T.R.Banga
3. Industrial Engineering and Management- by O.P.Khanna
4. S.O.C.- by Juran

Table Of Specification for Industrial Engineering																	
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type				Total	
			K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	
1	45	Work Study	2	4	2	8	3	2	4	0	6	0	6	6	5	17	34
2	6	Job Evaluation and Merit Rating	1	2	0	3	2	1	2	0	5	0	3	3	0	6	14
3	6	Wage and Incentive System	1	2	0	3	2	1	0	0	3	0	3	5	0	8	14
3	8	Inspection and Statistical Quality Control	2	1	0	3	1	1	2	0	4	0	6	4	0	10	17
5	6	Net work analysis	2	1	0	3	2	2	2	0	6	0	4	4	3	7	18

Annexure -I Industrial Engineering								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total
1	Work Study	15	31.11	5	12	12	5	34
2	Job Evaluation and Merit Rating	7	13.33	3	6	5	0	14
3	Wage and Incentive System	7	13.33	3	6	5	0	14
4	Inspection and Statistical Quality Control	8	17.78	3	8	6	0	17
5	Net work analysis	8	13.33	6	9	3	0	18

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### 3: Course Title: PLANT MAINTENANCE ENGINEERING

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<b>Subject Title</b>	:	<b>Plant Maintenance Engineering</b>		
<b>Subject Code</b>	:	<b>Me-503</b>		
<b>Hours Per Week</b>	:	<b>3</b>		
<b>Hours Per Semester</b>	:	<b>45</b>		
<b>Class Test</b>	:	<b>03</b>		
<b>Total hours</b>	:	<b>48</b>		
<b>Full marks(Theory)</b>	:	<b>70</b>		
<b>Sessional Marks</b>	:	<b>30</b>		
<b>Class hours</b>		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>0</b>	<b>0</b>

**Pre Requisites: None**

**Course Objectives(CO)**

**On the completion of the course the students should be able to:**

1. Interpret the need of the maintenance in industry
2. Know the way of maintenance of guide surface of machine tools
3. Explain the Use of seals , packing and gaskets
4. Acquire the knowledge of Installation procedure of engines and machines
5. Acquire the knowledge of maintenance of power plant
6. Justify the need of the preventive maintenance and repair cycle
7. Know about the electrical maintenance of plant/industry



**COURSE CONTENT**

## Chapter-I- Introduction of maintenance ,

1. Maintenance and Industrialization of Mechanical Equipment
2. Fits and Tolerance , Tools and Equipment, Mechanical and Electrical instrument used in maintenance work.
3. Maintenance and guide surface of machine tools, fitting of keys, bearing coupling, clutches and other transmission devices, their defects and remedies
4. Repair on cracks of machine parts, restoration of parts by welding and building up, repairs of threaded parts
5. Seals packing and gaskets and their uses
6. Installation of Engine and Machines Marking out foundation work , levelling alignment, concreting of foundation bolts and final finishing up of engine and machine on foundation
7. Maintenance of mechanical equipment(fan, exhaust system, blowers and dust collecting equipment etc.)
8. Installation Starting and maintenance of pumps, air compressor, lifting machine, portable electrical and air tools, welding equipment etc.
9. Corrosion and its control using chemicals
10. Maintenance of Pipe lines and pipe fitting and maintenance.

## Chapter –II Power Plant

1. Power Plant, Boiler and its mounting cleaning, inspection, test and repairs, maintenance of feed water heater, economizer, air preheater, super heater ,pre heater feed pump, feed pump, mechanical stocker, fuel burners, water treatment plant stone pipes and fittings
2. Periodic inspection of steam engine components, turbine components and their maintenance
3. IC engine top and major overhaul trouble shooting and rectification , ignition fuel, system maintenance

## Chapter III –Maintenance and its type

1. Planning of preventive maintenance schedule, overhauling and repair cycle, spare parts planning, test charts, depreciation and machine life record , lubrication

## Chapter IV – Electrical maintenance

1. Examination and testing of electrical fittings, motor, switch gear etc.



2. Locating faults and repairs , safety procedures to be adopted.

Reference:

1. Industrial Engineering by H P Garg
2. Industrial Engineering by S K Chakravorty

Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total	
			K	C	A	T	K	C	A	HA	T	K	C	A	HA	T		
	45																	<b>97</b>
1	15	Introduction of Maintenance Engineering	3	3	0	6	0	4	4		8	6	6	6	0		18	32
2	15	Power Plant Maintenance	3	2	2	7	0	4	3		7	2	6	6	4		18	32
3	10	Preventive Maintenance	4	2	0	6	0	2	2		4	3	0	5	4		12	22
4	5	Electrical Maintenance	2	2	0	4	0	0	2		2	0	5	0	0		5	11

Annexure -I <b>Plant Maintenance Engineering</b>								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total 97
1	Introduction of Maintenance Engineering	15	33.33	9	13	10	0	32
2	Power Plant Maintenance	15	33.33	5	12	11	4	32
3	Preventive Maintenance	10	22.22	7	4	7	4	22
4	Electrical Maintenance	5	11.11	2	7	2	0	11

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## 4: Course Title: Advance Workshop Practice& CNC Machine(Theory Part)

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<b>Subject Title</b>	:	<b>Advance Workshop Practice&amp; CNC Machine(Theory Part)</b>
<b>Subject Code</b>	:	<b>Me-504</b>
<b>Hours Per Week</b>	:	<b>2</b>
<b>Hours Per Semester</b>	:	<b>30</b>
<b>Class Test</b>	:	<b>02</b>
<b>Total hours</b>	:	<b>32</b>
<b>Theory Marks</b>	:	<b>35</b>
<b>Sessional Marks</b>	:	<b>15</b>

**Pre Requisites:** Computer Applications and Programming, Manufacturing Technology

### **CO Out come based Objective**

**On the completion of the course the students should be able to:**

1. Justify the safety and security measures to be taken in the tool room
2. Identify the components of an CNC machine
3. Prepare a simple program for simple machining operation

### **Course Content**

**1. Introduction of the Shop Floor,**  
Safety and security measures inside the Tool Room

**2. FUNDAMENTALS OF CAM** 12hrs

1. Introduction
2. NC machine, basic components of NC systems (program of instruction, machine control unit & machine tool)
3. Problems with NC systems
4. NC programming (Simple example)
5. CNC machine tool ( general configuration, function, advantages)
6. DNC (configuration, type of DNC, benefit)



- 6.1 Classification of CNC system( based on feed back system & based on motion control system)
- 6.2 Salient features of CNC machine components ( feed back devices, spindle drives, axes feed drive, automatic tool changer, worktable, chip conveyer)

3.MANUAL PART PROGRAMMING 16 hrs

- 1.Axis identification and details
- 2.Co-ordinatesystem( absolute& relative co-ordinate referencing)
- 3.Zero point :Floating& Fixed ( machine zero, job zero, zero shift)
- 4.Part programming format

Table Of Specification for Advance Workshop Practice & CNC																	
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total
			K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	
1	3	Introduction	2			2	1	2			3						5
2	12	Fundamentals of CAM	2	2		4	3	3			6		2	4	4		20
3	15	Manuals Part programming	2	2		4		3	2	3	8		4	4	4		24

Annexure -I Advance Workshop Practice & CNC								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total 49
1	Introduction	3	10.00	3	2			5
2	Fundamentals of CAM	12	40.00	2	7	7	4	20
3	Manual Part Programming	15	50.00	2	9	6	7	24

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## 4: Course Title: Advance Workshop Practice& CNC Machine Practical

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<b>Subject Title</b>	:	<b>Advance Workshop Practice&amp; CNC Machine</b>		
<b>Subject Code</b>	:	<b>Me-504</b>		
<b>Hours Per Week</b>	:	<b>2(Th)+6 hrs practice</b>		
<b>Hours Per Semester</b>	:	<b>30(Th)+90(Pract)</b>		
<b>Class Test</b>	:	<b>02+06</b>		
<b>Total hours</b>	:	<b>32+96</b>		
<b>Full marks(Theory)</b>	:	<b>35</b>		
<b>Sessional Marks</b>	:	<b>15</b>		
<b>Total Marks</b>	:	<b>50</b>		
<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>	
	<b>2</b>	<b>0</b>	<b>6</b>	

Total Contact hours—90(Practical Part)

Theory—Contact hours -30

### **CO Out come based Objective**

**On the completion of the course the students should be able to:**

1. Follow the safety and security measures maintained in the tool room
2. Identify the components of an CNC machine
3. Execute a simple machining operation with CNC Machine

### Unit-1

1. Introduction
2. Machine Tools: Definition and development
3. A few basic machine tools
4. Requirement of Machine Tools

5. Cutting tool specification, IS

#### Unit-2

1. Shop Talk and activities
2. Lathe Machine- Function classification and specification
3. Main Lathe parts and working principles
4. Feed mechanism , feed reversing mechanism, feed drive and apron mechanism

#### Unit-3

1. Lathe Accessories and Attachment
2. Lathe Centers and Carriers etc.
3. Chucks, face plate, angle plates
4. Mandrels, Steady Rest, follower rest

#### Unit-4

1. Lathe tools
2. Different types of lathe tools used
3. Lathe operations- Turning , Parting, Facing, Taper turning, grooving, boring, threading (External and Internal) and knurling

#### Unit-5

1. Metal Cutting and Cutting tools
2. Orthogonal cutting and Oblique cutting
3. Chip formation and types of chips
4. Reference planes
5. ORS system and ASA system
6. Merchant circle diagram for cutting forces

#### Unit-6

1. Use of single point cutting tool and multiple point cutting tools
2. Knowledge of rake, clearance and cutting angles
3. Influence of tool angles and tool setting
4. Importance of positive, negative and zero, rake angle and restricted cutting
5. Mechanism of cutting , cutting speed and feeds



6. Factors determining speeds , feeds and depth of cut
7. Various cutting fluids
8. Method of lubrication
9. Measurement on different type of operation

Unit-7

1. Fundamentals of CAM
2. NC machine and its introduction
3. Basic Components of NC machines
4. Problems with NC machines
5. NC simple programming
6. CNC machine Tool
7. DNC machine
8. Classification of CNC machines

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## 5: Course Title: NON CONVENTIONAL ENERGY

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<b>Subject Title</b>	<b>: No Conventional Energy</b>		
<b>Subject Code</b>	<b>: EI/Me/Au/IPE-505</b>		
<b>Hours Per Week</b>	<b>: 03</b>		
<b>Hours Per Semester</b>	<b>: 45</b>		
<b>Class test</b>	<b>: 03</b>		
<b>Total Hours</b>	<b>: 48</b>		
<b>Full marks(Theory)</b>	<b>: 70</b>		
<b>Sessional Marks</b>	<b>: 30</b>		
<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>
	<b>3</b>	<b>0</b>	<b>0</b>

**Prerequisite-** None

**CO-----Outcome based course objectives**

After studying the course the students will be able to

1. Explain the details of Non Conventional energy sources and its uses
2. Illustrate the principle of solar energy collection
3. Analyze the principle of thermal energy storage system
4. Know the principle of wind energy conversion system
5. Differentiate the principle of ocean thermal energy conversion with energy from tidal power
6. Know about the geothermal energy
7. Identify the components of a biogas Plant
8. Explain the MHD (Magneto Hydrodynamic System)
9. Know about the chemical storage system



## COURSE CONTENTS

### 1.0 Introduction to Non-Conventional Energy Sources

- 1.1 Energy consumption
- 1.2 Energy Sources & their Availability
- 1.3 Importance of Non Conventional Energy sources.

### 2.0 Solar Energy Engineering

- 2.1 Introduction
- 2.2 Solar Constant
- 2.3 Solar Radiation at the Earth's surface
- 2.4 Solar Radiation Measurements
- 2.5 Solar Energy Collectors
  - 2.5.1 Principles of Conversion of Solar Radiation into heat
  - 2.5.2 Flat Plate Collectors – Types, Applications & Advantages
  - 2.5.3 Concentrating Collectors – Focusing & non-focusing types
  - 2.5.4 Advantages & Disadvantages of concentrating collectors over flat plate collectors.
- 2.6 Applications of Solar Energy - Water Heating, Air Heater, Solar Cooker, Solar Pond, Solar Photovoltaic and Solar Distillation.

### 3.0 Wind Energy Engineering

- 3.1 Introduction
- 3.2 Basic Principles of Wind energy conversion
  - 3.2.1 The nature of wind
  - 3.2.2 The power in the wind (No derivations)
  - 3.2.3 Forces on the Blades (No derivations)
- 3.3 Site Selection considerations
- 3.4 Basic components of a wind energy conversion system (WECS)
- 3.5 Wind energy collectors (Wind mill)
  - 3.5.1 Horizontal Axis Machines
  - 3.5.2 Vertical Axis Machines
- 3.6 Advantages & Limitations of WECS.



#### **4.0 Ocean Energy Engineering**

- 4.1 Introduction
- 4.2 Ocean Thermal Energy Conversion (OTEC)
  - 4.2.1 Introduction to OTEC
  - 4.2.2 Methods of OTEC
  - 4.2.3 Site Selection for OTEC
  - 4.2.4 Prospects of OTEC in India.
- 4.3 Tidal Energy
  - 4.3.1 Introduction
  - 4.3.2 Basic Principles of Tidal Power
  - 4.3.3 Components of Tidal Power Plants
  - 4.3.4 Schematic Layout of Tidal Power house
  - 4.3.5 Operation methods of utilization of Tidal energy (single and double basin arrangement)
  - 4.3.6 Advantages & Limitations of Tidal power
  - 4.3.7 Prospects of Tidal Energy in India.

#### **5.0 Geothermal Energy Engineering**

- 5.1 Introduction
- 5.2 Nature of Geothermal fields
- 5.3 Geothermal Sources
- 5.4 Hydro thermal Sources
  - 5.4.1 Vapour dominated systems
  - 5.4.2 Liquid dominated systems
- 5.5 Prime movers for geothermal energy conversion

#### **6.0 Bio Energy Engineering**

- 6.1 Introduction
- 6.2 Biomass conversion techniques
- 6.3 Biogas Generation.
- 6.4 Factors affecting biogas Generation
- 6.5 Types of biogas plants



6.6 Advantages and disadvantages of types of biogas plants

## 7.0 Direct Energy Conversion Systems

7.1 Magneto Hydro Dynamic Generator

7.1.1 Introduction

7.1.2 Basic principle

7.1.3 MHD Systems (open cycle & closed cycle)

7.1.4 Advantages of MHD

7.2 Thermo-Electric power

7.2.1 Basic Principles

7.2.2 Thermo electric power generator

7.2.3 Thermo Electric materials & selection of materials

7.3 Thermoionic Generation

7.3.1 Introduction

7.3.2 Thermoionic emission & work function

7.3.3 Basic Thermoionic generator

## 8.0 Chemical Energy Sources

8.1 Fuel cells

8.1.1 Introduction

8.1.2 Fuel cells – Principles of operation, classification & Types

8.1.3 Applications of fuel cells

8.2 Hydrogen Energy

8.2.1 Introduction

8.2.2 Principles of operation

8.2.3 Applications

Reference:

1. Non conventional Energy sources by G.D.Rai, Khanna Publishers
2. Solar Energy by S P Sukhatme Tata Mc Graw Hill



3. Solar Energy Utilization G D Rai Khanna Publishers
4. Power Plant Technology by M M EI Wakil ,Tata McGraw Hill

Table Of Specification for Non Conventional Energy																		
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total	
	45		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	97	
1	2	Introduction to Non Conventional Energy sources	2	0	0	2	0	2	0	0	2	0	0	0	0	0	4	4
2	12	Solar Energy	2	3	0	5	0	2	3	0	5	0	4	4	7	15	25	
3	6	Wind Energy	0	2	0	2	2	1	0	0	3	2	0	5	0	7	12	
4	6	Ocean Energy	2	0	0	2	2	1	0	0	3	2	3	2	0	7	12	
5	4	Geo thermal Energy	2	0	0	2	0	2	0	0	2	2	4	0	0	6	10	
6	8	Energy for Bio mass	2	1	0	3	1	2	0	0	3	0	0	4	6	10	16	
7	5	Direct Energy Conversion	2	0	0	2	0	2	1	0	3	0	2	3	0	5	10	
8	4	Chemical Energy Storage	0	2	0	2	0	1	0	0	1	2	3	0	0	5	8	

Annexure -I Non Conventional Energy								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total
1	Introduction to Non Conventional Energy sources	2	4.44	2	2	0	0	4
2	Solar Energy	12	26.67	2	9	7	7	25
3	Wind Energy	6	13.33	4	3	5	0	12
4	Ocean Energy	6	13.33	6	4	2	0	12
5	Geo thermal Energy	4	8.89	4	6	0	0	10
6	Energy for Bio mass	8	17.78	3	3	4	6	16
7	Direct Energy Conversion	5	11.11	2	4	4	0	10
8	Chemical Energy Storage	4	8.89	2	6	0	0	8

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## 6: Course Title: PROFESSIONAL PRACTICE III

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**Subject code-Me -510**

<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>
	<b>1</b>	<b>0</b>	<b>2</b>

### **Rational :**

To develop general confidence, ability to communicate and attitude in addition to basic technological concepts through Industrial visits , expert lectures, seminars on technical topics and group discussion.

### **Outcome Based Objectives:**

The student will be able to :

- Acquire information from different sources.
- Prepare notes for given topic.
- Present given topic in a seminar.
- Interact with peers to share thoughts.
- Prepare a report on industrial visit, expert lecture.

### **Contents**

### **Activities**

#### **11. INDUSTRIAL VISITS:**

**12**

Structured industrial visits be arranged and report of the same should be submitted by the individual student to form part of the term work.The industrial visits maybe arranged in the following areas / industries : Sugar factory / Dairy / Chemical Industry / Thermal Power Plant.

- i. Machine shop having CNC machines
- ii. ST workshop / Auto service station
- iii. City water supply pumping station
- iv. Manufacturing unit to observe finishing and super finishing processes.

#### **12. LECTURES BY PROFESSIONAL/ INDUSTRIAL EXPERT LECTURES TO BE ORGANIZED FROM ANY THREE OF THE FOLLOWING AREAS :10**

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- Interview Techniques
- Modern Boilers – Provisions in IBR
- Applications of Sensors and Transducers
- Alternate fuels- CNG / LPG, Biodiesel, Ethanol, Hydrogen
- Piping Technology

### 13. INFORMATION SEARCH: 10

Information search can be done through manufacturer's catalogue ,websites,magazines,booksetc. and submit a report on **any one** topic :

Following topics are suggested:

- i. Engine lubricants and additives.
- ii. Automotive gasket and sealants.
- iii. Engine coolants and additives.
- iv. Two and Four wheeler carburettor.
- v. Power steering.
- vi. Filters.
- vii. Different drives / Transmission systems in two wheelers.
- viii. Types of bearings – applications and suppliers.
- ix. Heat Exchangers.
- x. Maintenance procedure for solar equipment
- xi. Tools holder on general purpose machines and drilling machines.
- xii. Recent model of automobile sector
- xiii. Ice making plant

### 14. SEMINAR 13

Seminar topic shall be related to the subjects of fourth semester . Each student shall submit a report of at least 10 pages and deliver a seminar (Presentation Time – 10 minutes )

Mini Project / activities (any one)

- a) Prepare one model out of cardboard paper /acrylic /wood / thermocol /metal such as
  - i) Elliptical trammel



- ii) Pantograph
  - iii) Coupling
  - iv) Cams and followers
  - v) General mechanism
- b) Dismantling of assembly (eg. jig /fixtures, tool post, valves etc.) Take measurement and prepare drawings/sketches of different parts.
- c) Make a small decorative water fountain unit.
- d) Toy making with simple operating mechanisms.



## 7: Course Title: AUTOMOBILE ENGINEERING( Elective )

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<b>Subject Title</b>	<b>:AUTOMOBILE ENGINEERING</b>		
<b>Subject Code</b>	<b>:</b>	<b>Me-507</b>	
<b>Hours Per Week</b>	<b>:</b>	<b>03</b>	
<b>Hours Per Semester</b>	<b>:</b>	<b>45</b>	
<b>Class Test hrs</b>	<b>:</b>	<b>03</b>	
<b>Total hours</b>	<b>:</b>	<b>48</b>	
<b>Full marks(Theory)</b>	<b>:</b>	<b>70</b>	
<b>Sessional Marks</b>	<b>:</b>	<b>30</b>	
<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>
	<b>3</b>	<b>1</b>	<b>3</b>

**Prerequisite:** Physics, Thermodynamics

### COURSE OBJECTIVES

On completion of the course the student should be able to

1. Acquire the information about Self-propelled vehicle ,Chassis and Frame
2. Explain the Engine Fuel supply system
3. Explain the function of Engine Lubricating, Cooling , Intake & Exhaust system.
4. Identify the components of Automotive Electrical system.
5. Explain Suspension System, Front axle and Steering System.
6. Identify the components of Power Transmission system
7. Identify the components of Brake system
8. Know about the functions of Wheels and Tyres

### COURSE CONTENT

#### 1.0 Introduction

#### 1.1 Introduction to Automobile, Classification of Automobiles.

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- 1.2** Chassis, layout of chassis and its main components ,classification of chassis. Chassis lubrication, Importance of chassis lubrication,Lubricants used for chassis lubrication
- 1.3** Frame, Functions of frame and different parts of a frame,  
Types of frame sections , Sub frame, Functions of sub frame **4hrs**
- 2.0 Engine Operations and Constructions**
- 2.1** Heat Engines, Difference between I.C Engines and E.C engines
- 2.2** Engine operations of Four stroke and Two stroke - Spark Ignition Engines and Compression Ignition Engines, Comparison of Four stroke cycle Engines and Two stroke cycle Engines, Comparison between Petrol and Diesel Engines .
- 2.3** Scavenging: meaning and necessity of scavenging. Cross flow, back flow and uniform flow scavenging.
- 2.4** Diesel and Petrol Engines parts and their functions :  
Material used , constructional details and function of cylinder block, cylinder Head , cylinder liner(dry and wet type),crank case, crankshaft, camshaft, piston Piston rings, piston pin, connecting rod, Gasket, inlet and exhaust manifolds, etc.
- 2.5** Valve mechanism, classification of engines according to valve arrangement, valve Timing diagrams(Theoretical and Actual ) ,valve overlap, tappet clearance**8hrs**
- 3. Engine Fuel system:**
- 3.1** Line diagram of petrol engine fuel system , components of petrol engine fuel system and constructional details of mechanical and electrical fuel pump.
- 3.2**Atomization and vaporization, carburetion, air fuel ratio, Rich mixture , lean mixture, maximum power ratio, economic ratio for average cruising operation.  
Carburetor- Working principles of simple carburetor, constructional details of different components of a simple carburetor -Choke, venturi, throttle valve, float chamber, needle valve, etc.
- 3.3** Line diagram of Diesel engine fuel system, components of Diesel engine fuel system and constructional details of fuel injector(Atomizer). Types of fuel injection systems, Types of fuel injection nozzles. Function of governors in Diesel engine. Concepts ofCRDI system.
- 3.4** Concepts of Multi Point Fuel Injection system, Types of Multipoint Fuel Injection System.  
supercharging, Object of Supercharging, Superchargers-centrifugal, van type, blower type etc. Turbo-supercharger and its uses. **5hrs**



**4. Engine Lubricating , Cooling & Intake & Exhaust system :**

- 4.1 Function of lubricating system , Parts of lubricating system ,constructional details of lubricating system: Pet roil type, splash type, forced feed lubrication ,dry sump ,wet sump system.
- 4.2 Functions of engine lubricants, physical and chemical properties of lubricants, rating of lubricants, viscosity, viscosity index, SAE numbers , specific gravity flash point, fire point, pour point etc.  
crank case ventilation.
- 4.3 Necessity of engine cooling system, disadvantages of overheating and under cooling.
- 4.4 Cooling system: air cooling constructional details, fins  
Water cooling system: types, thermo-siphon system, forced circulation system, constructional details of the systems.  
Functions of different parts of water cooling system-water pump, radiator, thermostat, fan, water jacket.
- 4.5 Air cleaner, type and functions, intake and exhaust manifolds, silencer. **5hrs**

**5. Automotive Electrical system:**

- 5.1 Starting system: Introduction to starting system, Functions of Battery & Starting motor.
- 5.2 Charging system : Introduction to charging system ,Functions of Generator(Dynamo) and Alternator (A.C. generator).
- 5.3 Ignition System: Purpose of ignition system , Types of ignition system-Battery ignition and Magneto ignition system, comparison between these two circuit of the system. Voltage necessary for ignition, Ignition in single cylinder and multi cylinder engines, Firing order, Function of distributor, coil condenser, spark plug, battery, Effect of enhancing and retarding of ignition.  
**4hrs**

**6. Suspension System , Front axle and Steering System:**

- 6.1 Functions of Suspension System ,Rigid axle front wheel and independent front wheel suspension system, Types of suspension springs used in suspension system., Shock absorbers, principle, construction and working of a telescopic shock absorber, Functions of Shackle, Torsion bar, stabilizer
- 6.1Necessity of Front Axle, types, stub axles and types. Front wheel drive assembly, live axle, dead axle, Functions of Steering System, Different components of Steering System, Different type of steering gear mechanism, steering gear ratio



6.2 Fundamental equation for correct steering Factors effecting Wheel alignment, Steering geometry- camber angle, caster angle, king pin inclination, included angle, toe-in, toe-out Cornering force, slip angle, turning radius, under-steering, over steering, Concepts of Power Steering. Common defects and remedies in steering system. **4hrs**

## 7 Power Transmission system

7.1 Clutch: Function of clutch, Principles of operation of a clutch, Main parts of a clutch, concepts of different types of clutches- Friction clutch, centrifugal clutch, diaphragm clutch, dog and spline clutch, vacuum clutch, hydraulic clutch, Common defects and remedies in the clutch

7.2 Gear Box: Functions of Gear Box, Types of Gear Box-Sliding Mesh, Synchromesh, constant mesh Gear Box, epi-cyclic gear box.

7.3 Overdrive –Construction, operation and advantage

7.4 Common defects and remedies in the Gear Box

7.5 Propeller Shaft and Joints, Final Drive and Differential & Rear Axle:

Functions of propeller shaft. Universal joint, slip joints, Construction of Propeller shaft

7.6 Function of final drive, Function of Differential, principles of differential, description, differential lock

7.7 Rear axle drives-Hotchkiss drive, Torque tube drive Rear axle types- full floating, three quarter floating, semi floating axle, rear axle housings

7.8 Power transmission system of two wheelers like scooter, motor cycle etc. **9hrs**

## 8 Brake System

8.1 Necessity of brakes, Functions of brake , classification of brakes.

8.2 Drum brake and Disc brake, Parking and Emergency brake. brake shoe, brake lining, brake drum.

8.3 Hydraulic brake system, master cylinder, Tandem master cylinder, wheel cylinder, piping, bleeding

8.4 Common defects and remedies

**3hr**

## 9 Wheels and Tyres

9.1 Function of wheels, type of wheels, hubs, rims, assembly.

9.2 Functions of Tyres , types of tyre-tube tyre and tubeless tyre, tyre construction, tyre tread pattern, tyre pressure and wear-under inflation, over inflation and proper inflation.

Causes of tyre wear, tyre size, tyre maintenance



**Reference Books:-**

1. Automobile Engineering - R.B. Gupta
2. Automotive Mechanics - S Srinivasan
3. Automotive Mechanics - Joseph Heitner
4. The Automobile - Harbans Singh Reyat

Table Of Specification for Automobile Engineering																	
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total
			K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	
1	4	Introduction	2	1	1	4	0	2	2	0	4	0	0	0	0	0	8
2	7	Engine Operations and Constructions	2	1	1	4	1	0	2	2	5	0	3	3	0	6	15
3	5	Engine Fuel system	2	1	0	3	0	2	2	0	4	0	0	3	0	3	10
4	5	Engine Lubricating , Cooling & Intake & Exhaust system	2	1	0	3	1	2	2	0	5	0	0	2	0	2	10
5	4	Automotive Electrical system	2	0	1	3	0	3	3	0	6	0	0	0	0	0	9
6	4	Suspension System , Front axle and Steering System	2	0	0	2	0	2	2	0	4	0	0	3	0	3	9
7	7	Power Transmission system	1	2	0	3	2	2	2	2	8	0	0	3	2	5	16
8	3	Brake System	2	0	0	2	0	2	3	0	5	0	0	0	0	0	7
9	6	Wheels and Tyres	2	1	0	3	0	2	2	0	4	0	0	3	3	6	13

Annexure -I Automobile Engineering								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total(97)
1	Introduction	4	8.89	2	3	3	0	8
2	Engine Operations and Constructions	7	15.56	3	4	6	2	15
3	Engine Fuel system	5	11.11	2	3	5	0	10
4	Engine Lubricating , Cooling & Intake & Exhaust system	5	11.11	3	3	4	0	10
5	Automotive Electrical system	4	8.89	2	3	4	0	9
6	Suspension System , Front axle and Steering System	4	8.89	2	2	5	0	9
7	Power Transmission system	7	15.56	3	4	5	4	16
8	Brake System	3	6.67	2	2	3	0	7
9	Wheels and Tyres	6	13.33	2	3	5	3	13



## 7: Course Title: Automobile Engineering Laboratory

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### Course Objectives:

After performing the experiment the students will be able to

1. Calculate the power developed at different loads and fuel consumption
2. Explain the function of cooling system
3. Illustrate the function of lubricating pump
4. Explain the function of gear box
5. Identify the components of differential wheel
6. Explain the function of braking system
7. Identify the components of steering mechanism
8. Know the function of electrical system

### Aim of the Experiment

1. Determination of power of IC engine at different loads and fuel consumption
2. Dismantling of an engine- and reassembling of different parts
3. Study of cooling system
4. Study of Carburetor, Zenith Carburetor, fuel pump
5. Study the function of lubricating pump,
6. Study the function of clutch mechanism
7. Study the function of gear box, its servicing procedure
8. Study the function of differential wheel, dismantling and maintenance
9. Study of braking system, master cylinder, wheel cylinder, brake drum, bleeding
10. Observation of steering mechanism, dismantling and servicing procedure
11. Study the function of Electrical System including charging of battery

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## 8: Course Title: REFRIGERATION AND AIR CONDITIONING ( Elective )

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<b>Subject Title</b>	<b>:REFRIGERATION AND AIR CONDITIONING</b>		
<b>Subject Code</b>	<b>:</b>	<b>Me-506</b>	
<b>Hours Per Week</b>	<b>:</b>	<b>04</b>	
<b>Hours Per Semester</b>	<b>:</b>	<b>45</b>	
<b>Class Test hrs</b>	<b>:</b>	<b>03</b>	
<b>Total hours</b>	<b>:</b>	<b>48</b>	
<b>Full marks(Theory)</b>	<b>:</b>	<b>70</b>	
<b>Sessional Marks</b>	<b>:</b>	<b>30</b>	
<b>Class hours</b>	<b>L</b>	<b>T</b>	<b>P</b>
	<b>3</b>	<b>1</b>	<b>3</b>

**Prerequisite:** Thermodynamics, Applied sciences

### CO----Outcome Based Objectives

After studying the course the students will be able to

1. Explain the principle of refrigeration, its different cycles & systems
2. Identify the components of refrigeration system
3. Compare the functions and properties of refrigerant
4. Recognize the psychometric processes
5. Identify the components of air conditioning system
6. Estimate the cooling load
7. Illustrate the application of refrigeration and air conditioning in day to day life



8. Apply different tools and measuring instruments for the maintenance of refrigeration and air conditioning system.

## **DETAIL COURSE CONTENT**

### **1.0 INTRODUCTION**

- 1.1 Terms and definition – Heat engine, refrigerator, heat pump, refrigeration, refrigerant, refrigerating effect, refrigeration capacity, COP, relative cop
- 1.2 Methods of refrigeration ( names and application)

### **2.0 AIR REFRIGERATION SYSTEM**

- 2.1 Reversed Carnot cycle, determination of cop(simple problems)
- 2.2 Bell-Coleman cycle- open system, closed system. Determination of cop ( problem)

### **3.0 VAPOUR COMPRESSION REFRIGERATION SYSTEM**

- 3.1 Fundamental operations and analysis with schematic T-S and p-h diagrams for simple cycle , COP
- 3.2 Advantages and disadvantages of vapour compression system over air refrigeration system
- 3.3 Actual vapour compression cycle—variation from theoretical cycle
- 3.4 Effects of sub cooling and superheating
- 3.5 Simple problems

### **4.0 VAPOUR ABSORPTION SYSTEM**

- 4.1 Flow diagram and operation of NH<sub>3</sub>- WATER cycle, components- absorber, generator, rectifier, condenser, evaporator, absorber, heat exchanger, pump
- 4.2 Flow diagram and operation of Lithium bromide – water cycle
- 4.3 Flow diagram and operation of electrolux refrigerator
- 4.4 Comparison between vapour compression and vapour absorption systems.

### **5.0 REFRIGERANTS**

- 5.1 Definition and function of refrigerant
- 5.2 Desirable properties of refrigerant
- 5.3 Classification of refrigerant
- 5.4 Important requirements, secondary requirements
- 5.5 Selection of refrigerant for required purpose



## 6.0 REFRIGERATION COMPONENTS, CONTROL AND SAFETY DEVICES

- 6.1 Brief description and field of application of reciprocating compressor, rotary compressor, centrifugal compressor
- 6.2 Brief description and field of application of air cooled and water cooled condensers
- 6.3 Brief description and field of application of evaporators
- 6.4 Brief description and field of application of expansion devices-capillary tube, thermostatic expansion valve
- 6.5 Control and safety devices- low side float valve, high side float valve, solenoid valve, compressor over current and over heating protection, high and low pressure cut-outs

## 7.0 APPLICATION OF REFRIGERATION

- 7.1 Food preservation- spoilage agents and their control, preservation by refrigeration
- 7.2 Cold storage-construction (layout), capacity and application
- 7.3 Refrigerators and freezers
- 7.4 Ice plant- construction (layout), capacity and application
- 7.5 Ice- cream plant- construction (layout) and operational features
- 7.6 Dry ice production- construction (layout) and operation of simple system, application
- 7.7 Water cooler
- 7.8 Refrigerated Truck

## 8.0 INTRODUCTION TO AIR CONDITIONING

- 8.1 Definition of air conditioning , factors affecting human comfort and comfort values

## 9.0 PSYCHOMETRICS

- 9.1 Definitions of different terminology
- 9.2 Psychometric properties, relations , processes and use of psychometric charts



## 10.0 Cooling load Estimation

10.1 A brief idea ,factors forming the cooling loadin an air conditioning space

10.2 Cooling and heating load estimation

## 11.0 Air Conditioning System

11.1 Summer Air Conditioning

11.2 Winter Air Conditioning

11.3 Unit And Control System, Central ac system

11.4 Plant Layout

## 12.0 Application of A/C System

12.1 Residential building , office, Schools, Commercial Establishments

12.2 Industrial Applications

12.3 Automobile , train and air craft air conditioning system

12.4 Computer centre , TV , telephone exchange and hospital air conditioning

Table Of Specification for Refrigeration and Air Conditioning																		
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type				Total		
	45		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T		
1	1	Introduction	2			2												2
2	4	Air Refrigeration system	2			2		2			2	2		2				5
3	6	Vapour Compression Refrigeration System	2	1		3	2	1			3		3	4				7
4	3	Vapour Absorption Refrigeration System		1	1	2			1	1	2		3					3
5	5	Refrigerants	2			2		2			2		2	5				7
6	3	Refrigeration controls and safety devices	2			2		2			2		2					2
7	4	Application of refrigeration	1	1		2	1	1			2	3	2					5
8	1	Air Conditioning System						2			2							2
9	6	Psychometric Charts	1	1		2	2	1			3		3	3	2			8
10	4	Cooling Load	1	2		3	2	1			3		1	2				3
11	5	AC System	2			2			2		2		3	3				6
12	3	Application of ac system	1			1	2				2		2	2				4

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Annexure -I Refrigeration and Air Conditioning								
Sl No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total
1	Introduction	1	2.22	2				2
2	Air Refrigeration system	4	8.89	4	2	2		8
3	Vapour Compression Refrigeration System	6	13.33	4	5	4		13
4	Vapour Absorption Refrigeration System	3	6.67		4	2	1	7
5	Refrigerants	5	11.11	2	4	5		11
6	Refrigeration controls and safety devices	3	6.67	2	4			6
7	Application of refrigeration	4	8.89	5	4			9
8	Air Conditioning System	1	2.22	2				2
9	Psychometric Charts	6	13.33	3	5	3	2	13
10	Cooling Load	4	8.89	3	4	2		9
11	AC System	5	11.11	2	3	5		10
12	Application of ac system	3	6.67	3	2	2		7

## References:

- 1.A Text Book of Refrigeration and Air Conditioning(For Polytechnics)by R K Rajput-Katsons
2. Refrigeration and Air Conditioning by C P Arora . Tata McGraw Hill Publishing
3. Refrigeration and Air Conditioning by Manohar Prasad , Wiley Eastern Limited



## 8: Course Title: Refrigeration and Air-conditioning Laboratory

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### CO- Course Objectives

After performing the course the students will be able to

1. Know the use of different tools used in refrigeration and air conditioning Laboratory
2. Identify the components of vapour compression refrigeration system
3. Identify the components of a window type air conditioning system
4. Explain the operation of a small ice making plant.

### Course Content:

1. Use of tools and equipment in Refrigeration laboratory
  - i) Flaring tool
  - ii) Brazing tool
  - iii) Pipe bender
  - iv) Pipe cutter
  - v) Halide torch etc.
2. Study the working of a Simple vapour compression refrigeration system and determine the COP at different evaporating temperature (using expansion valve and capillary tubes)
3. Study of working of a window air conditioner system
4. Study of Psychometric chart
5. Humidity determination and use of dry & wet bulb thermometer
6. Study and operation of a small ice making plant
7. To demonstrate a water cooling system at different temperatures.
8. Study and demonstrate a central air conditioning system
9. Visit to a local Air conditioning / Cold Storage unit



## 9: Course Title: MECHATRONICS

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<b>Subject Title</b>	:	<b>MECHATRONICS</b>		
<b>Subject Code</b>	:	<b>Me/Mc-501</b>		
<b>Hours Per Week</b>	:	<b>3</b>		
<b>Hours Per Semester</b>	:	<b>45</b>		
<b>Class Test</b>	:	<b>03</b>		
<b>Total Marks</b>	:	<b>100</b>		
<b>Theory</b>	:	<b>70</b>		
<b>Sessional</b>	:	<b>30</b>		
<b>Class hours</b>		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>1</b>	<b>3</b>

### Course Objectives:

On the completion of the course the students should be able to

- 1) Know the performance of commonly used sensors and evaluate them
- 2) Explain the requirements for signal conditioning and data acquisition
- 3) Illustrate the importance of digital logic
- 4) Describe the basic structure of a microprocessor and microstructure
- 5) Justify the interface requirements
- 6) Explain the structure of PLC and develop programs using ladder logic
- 7) Explain the importance of communication systems and its interfaces
- 8) Find possible solutions to design problems from mechatronics point of view

### Course contents

Chapter-I----Introduction to Mechatronics



- 1.1 Introduction
- 1.2 Systems
- 1.3 Measurement systems
- 1.4 Control systems
- 1.5 Mechatronics approach to problems

#### Chapter –II ----Sensors and transducers

- 2.1 Sensors and Transducers
- 2.2 Performance terminology
- 2.3 Displacement, position and proximity
- 2.4 Velocity and motion
- 2.5 Force
- 2.6 Fluid power
- 2.7 Liquid flow, Liquid level
- 2.8 Temperature
- 2.9 Light sensors
- 2.10 Selection of sensors
- 2.11 Entering of data by switches

#### Chapter –III ---- Signal Conditioning

- a. Signal Conditioning
- b. The Operational amplifier
- c. Protection
- d. Filtering
- e. Wheatstone Bridge
- f. Digital Signals
- g. Multiplexers
- h. Data Acquisition
- i. Signal data processing
- j. Pulse modulation

#### Chapter---IV---Digital Logic

- 4.1 Digital Logic



- a. Number systems
- b. Logic gates
- c. Boolean Algebra
- d. Karnaugh Maps
- e. Application of Logic Gates
- f. Sequential Logic

#### Chapter—V--- Microprocessors

- 5.0 Control
- 5.1 Microcomputer Structure
- 5.2 Microcontrollers
- 5.3 Applications

#### Chapter –VI---Input/Output Devices

- 6.1 Interfacing
- 6.2 Input/output ports
- 6.3 Interface requirements
- 6.4 Peripheral Interface Adapters
- 6.5 Serial communication interface
- 6.6 Examples of interfacing

#### Chapter---VII-----Programmable Logic Controllers(PLC)

- 7.0 Programmable Logic Controller
- 7.1 Basic Structure
- 7.2 Input Output Processing
- 7.3 Programming
- 7.4 Mnemonics
- 7.5 Timers, Internal relays and counters
- 7.6 Shift Registers
- 7.7 Master and Jump Controls
- 7.8 Data Handling

7.9 Analogue input/output

7.10 Selection of a PLC

#### Chapter -----VIII----- Communication systems

8.0 Digital Communication Systems

8.1 Centralized , Hierarchical and Distributed Control

8.3 Networks

8.4 Protocols

8.5 Open Systems Interconnections communication Model

8.6 Communication Interfaces

#### Chapter ----IX-----Design of Mechatronics Systems

9.1 Designing

9.2 Possible Design solution-case studies

Table Of Specification for Mechatronics																	
Sl No	Hrs	Topic	Objective Type				Short Answer Type					Essay Answer Type					Total
	45		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	97
1	4	Introduction to Mechatronics	2	1		3		2			2		2	3		5	10
2	5	Sensors & Transducers	1	1	1	3		2	2		4			5		5	12
3	5	Signal Conditioning	2	2		4		2	2		4			4		4	12
4	5	Digital Logic	2	2		4		2			2		2	2	2	6	12
5	4	Microprocessors	1	1		2		1	1		2		2	3		5	9
6	5	Input Or Output System	2			2		2			2		3	5		8	12
7	6	Programmable Logic Controllers(PLC)	1	1	1	3		2	1		3			4	4	8	14
8	5	Communication System	1	1	1	3			1	1	2		2	2	3	7	12
9	6	Design Of Mechatronics Systems		1	1	2		1	1	1	3			4	5	9	14



Annexure -I <b>Mechatronics</b>								
SI No	Topic	Time Allotted(hrs)	Percentage Weightage	K	C	A	HA	Total
1	Introduction to Mechatronics	4	8.89	2	5	3		10
2	Sensors & Transducers	5	11.11	1	3	8		12
3	Signal Conditioning & DAQ system	5	11.11	2	4	6		12
4	Digital Logic	5	11.11	2	6	2	2	12
5	Microprocessors	4	8.89	1	4	4		9
6	Input Or Output System	5	11.11	2	5	5		12
7	Programmable Logic Controllers	6	13.33	1	3	6	4	14
8	Communication System	5	11.11	1	3	4	4	12
9	Design Of Mechatronics Systems	6	13.33		2	6	6	14

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## 9: Course Title: MECHATRONICS (Laboratory)

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<b>Subject Title</b>	<b>:</b>	<b>MECHATRONICS LAB</b>
<b>Subject Code</b>	<b>:</b>	<b>Mc-507</b>
<b>Hours Per Week</b>	<b>:</b>	<b>3</b>
<b>Hours Per Semester</b>	<b>:</b>	<b>45</b>
<b>Total Marks</b>	<b>:</b>	<b>50</b>
<b>Practical</b>	<b>:</b>	<b>25</b>
<b>Sessional</b>	<b>:</b>	<b>25</b>

Course Objectives:

On the completion of the course the students should be able to

- 1) Design and Simulate Digital circuits using Multisim or digital circuit simulator
- 2) Construct a timing circuit
- 3) Design and Simulate Ladder diagram to execute small operation

Section—I

Design and Simulatethe following digital circuits using Multisim or any digital circuit simulator

1. Basic Logic Gates
2. DE Morgan's theorem
3. Combination Logic
4. Encoders and Decoders
5. Digital Oscillator
6. Flip Flops



## Section -----II

1. Draw the ladder rungs to represent
  - i) Two switches normally open and both have to be closed for the motor to operate
  - ii) Either of the normally open switches to be closed for the coils to be energized
2. Device a timing circuit, that will switch on for 20s and then switch it off.
3. Device a timing circuit that will switch on for 10s and off 20s and so on...
4. Device a circuit that can be used to start a motor and then to start a pump after delay of 50s. Then the motor is switched off 10s before the pump is switched off when the pump remains on for 50s.
5. Device a circuit that can be used with the domestic washing machine to switch on a pump to pump water for 100s into the machine. Then switch on a heater for 50s to heat the water. The heater is switched off and another pump is switched on to empty the water for 100s.

## Section – III

Design and simulate the following systems using automation studio/any equivalent simulator software.

1. Design and simulate a ladder diagram for the forward and reverse movement of the piston in a pneumatic cylinder. The output 01 and 02 of the PLC are to be connected to the forward and retract coil of the cylinder.
2. Design and simulate a ladder diagram to operate a garage door.
3. Design and simulate a ladder diagram for car parking (hint-car is to be detected and entered into the parking space to a particular location if space is available, if there is no space a lamp should indicate that parking is full).
4. Design and simulate a ladder diagram to detect a bottle without cap on a conveyer in a bottling plant and indicate the same through an indicator.

## System Requirements

1. Computers with latest configuration CPU-3.0 GHz / RAM-2 GB / hdd-250 GB / Dedicated graphics card 1 GB
2. UPS minimum 7.5 kVA



3. Printer – Laser 2 Nos.
4. LCD projector 2 Nos.

#### Software Requirements

1. MultiSim/similar software – Latest version with 20 user licenses
2. Automation Studio – Latest educational version with 20 user licenses
3. PLC Trainer kit 5 Nos. (Siemens/Allen Bradley/Keyence/Fanuc)

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