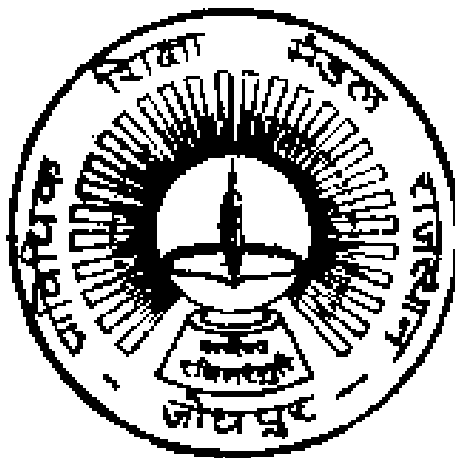


GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN
JODHPUR

SEMESTER SCHEME-2020-21

(SESSION 2021-2022 & ONWARDS)



TEACHING AND EXAMINATION SCHEME
AND SYLLABUS

MECHANICAL (REFRIGERATION)
ENGINEERING

(MR)

.....
Curriculum Development Cell
Board of Technical Education, Rajasthan
W-6 Residency Road,

Jodhpur

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA III SEMESTER MECHANICAL (RAC) ENGINEERING (MR)
SESSION 2021-2022 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration						Total Marks	Credits	
			Hours per week				End Semester Exam			Internal Assessment					
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi			PR(S)
PC	MR 3001	Basic Refrigeration	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR 3002	Basic Air Conditioning	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR 3003	Heat Transfer	3	1	--	4	60	3	--	--	20	20	--	100	4
PC	MR 3004	Thermal Engineering	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR 3005	Fluid Engineering	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR 3006	Basic Refrigeration Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 3007	Basic Air Conditioning Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 3008	Thermal Engineering Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 3009	Fluid Engineering Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
SI	MR 3010	Summer Internship – I (4 weeks after II sem)	--	--	--	--	--	--	100	--	--	--	--	100	2
VS	+MR 3333	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	15	1	12	28	300	--	260	--	100	100	340	1100	24
Grand Total :													1100	24	

- | | |
|--|---|
| 1. L : Lecture | 5. PR : Marks for End Semester Exam for Practical |
| 2. T : Tutorial | 6. CT : Marks for class tests (Internal Assessment) |
| 3. P : Practical | 7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment) |
| 4. TH : Marks for End Semester Exam for Theory | 8. PR(S) : Marks for practical and viva (Internal Assessment) |

1. +MR 3333 is same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA IV SEMESTER MECHANICAL (RAC) ENGINEERING (MR)
SESSION 2021-2022 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration						Total Marks	Credits	
			Hours per week				End Semester Exam			Internal Assessment					
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi			PR(S)
PC	MR 4001	Advance Refrigeration-I	2	--	--	2	60	3	--	--	20	20	--	100	2
PC	MR 4002	Advance Air Conditioning –I	2	--	--	2	60	3	--	--	20	20	--	100	2
PC	MR 4003	Electrical Engineering	3	--	--	3	60	3	--	--	20	20	--	100	3
PE	MR 4004	Program Elective-I MR40041- Maintenance and Safety Engineering MR40042- Material Science and Technology	3	--	--	3	60	3	--	--	20	20	--	100	3
PE	MR 4005	Program Elective-II MR40051- Total Quality Management MR40052- Industrial Management	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR4006	Advance Refrigeration-I Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 4007	Advance Air Conditioning -I Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 4008	Electrical Engineering Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
PC	MR 4009	RAC Drawing	--	--	4	4	--	--	40	3	--	--	60	100	2
PR	MR 4010	Minor Project	--	--	4	4	--	--	40	--	--	--	60	100	2
AU	+MR 4222	Essence of Indian Knowledge and Tradition	2	--	--	2	--	--	--	--	--	--	--	--	--
VS	+MR 4444	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	--	--	3	3	--	--	--	--	--	--	--	--	--
		Total	15	0	18	33	300	--	200	--	100	100	400	1100	22
Grand Total :													1100	22	

- | | |
|--|---|
| 1. L : Lecture | 5. PR : Marks for End Semester Exam for Practical |
| 2. T : Tutorial | 6. CT : Marks for class tests (Internal Assessment) |
| 3. P : Practical | 7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment) |
| 4. TH : Marks for End Semester Exam for Theory | 8. PR(S) : Marks for practical and viva (Internal Assessment) |

1+MR 4222 and +MR 4444 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

Note: Students will go for 6 Weeks Summer Internship in the Summer Vacations after Fourth Semester. The assessment of the Summer Internship will be done in Fifth Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA V SEMESTER MECHANICAL (RAC) ENGINEERING (MR))
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
PC	MR 5001	Advance Refrigeration-II	2	--	--	2	60	3	--	--	20	20	--	100	2
PC	MR 5002	Advance Air Conditioning –II	2	--	--	2	60	3	--	--	20	20	--	100	2
OE	+MR 5100	Open Elective-I +MR 51001- Economic Policies in India +MR 51002- Engineering Economics & Accountancy	3	--	--	3	60	3	--	--	20	20	--	100	3
PC	MR 5003	Modern RAC Practices	2			2	60	3	--	--	20	20	--	100	2
PE	MR 5004	Programme Elective-III MR 50041- RAC Application MR 50042- HVAC System control	3	--	--	3	60	3	--	--	20	20	--	100	3
PE	MR 5005	Programme Elective-IV MR 50051- Fire Prevention and Protection MR 50052- Electrical Machines	3	--	--	3	60	3	--	--	20	20		100	3
PC	MR 5006	Advance Refrigeration-II Lab	--	--	4	4	--	--	40	3	--	--	60	100	2
PC	MR 5007	Advance Air Conditioning –II Lab	--	--	4	4	--	--	40	3	--	--	60	100	2
PC	MR 5008	Modern RAC Practices Lab	--	--	2	2	--	--	40	3	--	--	60	100	1
SI	MR 5009	Summer Internship – II(6 weeks after IVSem)	--	--	--	--	--	--	100	--	--	--	--	100	3
PR	MR 5010	Major Project	--	--	2	2	--	--	--	--	--	--	--	--	--
VS	+MR 5555	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	15	--	16	31	360		220		120	120	280	1100	25
Grand Total :													1100	25	

1. L : Lecture

2. T : Tutorial

3. P : Practical

4. TH : Marks for End Semester Exam for Theory

5. PR : Marks for End Semester Exam for Practical

6. CT : Marks for class tests (Internal Assessment)

7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)

8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +MR 51001, +MR51002 and +MR 5555 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

Note:Major Project will be continued and Assesed in VI Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA VI SEMESTER MECHANICAL (RAC) ENGINEERING (MR)
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
HS	+MR 6111	Entrepreneurship and Start-ups	3	1	--	4	60	3	--	--	20	20	--	100	4
OE	+MR 6200	Open Elective-II	3	--	--	3	60	3	--	--	20	20	--	100	3
		+MR 62001- Project Management +MR 62002- Renewable Energy Technologies													
OE	+MR 6300	Open Elective-III	3	--	--	3	60	3	--	--	20	20	--	100	3
		+MR 63001- Product Design +MR 63002- Disaster Management													
AU	+MR 6333	Indian Constitution	2	--	--	2	--	--	--	--	--	--	--	--	--
PC	MR 6001	Air Conditioning System Design	4	--	--	4	60	3	--	--	20	20	--	100	4
PC	MR 6002	Refrigeration System Design	2	--	--	2	60	3	--	--	20	20	--	100	2
PR	MR 6003	Major Project	--	--	6	6	--	--	40	--	--	--	60	100	4
SE	MR 6004	Seminar	1	--	--	1	--	--	--	--	--	--	100	100	1
VS	+MR 6666	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	18	1	10	29	300	--	40	--	100	100	260	800	23
Grand Total :													800	23	

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +MR 6111, +MR 62001, +MR 62002, +MR 63001, +MR 63002, +MR 6333 and +MR 6666 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR
SEMESTER SCHEME-2020-21



III SEMESTER
(SESSION 2021-2022 & ONWARDS)

BASIC REFRIGERATION

Course Code	MR 3001
Course Title	Basic Refrigeration
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the concept of refrigeration
- To acquire knowledge of methods of refrigeration
- To acquire knowledge of Air refrigeration system
- To acquire knowledge of vapour compression and vapour absorption refrigeration system.
- To acquire knowledge of refrigerants

Course Outcomes:

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

CO1	Describe the concept of refrigeration and its unit.
CO2	Describe different methods of refrigeration.
CO3	Explain air refrigeration cycle and its application in air craft.
CO4	Explain vapour compression refrigeration system
CO5	Explain vapour absorption refrigeration system
CO6	Explain properties of refrigerants

Course Contents**Unit-1 Introduction to Refrigeration:**

- 1.1 Brief history of refrigeration
- 1.2 Definition
- 1.3 Methods of producing cold
- 1.4 Heat engine, heat pump and refrigerating machine
- 1.5 Coefficient of performance, unit of refrigeration
- 1.6 Reversed Carnot cycle
- 1.7 Classification of refrigeration systems.

Unit-2 Air Refrigeration Cycle:

- 2.1 Reversed Brayton cycle
- 2.2 Analysis of gas cycle
- 2.3 Actual gas cycle
- 2.4 Application to aircraft refrigeration
- 2.5 Air cycle systems for aircraft
 - 2.5.1 Simple system
 - 2.5.2 Bootstrap system
 - 2.5.3 Regenerative system
 - 2.5.4 Reduced ambient system
- 2.6 Simple numerical problems

Unit-3 Simple Vapour Compression System:

- 3.1 Vapour compression cycle
- 3.2 Pressure-enthalpy and temp.-entropy diagrams and calculations
- 3.3 Dry and wet compression
- 3.4 Effect of evaporator and condenser pressure
- 3.5 Effect of suction superheat and liquid subcooling
- 3.6 Effect of pressure losses
- 3.7 Actual vapour compression cycle
- 3.8 Simple numerical problems

Unit-4 Refrigerants:

- 4.1 Survey of refrigerants

- 4.2 Designation
- 4.3 Selection of refrigerants
- 4.4 Desirable properties
- 4.5 Primary and secondary refrigerants
- 4.6 Properties of some commonly used refrigerants
- 4.7 Azeotropes
- 4.8 Ozone safe refrigerants

Unit-5 Vapour Absorption Systems:

- 5.1 Simple vapour absorption system
- 5.2 Modification to simple system
- 5.3 Desirable properties of refrigerant absorbent
- 5.4 Lithium bromide water system
- 5.5 Electrolux Refrigerator

References:

1. A Course in Refrigeration & Air Conditioning :- Domkundwar & Arora
2. Refrigeration & Air Conditioning :- C.P. Arora
3. Refrigeration & Air Conditioning (Hindi) :- N.K. Mangal
4. Refrigeration & Air Conditioning :- Ballaney
5. Refrigeration & Air Conditioning :- R. K. Rajput

SEMESTER SCHEME-2020-21

BASIC AIR CONDITIONING

Course Code	MR 3002
Course Title	Basic Air Conditioning
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the need of Air Conditioning.
- To understand psychrometric properties & processes.
- To acquire knowledge of Air Conditioning Systems.
- To acquire knowledge of Air Cooling Systems.

Course Outcomes:

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

CO1	Describe effect of temperature on human health.
CO2	Define various air properties and psychrometric processes.
CO3	Explain various air conditioning systems.
CO4	Explain various air cooling systems.

Course Contents**Unit- 1 Introduction to Air Conditioning:**

- 1.1 Concept of air conditioning
- 1.2 Physiological basis
- 1.3 Air conditioning systems
 - 1.3.1 Classification
 - 1.3.2 Components

Unit- 2 Human Comfort :

- 2.1 Factors influencing comfort
- 2.2 Air temperature and human health
- 2.3 Physical impurities of air
- 2.4 Body temperature regulation
- 2.5 Ventilation requirements
- 2.6 Concept of effective temperature
- 2.7 Factors influencing effective temperature
- 2.8 Comfort chart
- 2.9 Comfort zone
- 2.10 Limitations of comfort chart

Unit- 3 Psychrometry :

- 3.1 Introduction
- 3.2 Psychrometric properties
- 3.3 Psychrometric relations
- 3.4 Psychrometric chart
- 3.5 Psychrometric processes
 - 3.5.1 Sensible heating and cooling
 - 3.5.2 Heating with Humidification
 - 3.5.3 Cooling with dehumidification
 - 3.5.4 Mixing of air streams
- 3.6 Apparatus dew point
- 3.7 Sensible heat factor and bypass factor

Unit- 4 Air Conditioning Systems :

- 4.1 Classification & working of air conditioning systems
 - 4.1.1 Unitary system

- 4.1.2 Package system
- 4.1.3 Split system
- 4.1.4 Central station system
- 4.1.5 VRV system
- 4.2 Factors affecting design and installation of a central station system
- 4.3 Unitary system for multi room buildings- Fan coil unit system

Unit- 5 Evaporative cooling system :

- 5.1 Introduction
- 5.2 Basic psychrometric of evaporative cooling
- 5.3 Saturation efficiency
- 5.4 Limitations of evaporative cooling
- 5.5 Removing heat by evaporative cooling
- 5.6 Types of evaporative coolers
 - 5.6.1 Spray type
 - 5.6.2 Rotary type
 - 5.6.3 Wetted pad type
- 5.7 Concept & working of two stage evaporative cooling system

References:

- | | |
|---|--------------------|
| 1. Refrigeration and Air Conditioning | C.P.Arora |
| 2. Modern Air Conditioning Practice | Norman C.Harris |
| 3. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 4. Air Conditioning & Refrigeration | Severns & Fellows |

HEAT TRANSFER

Course Code	MR 3003
Course Title	Heat Transfer
Number of Credits	4 (L:3, T:1, P:0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the concepts of conduction.
- To understand the concepts of convection.
- To understand the concepts of radiation.
- To understand the basics of heat exchanger.
- To understand the concept of fins.
- To acquire knowledge of insulating material

Course Outcomes:

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

CO1	Explain the basics of heat transfer.
CO2	Ability to understand and solve convection problems.
CO3	Ability to understand and solve radiation problems.
CO4	Analyze the performance of heat exchanger.
CO5	Explain importance of fins in heat transfer.
CO6	Explain importance & uses of insulating materials.

Course Contents**Unit- 1 Conduction :**

- 1.1 Importance of heat transfer
- 1.2 Study state unidirectional heat conduction without heat generation
- 1.3 Fourier's equation
- 1.4 Heat flow through: Plane wall, Composite wall, Cylinder of uniform conductivity.
- 1.5 Electrical analogy
- 1.6 Log mean area
- 1.7 Simple numerical problems

Unit -2 Convection :

- 2.1 Basic theory
- 2.2 Newton's Law of cooling
- 2.3 Free convection
- 2.4 Forced convection
- 2.5 Hydrodynamic and thermal boundary layers
- 2.6 Commonly used dimensionless numbers and their significance

Unit -3 Radiation :

- 3.1 Basic theory
- 3.2 Plank's law
- 3.3 Stefan Boltzmann equation
- 3.4 Absorption, reflection and transmission
- 3.5 Significance of black, white, grey and real surfaces
- 3.6 Kirchoff's law
- 3.7 Wien's displacement law(no proof)

UNIT4: Heat Exchangers:

- 4.1 Classification

- 4.2 Evaporators and condensers
- 4.3 Overall heat transfer coefficient
- 4.4 Log mean temperature difference
- 4.5 Effectiveness of heat exchanger
- 4.6 Concept of number of transfer units

Unit 5 Fins:

- 5.1 Types
- 5.2 Steady flow of heat from a long rectangular fin
- 5.3 Fin efficiency
- 5.4 Application and uses
- 5.5 Description of finned tube heat exchanger

Unit 6 Thermal Insulation:

- 6.1 Purpose
- 6.2 Types
- 6.3 Vapour barriers
- 6.4 Commonly used insulating materials and their properties.

References:

- 1. Heat and Mass Transfer
- 2. Heat Transfer
- 3. Heat and Mass Transfer
- 4. Heat Transfer
- 5. Heat and Mass Transfer

Domkundwar
S.P. Sukhatme
J.P. Holman
Gupta & Prakash
Y A Cangle

SEMESTER SCHEME-2020-21

THERMAL ENGINEERING

Course Code	MR 3004
Course Title	Thermal Engineering
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PE

Course Objectives:

- To understand the science of energy transfer and its effect on physical properties of substance.
- To understand basic concepts, laws and principles of Thermodynamics.
- To study, analyse and evaluate the operation and the performance of IC engines.
- To understand the working of steam Boilers, functions of various mounting and accessories of boilers.

Course Outcomes:

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

CO1	Apply basic concepts, laws and principles of thermodynamics to use and select equipments/devices/machines working on these basics.
CO2	Outline various Thermodynamic processes and analyze them with respect to various parameters.
CO3	Understand the Limitations, applications of thermodynamic cycles.
CO4	Understand the functions of various parts of IC engines and the working of IC engines.
CO5	Distinguish between fire tube and water tube boiler and explain function of all mounting and accessories.

Course Contents**Unit- 1 Basics concept and laws of thermodynamics:**

- 1.1 Basic concepts-Definitions :system - boundary, surrounding
- 1.2 Thermodynamic systems – closed, open and isolated systems with examples
- 1.3 Properties of system
 - 1.3.1 Intensive: Pressure, Temperature
 - 1.3.2 Extensive properties: Mass, volume, specific heat, Internal energy, Heat, work and enthalpy.
- 1.4 Gas Laws:
 - 1.4.1 Boyle's law, Charles Law
 - 1.4.2 Characterized gas equation, Universal gas constant
- 1.5 Laws of thermodynamics
 - 1.5.1 Zeroth, first and second laws of thermodynamics
- 1.6 Simple numerical problems

Unit-2 Thermodynamic Processes:

- 2.1 Study and p-v diagrams
 - 2.1.1 Constant pressure
 - 2.1.2 Constant temperature
 - 2.1.3 Hyperbolic
 - 2.1.4 Reversible adiabatic
 - 2.1.5 Polytropic
 - 2.1.6 Free expansion and throttling
- 2.2 Derivation of Work done for the above processes
- 2.3 Change of internal energy
- 2.4 Change of entropy
- 2.5 Simple numerical problems

Unit -3 Thermodynamic Cycle:

- 3.1 Concept of reversibility
- 3.2 Thermal efficiency of cycle
- 3.3 Air standard efficiency and its assumption

- 3.4 Explanation of Carnot cycle,
 - 3.4.1 P-v diagram and T-S diagram
 - 3.4.2 Thermal efficiency
 - 3.4.3 Application
 - 3.4.4 Limitation
- 3.5 Simple numerical problems

UNIT4: IC ENGINES

- 4.1 Classification of I.C. Engines.
- 4.2 Two stroke and four stroke cycles.
- 4.3 Working of four stroke Petrol and Diesel Engine.
- 4.4 Valve Timing diagram for four stroke engine
- 4.5 Explanation of Otto cycle, diesel cycle.
- 4.6 Methods of finding Indicative power and Brake power.
- 4.7 Formula for brake thermal efficiency, relative efficiency.
- 4.8 Mechanical energy balance sheet of I.C. engines.

Unit 5 Steam Boilers:

- 5.1 Classification
- 5.2 Description and working of Cochran, Babcock and Wilcox boilers.
- 5.3 Comparison of water tube and fire tube boiler.
- 5.4 Boiler mountings and accessories.

References:

- | | | |
|----|---------------------------------|-----------------|
| 1. | Thermal Science and Engineering | Mathur & Mehta |
| 2. | Thermal Engineering | Rai & Saro |
| 3. | Thermal Engineering | Balani |
| 4. | Thermal Engineering | Verma & Gulecha |
| 5. | Engineering Thermodynamics | P.K NAG |

SEMESTER SCHEME-2020-21

FLUID ENGINEERING

Course Code	MR 3005
Course Title	Fluid Engineering
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the properties of fluid.
- To understand basic fundamentals of fluid flow.
- To calculate the rate of flow and pressure in a fluid line.
- To acquire knowledge about centrifugal pump & turbine.

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

CO1	To calculate the pressure in a fluid line
CO2	To calculate the rate of flow in a fluid line
CO3	To identify the performance of centrifugal pump
CO4	To know the uses of turbines for particular applications

Course Contents**Unit-1 Properties of Fluid :**

- 1.1 Introduction
- 1.2 Definition of a fluid
- 1.3 Density, specific volume, relative density
- 1.4 viscosity, vapour pressure
- 1.5 Surface tension and capillary

Unit-2 Fluid Pressure and its Measurement :

- 2.1 Fluid pressure at a point
- 2.2 Pascal's law
- 2.3 Atmospheric, absolute, gauge and vacuum pressure
- 2.4 Measurement of pressure
 - 2.4.1 Simple manometer
 - 2.4.2 Differential manometer
 - 2.4.3 Mechanical gauges

Unit-3 Fundamentals of Fluid Flow :

- 3.1 Introduction
- 3.2 Velocity of fluid particles
- 3.3 Types of fluid flow
- 3.4 Continuity equation

Unit-4 Equation of Motion and Energy Equation :

- 4.1 Introduction
- 4.2 Bernoulli's equation
- 4.3 Application of Bernoulli's equation
- 4.4 Venturimeter
- 4.5 Orifice meter
- 4.6 Rotameter
- 4.7 Pitot tube

Unit-5 Flow Through Pipes :

- 4.8 Introduction
- 5.1 Types of flow
- 5.2 Laws of fluid friction
- 5.3 Darcy-Weisbach equation
- 5.4 Energy losses in pipes

- 5.5 Hydraulic gradient and total energy line
- 5.6 Flow through pipes
- 5.7 Pipes in series, parallel or compound pipes
- 5.8 Equivalent pipe
- 5.9 Transmission of power through pipes
- 5.10 Water hammer in pipes

Unit-6 Centrifugal Pump :

- 6.1 Introduction
- 6.2 Need of a pump
- 6.3 Component parts
- 6.4 Working
- 6.5 Work done by the impeller
- 6.6 Losses and efficiencies
- 6.7 Cavitation in pump
- 6.8 Priming

Unit-7. Water Turbines

- 7.1 Classification of water turbines
- 7.2 Construction and working of Pelton , Francis and Kaplan turbines
- 7.3 Function of draft tubes
- 7.4 Cavitation
- 7.5 Surge Tanks

References:

- | | | |
|----|------------------------|----------------|
| 1. | Fluid Mechanics & M/Cs | Dr Jagdish Lal |
| 2. | Fluid Mechanics & M/Cs | Dr R.K.Bansal |
| 3. | Fluid Mechanics & M/Cs | Dr R.S. Khurmi |

SEMESTER SCHEME-2020-21

BASIC REFRIGERATION LAB

Course Code	MR 3006
Course Title	Basic Refrigeration Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To acquire knowledge of RAC tools and equipments.
- To acquire knowledge of copper tube joining process
- To understand the working of domestic refrigerator & water cooler.
- To understand the performance investigation of a refrigeration system.

Course Outcomes:

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

CO1	Identify and use different RAC tools and equipments.
CO2	Join the copper tube practically.
CO3	Explain working of various refrigeration machines
CO4	Calculate the power consumption of various refrigeration machine.

Course Contents

S.No.	Topics for Practice
1	To study the safety rules and introduction of tools and equipments used in refrigeration and air conditioning.
2	Practice of cutting, flaring and bending copper tubes.
3	Practice of swaging and brazing of copper tubes
4	Study of domestic refrigerator with special reference to refrigeration system and electrical circuit
5	Study of water cooler with special reference to refrigeration system and electrical circuit
6	Study of Electrolux refrigerator with special reference to refrigeration system circuit
7	Study of different parts of a refrigeration testing rig
8	To find out power consumption of domestic refrigerator, deep freezer and water cooler.
9	To observe pressures and temperatures at different points on operating units
10	Study & measurement of refrigerant operating characteristics.

References:

- | | |
|---|--------------------------|
| 1. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |
| 2. Modern Air Conditioning Practice | Norman C.Harris |
| 3. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 4. Refrigeration and Air Conditioning | G.S.Sawhney |
| 5. Practical Refrigeration and Air Conditioning | M. Adithan & S C Laroija |

BASIC AIR CONDITIONING LAB

Course Code	MR 3007
Course Title	Basic Air Conditioning Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To determine psychrometric properties of air.
- To understand psychrometric processes.
- To understand the working & types of air conditioner.
- To understand working & types of evaporative coolers.

Course Contents

S.No.	Topics for Practice
1	To find out various psychrometric properties with a sling psychrometer.
2	Study and perform mixing process of air streams.
3	Study and perform sensible heating and cooling process.
4	Study and perform heating with humidification process.
5	Study and perform cooling with dehumidification process.
6	Study of window air conditioner with reference to refrigeration system circuit and identification of components.
7	Study of split air conditioner with reference to refrigeration system circuit and identification of components.
8	Study & determination of saturation efficiency of a wood wool pad type air cooler.
9	Study & determination of saturation efficiency of a cellulose pad type air cooler.
10	Determination of cooling effect of an air conditioner and power consumption measurement.

References:

- | | |
|---|--------------------|
| 1. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |
| 2. Modern Air Conditioning Practice | Norman C.Harris |
| 3. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 4. Refrigeration and Air Conditioning | G.S.Sawhney |

THERMAL ENGINEERING LAB

Course Code	MR 3008
Course Title	Thermal Engineering Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the working of boiler.
- To observe various part of engine and understand their function.
- To identify physical difference between S.I and C.I Engine.
- To understand Port/Valve timing diagram.

Course Outcomes:

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

CO1	Explain the working of fire tube and water tube boilers.
CO2	Comparison of actual valve/port timing diagram with theoretical valve/port timing diagram.
CO3	Understand the functions of various parts of IC engines and the working of IC engines.
CO4	Familiarize the parts, functions and types of Air Compressor.

Course Contents

S.No.	Topics for Practice
1	Study by models/charts/of Cochran fire tube boiler.
2	Study by models/charts/ of Babcock water tube boiler.
3	Study by models/charts /actual unit of the following- 3.1 Boiler mountings 3.2 Boiler accessories
4	Study of Port timing diagram of two stroke petrol engine.
5	Study of Valve timing diagram of four stroke petrol engine.
6	Study of Valve timing diagram of four stroke diesel engine.
7	Study by models, charts and actual units of Carburetor.
8	Assembling and disassembling of I.C Engines.
9	Study of reciprocating air compressor.
10	Study of centrifugal air compressor.

References:**References**

- | | | |
|----|---------------------|-----------------|
| 1. | Thermal Engineering | Mathur & Mehta |
| 2. | Thermal Engineering | Rai & Saro |
| 3. | Thermal Engineering | P.L Balani |
| 4. | Thermal Engineering | Verma & Gulecha |
| 5. | Thermal Engineering | Nag |

FLUID ENGINEERING LAB

Course Code	MR 3009
Course Title	Fluid Engineering Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To measure the liquid pressure
- To understand the basic principles of fluid
- To understand the effect of fluid friction on pressure losses
- To understand working and operating conditions of centrifugal pump
- To understand the Classification of turbine

Course Outcomes:

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

CO1	To measure the pressure in a fluid line
CO2	To measure the rate of flow in a fluid line
CO3	To determine the performance of centrifugal pump
CO4	To know the uses of turbines for particular applications

Course Contents

S.No.	Topics for Practice
1	Study of manometers and pressure gauges
2	Verification of bernoulli's theorem
3	Determination of C_d for venturimeter
4	Determination of C_d for orificemeter
5	Determination of C_c , C_v , C_d for small orifice
6	Determination of coefficient of friction for pipes
7	Testing of centrifugal pump for discharge and head
8	Study of pelton wheel turbine with the help of chart/model
9	Study of francis turbine with the help of chart/model
10	Study of kaplan turbine with the help of chart/model

Refrences:

- | | |
|---------------------------------|-----------------|
| 1. Fluid mechanics and machines | Dr. Jagdish lal |
| 2. Fluid mechanics and machines | Dr. R.K bansal |
| 3. Fluid mechanics and machines | Dr. R.S khurmi |

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR
SEMESTER SCHEME-2020-21



IV SEMESTER
(SESSION 2021-2022 & ONWARDS)

ADVANCE REFRIGERATION - I

Course Code	MR4001
Course Title	Advance Refrigeration - I
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To acquire knowledge of various type compressors used in refrigeration & air conditioning.
- To acquire knowledge of condenser in detail.
- To acquire knowledge of various type expansion devices used in refrigeration & air conditioning.
- To acquire knowledge of evaporator in detail.

Course Outcomes:

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

CO1	Describe the working & performance of various type compressors.
CO2	Explain the working, types and performance of condenser.
CO3	Explain the working detail of expansion devices and its suitability.
CO4	Explain the working, types and performance of evaporator.

Course Contents**Unit-1 Compressors:**

- 1.1 Rotary compressor
 - 1.1.1 Types
 - 1.1.2 Construction, working principle and performance
- 1.2 Centrifugal compressor
 - 1.2.1 Types
 - 1.2.2 Construction, working principle and performance
- 1.3 Screw compressor
 - 1.3.1 Construction, working principle and performance
- 1.4 Scroll compressor
 - 1.4.1 Construction, working principle and performance
- 1.5 Reciprocating Compressor
 - 1.5.1 Types, Construction, working principle and performance
 - 1.5.2 Compression cycle, Total volumetric efficiency
 - 1.5.3 Effect of suction, superheat and sub cooling on compressor Performance
- 1.6 Lubricating oils

Unit-2 Condensers :

- 2.1 Types
- 2.2 Condenser load
- 2.3 Condenser capacity
- 2.4 Quantity and temperature rise of condensing medium
- 2.5 Condenser applications
- 2.6 Air cooled condensers
 - 2.6.1 Types
 - 2.6.2 Air quantity and velocity
 - 2.6.3 Rating and selection
- 2.7 Water cooled condensers
 - 2.7.1 Types
 - 2.7.2 Rating and selection
- 2.8 Water cooled condensing system
 - 2.8.1 Waste water system
 - 2.8.2 Recirculated water system
- 2.9 Fouling rates

2.10 Evaporative condensers

Unit-3 Expansion Devices:

- 3.1 Types
 - 3.1.1 Capillary tube
 - 3.1.2 Automatic expansion valve
 - 3.1.3 Thermostatic expansion valve-internally and externally equalized
 - 3.1.4 Float valve-low and high side
- 3.2 Suitability of expansion device
- 3.3 Rating and selection

Unit-4 Evaporators :

- 4.1 Types
 - 4.1.1 Flooded
 - 4.1.2 Dry expansion
- 4.2 Types of construction
 - 4.2.1 Bare tube
 - 4.2.2 Finned tube
 - 4.2.3 Plate surface
- 4.3 Evaporator capacity
- 4.4 Log mean temperature difference
- 4.5 Effect of air quantity on evaporator capacity
- 4.6 Surface area
- 4.7 Evaporator circuiting
- 4.8 Evaporator T.D.
- 4.9 Effect of coil T.D. on space humidity
- 4.10 Natural convection evaporators-rating and selection
- 4.11 Forced convection evaporators-rating and selection
- 4.12 Various types of liquid chilling evaporators

REFERENCE BOOKS:

- | | |
|---|-----------------------------|
| 1. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 2. Principles of Refrigeration | Roy J.Dossat (S.I. Edition) |
| 3. Refrigeration and Air Conditioning | C.P.Arora |
| 4. Air Conditioning & Refrigeration | Severns & Fellows |
| 5. Refrigeration & Air Conditioning | Ballaney |

ADVANCE AIR CONDITIONING-I

Course Code	MR 4002
Course Title	Advance Air Conditioning-I
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	NIL
Course Category	PC

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

CO1	Describe the working of different heat pumps, dehumidifiers & humidifiers.
CO2	Explain necessity of ventilation for human health.
CO3	Explain various methods of air cleaning.
CO4	Describe air distribution systems.

Course Objectives:

- To understand the Heat pump system.
- To understand importance of ventilation & air purification.
- To acquire knowledge of Air Conditioning Systems components.
- To acquire knowledge of Air distribution Systems.

Course Contents**Unit- 1 Heat Pump:**

- 1.1 Basic principles
- 1.2 Types of heat pumps
 - 1.2.1 Air to air system
 - 1.2.2 Air to water system
 - 1.2.3 Water to water system
- 1.3 Limits of heating capacity
- 1.4 Heat pump economics

Unit- 2 Air Conditioning System Components:

- 2.1 Chilled water and direct expansion coil
- 2.2 Dehumidification by sorbent materials
 - 2.2.1 Sorbents, absorbents, adsorbents
- 2.3 Liquid absorption system
- 2.4 Solid absorption system
- 2.5 Humidifiers
 - 2.5.1 Residential humidifiers
 - 2.5.2 Industrial humidifiers

Unit- 3 Ventilation:

- 3.1 Necessity of ventilation
- 3.2 Quantities of ventilating air required
- 3.3 System of ventilation
 - 3.3.1 Central ventilation systems
 - 3.3.2 Unit ventilators
- 3.4 Ventilation System for following applications
 - 3.4.1 Parking area
 - 3.4.2 Kitchen
 - 3.4.3 Wash rooms

Unit- 4 Air Purification:

- 4.1 Odour suppression and air sterilization
- 4.2 Classification of aerosols

- 4.3 Classification of air cleaners
 - 4.3.1 Viscous impingement type
 - 4.3.2 Dry type
 - 4.3.3 Cyclone
 - 4.3.4 Rotoclone
 - 4.3.5 Electro static type
 - 4.3.6 Air washers
- 4.4 Cleaning efficiency
- 4.5 Different type of filters e.g. microvee, HDPE & HEPA filters

Unit- 5 Air Distribution:

- 5.1 Schematic diagram of typical air distribution system and identification of all the components
- 5.2 Duct shapes and materials
- 5.3 Duct fittings and joints
- 5.4 Duct systems
- 5.5 Air distribution outlets
 - 5.5.1 Types
 - 5.5.2 Functions
 - 5.5.3 Location
- 3.7 Definition of terms connected with outlets
- 3.8 Selection of outlets
- 3.9 Laminar flow air distribution for operation theatre

References:

- 1. Modern Air Conditioning Practice Norman C.Harris
- 2. A Course in Refrigeration & Air Conditioning Domkundwar & Arora
- 3. Refrigeration & Air Conditioning C.P. Arora

ELECTRICAL ENGINEERING

Course Code	MR 4003
Course Title	Electrical Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the basic terms of Electricity
- To acquire knowledge of D C circuits.
- To understand the working of capacitors.
- To acquire knowledge of various electrical instruments and control devices.

Course Outcomes:

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

CO1	Explain the basic terms of Electricity
CO2	Explain and draw simple D C circuits.
CO3	Explain the working of capacitors
CO4	Explain the application of various electrical instruments and control devices.

Course Contents**Unit-1 Current Electricity:**

- 1.1 Definition of Resistance, Voltage, Current, Power, Energy, Frequency and their units,
- 1.2 Relation between electrical, mechanical and thermal units,
- 1.3 Temperature variation of resistance,
- 1.4 Difference between AC and DC voltage and current

Unit-2 D.C. Circuits:

- 2.1 Resistance, Series – parallel resistance circuits
- 2.2 Calculation of equivalent resistance
- 2.3 Ohm's Law
- 2.4 Kirchhoff's Laws and their applications.

Unit-3 Capacitance

- 3.1 Capacitor and its capacity,
- 3.2 Concept of charging and Discharging of capacitors,
- 3.3 Types of Capacitors and their use in circuits,
- 3.4 Series and parallel connection of capacitors,
- 3.5 Energy stored in a capacitor.

Unit-4 Classification of Electrical Engineering Materials:

- 4.1 Classification of materials into conducting, semi-conducting and insulating materials through a brief reference to atomic structure.
- 4.2 General properties of following materials
 - 4.2.1 Low resistivity materials
 - 4.2.2 High resistivity materials
 - 4.2.3 Brush material
 - 4.2.4 Contact materials
- 4.3 Special purpose materials
 - 4.3.1 Metals/alloys for fuses with their properties, composition and uses
 - 4.3.2 Composition and properties of soldering materials
 - 4.3.3 Materials for bimetal

Unit-5 Instrumentation and Measurement:

- 5.1 Principle, construction and working of the following measuring instruments –
 - 5.1.1 Ammeter and voltmeter (moving coil and moving iron type)

- 5.1.2 Dynamometer types wattmeter
- 5.1.3 Single phase AC energy meter
- 5.1.4 Multimeter and megger
- 5.2 Transducers and its classifications
- 5.3 Measurements of mechanical quantities like pressure, strain, and temperature.

Unit-6 Control Equipment

- 6.1 HRC Fuses
- 6.2 MCB
- 6.3 ELCB
- 6.4 ACB
- 6.5 Relay
- 6.6 Types of Earthing and its importance.

REFERENCES:

- | | |
|---|-------------|
| 1. Electrical engineering (Hindi & English) | K.D.Sharma |
| 2. Electrical engineering | D.R Nagpal |
| 3. Electrical technology | B.L.Theraja |
| 4. Electrical and Electronics Measurement and Instrumentation | A.K.Sawhney |

SEMESTER SCHEME-2020-21

MAINTENANCE & SAFETY ENGINEERING

Course Code	MR 40041
Course Title	Maintenance & Safety Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

Course Objectives:

- To acquire knowledge of various types of maintenance.
- To acquire knowledge of various aspects of maintenance management.
- To acquire Knowledge of various maintenance stages.
- To acquire knowledge of trouble shooting and general maintenance of mechanical equipments.
- To acquire knowledge of safety engineering

Course Outcomes:

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

CO1	Explain various types of maintenance systems.
CO2	Explain need, functions and organizational setup of maintenance department.
CO3	Explain various maintenance procedure and stages.
CO4	Explain general maintenance of various mechanical equipments.
CO5	Explain various safety rules and precautions applied on machine and operations.

Course Contents**Unit -1. Maintenance:**

- 1.1 Objectives of Maintenance
- 1.2 Types of maintenance
 - 1.2.1 Preventive maintenance
 - 1.2.2 Predictive maintenance
 - 1.2.3 Breakdown maintenance
 - 1.2.4 Condition Based Maintenance (CBM)
- 1.3 Total Productive Maintenance (TPM)

Unit -2. Maintenance Management:

- 2.1 Organizational setup of maintenance department.
- 2.2 Need of maintenance department
- 2.3 Functions of maintenance department
- 2.4 Maintenance planning and scheduling
- 2.5 Equipment history cards

Unit -3. Maintenance Stages:

- 3.1 Maintenance procedure
- 3.2 Disassembly of machine tool
 - 3.2.1 Preparation of disassembly
 - 3.2.2 Disassembly sequence and rules
 - 3.2.3 Examples of disassembly
 - 3.2.4 Designing parts for facilitating assembly and disassembly
- 3.3 Washing of parts
- 3.4 Fault finding
- 3.5 Rectification of faults
- 3.6 Assembly of mechanisms and machines

Unit- 4. Trouble Shooting and General Maintenance of Various Mechanical Equipment :

- 4.1 Pumps
- 4.2 Air-Compressors
- 4.3 I.C. engines
- 4.4 Two wheeler

Unit- 5. Safety Engineering:

- 5.1 Importance of safety
- 5.2 Analysis of accidents
- 5.3 General safety devices used on machines
- 5.4 General safety rules and precautions in material handling and working of machines.
- 5.5 Knowledge of first aid, artificial respiration and operation of firefighting equipments

REFERE CES :

- 1. Installation, Servicing & Maintenance
- 2. Industrial Engineering
- 3. Industrial Maintenance Management
- 4. Plant Maintenance
- 5. Maintenance Engg. & Management

S.N. Bhattacharya
H.P.Garg
S.K. Srivastava
V.B.Saxena
R.C. Mishra & Pathde

SEMESTER SCHEME-2020-21

MATERIAL SCIENCE AND TECHNOLOGY

Course Code	MR 40042
Course Title	Material Science And Technology
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PE

Course Objectives:

- To understand basic concept of material science.
- To understand the properties and uses of some metals and alloys of industrial importance.
- To understand the engineering requirement and selection of materials based on the properties for various applications.

Course Outcomes:

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

CO1	Understand the basic knowledge such as internal structure, crystal imperfections of the engineering materials.
CO2	Explain the various properties and uses of selected materials in industries.
CO3	Understand the metallic and nonmetallic material selection and handling of materials in the field of RAC equipment design.

Course Contents**Unit- 1 .General Introduction:**

- 1.1 Meaning of material Science
- 1.2 Classification of materials
- 1.3 Properties of materials
- 1.4 Selection of materials
- 1.5 Manufacturing processes
- 1.6 Heat treatment techniques

Unit- 2. Structure of atoms and molecules:

- 2.1 Atomic model
 - 2.1.1 Thomsons' plum pudding model
 - 2.1.2 Ruderford's nuclear model
 - 2.1.3 Bohr's atomic model
- 2.2 Important Terms
- 2.3 Concept of atoms
- 2.4 Electronic configuration of atoms
 - 2.4.2 Periodic table
 - 2.4.3 Importance of periodic table

Unit-3. Crystal structure and Imperfections in crystals

- 3.1 Crystal structure
 - 3.1.1 Unit cell and space lattice
 - 3.1.2 Lattice parameter and crystallographic planes
- 3.2 Crystal systems and Bravais's lattice
- 3.3 Crystal structure for metallic elements
- 3.4 Co-ordination Number and Atomic Packing Factor (APF)
- 3.5 Imperfections (defects) in crystals
- 3.6 Bonds in solids and classifications of solids

Unit-4. Properties and uses of metals and alloys:

- 4.1 Ferrous Metals and Alloys
 - 4.1.1 Iron ores
 - 4.1.2 Pig iron
 - 4.1.3 Cast iron,

- 4.1.4 Wrought iron
- 4.1.5 Composition, properties and uses of carbon steel
- 4.1.6 Comparison of cast iron wrought iron, mild steel and hard steel
- 4.1.7 Alloy steels
- 4.2 Non-ferrous Metals and Alloys
 - 4.2.1 Aluminium, Copper, Lead, Tin, Zinc and Nickel Metals
 - 4.2.2 Aluminium alloys
 - 4.2.3 Copper alloys
 - 4.2.4 Nickel alloys
 - 4.2.5 Bearing or antifriction alloys
 - 4.2.6 Solders

Unit-5. Non- Metallic Materials and Miscellaneous Materials:

- 5.1 Inorganic materials: Ceramics, Glass and refractories
- 5.2 Organic materials : Wood, plastics, rubber
- 5.3 Advanced materials : Biomaterials, nanomaterials and composites
- 5.4 Miscellaneous materials : Abrasives, Mica, celluloid

REFERENCE :

1. Material Science and Engineering- A first course : V. Raghavan
2. Material Science and Engineering R. Balasubramaniam
3. Engineering materials and material science : S.K. Bhatnagar
4. Material Science and Engineering : R. K. Rajput

SEMESTER SCHEME-2020-21

TOTAL QUALITY MANAGEMENT

Course Code	MR 40051
Course Title	Total Quality Management
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

Course Objectives:

- To introduce the main principles of business and social excellence.
- To generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

Course Outcomes:

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

CO1	Develop an understanding on quality management philosophies and frame works.
CO2	Develop in-depth knowledge on various tools and techniques of quality management.
CO3	Learn the applications of quality tools and techniques in both manufacturing and service industry.
CO4	Develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those.
CO5	Emerging concepts for quality and Taguchi optimization technique for off-line.

Course Contents**UNIT-I: Basic concepts:**

- 1.1 Definitions and history of quality control;
- 1.2 Quality function and concept of quality cycle;
- 1.3 Quality policy and objectives.
- 1.4 Economics of quality and measurement of the cost of quality.
- 1.5 Quality considerations in design.

Unit-II: Process control:

- 2.1 Machine and process capability analysis;
- 2.2 Use of control charts and process engineering techniques for implementing the quality plan.

Unit-III: Acceptance Sampling:

- 3.1 Single, double and multiple sampling,
- 3.2 lot quality protection
- 3.3 features and types of acceptance sampling tables,
- 3.4 Acceptance sampling of variables and statistical tolerance analysis.

Unit-IV: Quality education:

- 4.1 Principles of participation and participative approaches to quality commitment.

Unit-V: Emerging concepts of quality management:

- 5.1 Taguchi's concept of off-line quality control.
- 5.2 Ishikawa's cause and effect diagram.

References:

- 1.Total Quality Management M.P.Poonia & S.C Sharma
- 2.Total Quality Management An Introductory Text Paul James, Prentice hall
- 3.Quality Control and Application HOUSEN & Ghose
4. Industrial Engineering Management O.P Khanna

INDUSTRIAL MANAGEMENT

Course Code	MR 40052
Course Title	Industrial Management
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PE

Course Objectives:

- To understand given organization structure, major management skills and different leadership styles.
- To understand the role of Human resource development in industries.
- To understand material requirement planning, store keeping procedure and importance of inventory control.
- To understand need of work study and work measurement.

Course Outcomes:

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

CO1	Interpret organization structure and acquire management skills.
CO2	Explain the importance of HRD in Industries.
CO3	Explain material requirement planning and store keeping procedure.
CO4	Analyse importance of inventory control.
CO5	List and explain the need of method study and work measurements.

Course Contents**Unit- 1 Basics of management:**

- 1.1 Management, administration and organization, difference between them.
- 1.2 Functions of management, Fayol's principles of management
- 1.3 Types of ownership, sole trading, partnership, joint stock, co- operative and public enterprise.
- 1.4 Types of organization, different types and their charts.
- 1.5 Need for leadership, leadership qualities.
- 1.6 Motivation: Maslow's theory of motivation-hierarchy of needs.
- 1.7 Communication- process of communication, barriers for effective communication.

Unit- 2 Human Resource Development:

- 2.1 Introduction, object and functions of human resource development department
- 2.2 Recruitment, sources and methods of selection, need for effective training, method of Training, role of HRD in industries.
- 2.3 Definition and requirements of good wage system methods of wage payment
- 2.4 Wage incentives - type of incentive, difference in wage incentive and bonus.

Unit- 3 Material management:

- 3.1 Purchasing Functions and duties of purchase department, methods of purchasing, purchase order contracts, types of contracts ,merits and limitation of each contract system, departmental execution of works,. Tender, necessity, types of tenders, tendering procedure, earnest money and security money.
- 3.2 Store and store keeping: Functions and duties of store department, location and layout of store, bin cards, store ledger, receipt and issue procedure of materials, physical verification of stores, disposal method of unserviceable articles and codification of stores,
- 3.3 Enterprise resource planning –concept, feature and application –Material Requirement planning (MRP)-concept applications-Just in time (JIT)-concept and benefits-Supply chain management – concept and management.

Unit- 4 Introduction to Work Study:

- 4.1 Definition, need and concept of work study
- 4.2 Advantage of work study
- 4.3 Techniques of work study
- 4.4 Work study and management
- 4.5 Work study and productivity

- 4.6 Objectives of method study
- 4.7 Objectives of work management

Unit- 5 Inventory Control and Management:

- 5.1 Inventory and inventory control
- 5.2 Inventory classification
- 5.3 Inventory management
- 5.4 Objectives of inventory and inventory control
- 5.5 Costs affecting inventory
- 5.6 Economic order quantity
- 5.7 ABC analysis

References:

1. Industrial Management
2. Industrial Engg. & Management
3. Industrial Engg. & Management
4. Industrial Engg. & Operations Mgmt

V.K. Sharma & O.P. Harkut
O.P. Khanna
T.R. Banga
SK Sharma & Savita Sharma

SEMESTER SCHEME-2020-21

ADVANCE REFRIGERATION –I LAB

Course Code	MR 4006
Course Title	Advance Refrigeration –I Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the construction & working of various type compressors.
- To determine the capacity of condenser.
- To determine the friction loss and pressure drop through expansion devices.
- To determine the capacity of an evaporator.

Course Outcomes:

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

CO1	Describe the working of various type compressors.
CO2	Calculate the capacity of a condenser.
CO3	Calculate the friction loss and pressure drop through an expansion device.
CO4	Calculate the capacity of an evaporator.

Course Contents

S.No.	Topics for Practice
1	Study of various parts of a open type reciprocating compressor.
2	Study the constructional details of rotary compressor.
3	Study the constructional details of centrifugal compressor.
4	Study the constructional details of screw compressor.
5	Study the constructional details of scroll compressor.
6	To calculate the capacity of different types of condensers.
7	Study of different types of expansion devices
8	To calculate the capacity of different types of evaporators.

References:

- | | |
|---|-----------------------------|
| 1. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 2. Principles of Refrigeration | Roy J.Dossat (S.I. Edition) |
| 3. Refrigeration and Air Conditioning | C.P.Arora |
| 4. Refrigeration & Air Conditioning | Ballaney |
| 5. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |

ADVANCE AIR CONDITIONING-I LAB

Course Code	MR 4007
Course Title	Advance Air Conditioning-I LAB
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand working of a heat pump unit.
- To determine bypass factor of coil.
- To understand the working of humidifiers & dehumidifiers.
- To understand duct construction, supply/ return outlets and air filters.

Course Outcomes:

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

CO1	Describe working of a heat pump.
CO2	Define & measure bypass factor of coil.
CO3	Explain various types of humidifiers and dehumidifiers.
CO4	Explain complete air distribution system.

Course Contents

S.No.	Topics for Practice
1	Study of heat pump system.
2	Determination of bypass factor of cooling coil.
3	Determination of bypass factor of heating coil.
4	Study of humidifier & calculating quantity of water added in air stream.
5	Study of dehumidifier & calculating quantity of water removed from air stream.
6	Study of duct fittings and joints.
7	Study of air distribution components like grilles, registers, diffusers, control vanes, dampers etc.
8	Study of different types of air filters.
9	Study of central / unit ventilator system & determine air quantity.

References:

1. Refrigeration and Air Conditioning Theory and Practice
2. Modern Air Conditioning Practice
3. A Course in Refrigeration & Air Conditioning
4. Refrigeration & Air Conditioning

Pradhan & Soni
Norman C.Harris
Domkundwar & Arora
Althouse A.D.

ELECTRICAL ENGINEERING LAB

Course Code	MR 4008
Course Title	Electrical Engineering Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the measurement process of electrical units like voltage, current, resistance, power etc.
- To acquire knowledge of electrical circuits.
- To understand the Ohm's and Kirchhoff's law practically.
- To understand the working of different electrical instruments.

Course Outcomes:

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

CO1	Explain the measurement process of electrical units like voltage, current, resistance, power etc.
CO2	Explain to draw simple electrical circuits.
CO3	Describe the Ohm's and Kirchhoff's law practically.
CO4	Describe the working and application of different electrical instruments.

Course Contents

S.No.	Topics for Practice
1	Measurement of Voltage, Current, Resistance, power, consumed in an electrical circuit.
2	Formation of simple electrical circuit, series circuit and parallel circuit.
3	Verification of ohms Law.
4	Verification of Kirchhoff's Law.
5	Study and use of multi meter.
6	Measurement of displacement using LVDT.
7	Measurement of temperature using thermister and RTD.
8	Study and use of megger.

REFERENCE BOOKS:

- | | | |
|---|--|-------------|
| 5 | Electrical engineering (Hindi & English) | K.D.Sharma |
| 6 | Electrical engineering | D.R Nagpal |
| 7 | Electrical technology | B.L.Theraja |
| 8 | Electrical and Electronics Measurement and Instrumentation | A.K.Sawhney |

RAC DRAWING

Course Code	MR 4009
Course Title	RAC Drawing
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand and develop the ability to visualize the system components.
- To acquire knowledge and also make students familiar with symbols and various drafting practice.
- To acquire knowledge of wiring diagrams of Air Conditioners, Refrigerators and Water coolers of various popular brands are included so that students are at practical hand at their first training.
- To understand the working mechanism of different types of compressors.

Course Outcomes:

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

CO1	Understand and draw various symbols used in refrigeration and air-conditioning.
CO2	Explain and familiar with different system components and drafting practice.
CO3	Explain and make free hand sketch of wiring diagrams of relays and circuit diagram of water cooler, domestic refrigerator and window air-conditioner.
CO4	Explain the compression mechanism of different types of compressors.

Course Contents**Unit- 1.** Standard Graphical Symbols:

- 1.1 Basic symbols employed in Refrigeration and Air Conditioning
- 1.2 Symbols employed in heating
 - 1.3 Symbols employed in plumbing
 - 1.4 Symbols employed in sprinklers

Unit-2. Drawing of Following R & A/C Components:

- 2.1 Condensers
 - 2.1.1 Shell and tube type
 - 2.1.2 Evaporative type
- 2.2 Evaporators
 - 2.2.1 Dry expansion
 - 2.2.2 Flooded
 - 2.2.3 Shell and tube type chiller
- 2.3 Cooling Towers
 - 2.3.1 Natural draft
 - 2.3.2 Induced draft
 - 2.3.3 Forced draft
- 2.4 Thermoelectric Expansion Valves
 - 2.4.1 Externally equalized
 - 2.4.2 Internally equalized
- 2.5 Solenoid Valves
 - 2.5.1 One way
 - 2.5.2 Three way
- 2.6 Reciprocating Compressors
 - 2.6.1 Open type
 - 2.6.2 Hermetically sealed type
- 2.7 Centrifugal Compressor (compression mechanism only)
- 2.8 Rotary Compressor (compression mechanism only)
- 2.9 Scroll Compressor (compression mechanism only)
- 2.10 Screw Compressor (compression mechanism only)

Unit-3. Free Hand Sketching:

- 3.1 Internal wiring diagram of relays

- 3.1.1 Current type
- 3.1.2 Voltage type
- 3.2 Window A/C circuit diagrams
 - 3.2.1 CSR Circuit
 - 3.2.2 PSC Circuit
- 3.3 Domestic refrigerator circuit diagram
- 3.4 Water cooler circuit diagram

REFERENCE BOOKS :

- 1. Principles of Refrigeration
- 2. Refrigeration and Air Conditioning

Roy J. Dossat
Althouse A.D.

SEMESTER SCHEME-2020-21

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	MR 4222 (Same in All Branches of Engg.)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0(L-2,T-0, P-0)
Prerequisites	None
Course Category	AU

COURSE CONTENTS:

Basic Structure of Indian Knowledge System:

- (i) वेद,
- (ii) उन्नवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थानतल्यआदद)
- (iii) वेदथाथांग (शलकथा, कलन, ननरुत, व्थाकरण, ज्योनतषछथांद),
- (iv) उन्नथाइग (धर्मशासत्र, र्ीथाथांसाथा, नुरुथाण, तकशरथासत्र)
 - Modern Science and Indian Knowledge System
 - Yoga and Holistic Health care
 - Case Studies.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. V. Sivarama Krishna, “ Cultural Heritage of India- Course Material”, Bhartiya Vidya Bhavan, Mumbai, fifth Edition, 2014.
2. Swami Jitatanand, “ Modern Physics and Vedant”, Bhartiya Vidya Bhavan.
3. Fritz of Capra, “ The wave of Life”.
4. Fritz of Capra, “ Tao of Physics”.
5. V N Jha, “ Tarka sangraha of Annam Bhatta, International” Cinmay Foundation, Velliarnad, Amakuum.
6. R N Jha, “ Science of Consciousness Psychotherapy and Yoga Practices” Vidya nidhi Prakasham, Delhi, 2016.

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR
SEMESTER SCHEME-2020-21



V SEMESTER
(SESSION 2021-2022 & ONWARDS)

ADVANCE REFRIGERATION – II

Course Code	MR 5001
Course Title	Advance Refrigeration - II
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the knowledge of compounding in vapour compression cycle.
- To understand the working of miscellaneous refrigeration systems.
- To acquire knowledge of cooling tower.
- To acquire knowledge of defrosting methods in refrigeration System.

Course Outcomes:

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

CO1	Describe the compounding and its use in vapour compression system.
CO2	Explain working of various refrigeration systems.
CO3	Explain the working and performance investigation of cooling tower.
CO4	Explain various methods of defrosting in refrigeration systems.
CO5	Define the concept of refrigeration system balancing

Course Contents**Unit-1 Compound Vapour Compression System :**

- 1.1 Multistage compression system
- 1.2 Flash gas removal & flash gas intercooling
- 1.3 Multi evaporator system
- 1.4 Cascade system
- 1.5 Manufacture of solid carbon dioxide

Unit-2 Miscellaneous Refrigeration Systems:

- 2.1 Steam ejector system
 - 2.1.1 Thermodynamic cycle
 - 2.1.2 Theoretical analysis of steam ejector
- 2.2 Thermoelectric refrigeration
- 2.3 Magnetic refrigeration
- 2.4 Vortex tube
- 2.5 Solar refrigeration

Unit-3 Cooling Towers :

- 3.1 Types
 - 3.1.1 Natural draft & Mechanical draft
 - 3.1.2 Spray filled & Deck filled
 - 3.1.3 Forced and induced draft
 - 3.1.4 Counter and cross flow
- 3.2 Cooling tower calculations
 - 3.2.1 Efficiency
 - 3.2.2 Amount of water evaporated
- 3.3 Amount of air to be handled
- 3.4 Tower rating and selection

Unit-4 Defrosting:

- 4.1 Necessity
- 4.2 Defrosting interval
- 4.3 Methods of defrosting
 - 4.3.1 Water defrosting
 - 4.3.2 Electric defrosting
 - 4.3.3 Hot gas defrosting
 - 4.3.4 Reverse cycle defrosting
 - 4.3.5 Vapour defrosting
 - 4.3.6 Heat bank defrosting

Unit-5 System Equilibrium:

- 5.1 System balancing
- 5.2 Graphical analysis of system equilibrium
- 5.3 Effect of decreasing or increasing evaporator capacity
- 5.4 Effect of decreasing or increasing condensing unit capacity

REFERENCE BOOKS:

- | | |
|---|-----------------------------|
| 1. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 2. Principles of Refrigeration | Roy J.Dossat (S.I. Edition) |
| 3. Refrigeration and Air Conditioning | C.P.Arora |
| 4. Air Conditioning & Refrigeration | Severns & Fellows |
| 5. Refrigeration & Air Conditioning | Ballaney |

ADVANCE AIR CONDITIONING-II

Course Code	MR 5002
Course Title	Advance Air Conditioning-II
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the basics of fans.
- To understand use of solar power for heating & cooling.
- To acquire knowledge of water treatment.
- To acquire knowledge of sound & vibration control.
- To acquire knowledge of various measuring instruments.

Course Outcomes

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

CO1	Describe use and selection of fans for air conditioning.
CO2	Explain solar powers heating & cooling systems.
CO3	Explain various water treatment & heating systems.
CO4	Explain various measures for sound & vibration control.
CO5	Explain various measuring instruments.

Course Contents**Unit- 1 Fans:**

- 1.1 Fan classification
- 1.2 Fan nomenclature
- 1.3 Fan discharge and arrangement of drive
- 1.4 Total pressure difference developed by a fan
- 1.5 Fan air horse power
- 1.6 Fan efficiencies
- 1.7 Fan selection

Unit- 2 Solar Heating and Cooling:

- 2.1 Introduction to solar theory
- 2.2 Solar energy-its source of measurement
- 2.3 Solar radiation at the earth's surface
- 2.4 Effect of angle of tilt
- 2.5 Solar heating systems
 - 2.2.1 Approach to solar heating system design
 - 2.2.2 Passive system design
 - 2.3.3 Direct gain systems
 - 2.2.4 Green house systems
 - 2.2.5 Active system design
- 2.6 Flat plate solar collector
- 2.7 Heat storage capabilities
- 2.8 Methods of heating the space
- 2.9 Solar cooling systems
 - 2.9.1 Solar driven absorption cooling
 - 2.9.2 Solar driven Rankine-cycle cooling

Unit- 3 Water Conditioning Systems :

- 3.1 Design considerations
- 3.2 Fouling factor
- 3.3 Water conditioning chemicals

- 3.3.1 Feeding equipments
- 3.3.2 Method of feeding
- 3.4 Corrosion control
- 3.5 Slime and algae control

Unit- 4 Heating Methods:

- 4.1 Classification
- 4.2 Heating with warm air furnace
 - 4.2.1 Floor furnace
 - 4.2.2 Wall furnace
- 4.3 Heating with steam
 - 4.3.1 One pipe system
 - 4.3.2 Two pipe system
- 4.4 Heating with hot water
 - 4.4.1 Gravity flow system
 - 4.4.2 Forced flow system
- 4.5 Panel heating
 - 4.5.1 Floor heating
 - 4.5.2 Wall heating

Unit- 5 Sound and Vibration Control:

- 5.1 Sound power and sound power level
 - 5.1.1 Sound intensity and characteristics
 - 5.1.2 Loudness or loudness level
- 5.2 Noise, noise level
- 5.3 Motor sound sources
- 5.4 Sound control for outdoor machine
- 5.5 Sound control for indoor machine
- 5.6 Acoustic treatment for duct system
- 5.7 Vibration isolation
- 5.8 Vibration isolation materials

Unit- 6 Measuring Instruments:

- 6.1 Temperature measuring instruments
 - 6.1.1 Thermometers
 - 6.1.2 Thermocouples
 - 6.1.3 Thermister resistance thermometer
- 6.2 Pressure measuring instruments
 - 6.2.1 Pressure gauges
 - 6.2.2 Manometers
- 6.3 Humidity measuring instruments
 - 6.3.1 Psychrometer
 - 6.3.2 Dew point hygrometer
 - 6.3.3 Chemical hygrometer
- 6.4 Flow measuring instruments
 - 6.4.1 Pitot tube
 - 6.4.2 Anemometer
 - 6.4.3 Rotameter

References

- | | |
|---|--------------------|
| 1. Refrigeration and Air Conditioning | C.P.Arora |
| 2. Modern Air Conditioning Practice | Norman C.Harris |
| 3. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 4. Air Conditioning & Refrigeration | Severns & Fellows |

ECONOMIC POLICIES IN INDIA

Course Code	MR 51001(Same in All Branches of Engg.)
Course Title	Economic Policies in India
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

CO1	Understand Indian economics policy, planning strategies
CO2	It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes
CO3	Development Economics as a discipline encompasses different approaches to the problems of unemployment, poverty, income generation, industrialization from different perspectives
CO4	Able to identify the problems and capable to decide the application for future development
CO5	Analyze economic issues and find solutions to complex economic problems and take correct economic judgment

COURSE CONTENTS:**1. BASIC FEATURES AND PROBLEMS OF INDIAN ECONOMY:**

- 1.1. Economic History of India;
- 1.2. Nature of Indian Economy
- 1.3. Demographic features and Human Development Index,
- 1.4. Problems of Poverty, Unemployment, Inflation, income inequality, Blackmoney in India.

2. SECTORAL COMPOSITION OF INDIAN ECONOMY:

- 2.1. Issues in Agriculture sector in India,
- 2.2. land reforms
- 2.3. Green Revolution
- 2.4. agriculture policies of India,

3. INDUSTRIAL DEVELOPMENT,

- 3.1. Small scale and cottage industries,
- 3.2. Industrial Policy,
- 3.3. Public sector in India,
- 3.4. Service sector in India.

4. ECONOMIC POLICIES:

- 4.1. Economic Planning in India,
- 4.2. Planning commission v/s NITI Aayog,
- 4.3. Five Year Plans,
- 4.4. Monetary policy in India,
- 4.5. Fiscal Policy in India,
- 4.6. Centre state Finance Relations,

- 4.7. Finance commission in India
- 4.8. LPG policy in India

5. EXTERNAL SECTOR IN INDIA

- 5.1. India's foreign trade value composition and direction,
- 5.2. India Balance of payment since 1991,
- 5.3. FDI in India,
- 5.4. Impact of Globalization on Indian Economy,
- 5.5. WTO and India.

REFERENCE BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy .S Chand & Co.Ltd. New Delhi.
2. Mishra S. K & V. K Puri (2017). Indian Economy and Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India ,Oxford University Press.

SEMESTER SCHEME-2020-21

ENGINEERING ECONOMICS & ACCOUNTANCY

Course Code	MR 51002 (Same in All Branches of Engg.)
Course Title	Engineering Economics & Accountancy
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

COURSE OBJECTIVES

- To acquire knowledge of basic economics to facilitate the process of economic decision making.
- To acquire knowledge on basic financial management aspects.
- To develop the basic skills to analyze financial statements.

COURSE OUTCOMES:

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

CO1	Understand the macro-economic environment of the business and its impact on enterprise
CO2	Understand cost elements of the product and its effect on decision making
CO3	Prepare accounting records and summarize and interpret the accounting data for managerial decisions
CO4	Understand accounting systems and analyze financial statements using ratio analysis
CO5	Understand the concepts of financial management and investment

COURSE CONTENTS**1. INTRODUCTION:**

- 1.1. Managerial Economics;
- 1.2. Relationship with other disciplines;
- 1.3. Firms: Types, objectives and goals;
- 1.4. Managerial decisions;
- 1.5. Decision analysis.

2. DEMAND & SUPPLY ANALYSIS:

- 2.1. Demand;
 - 2.1.1. Types of demand;
 - 2.1.2. Determinants of demand;
 - 2.1.3. Demand function;
 - 2.1.4. Demand elasticity;
 - 2.1.5. Demand forecasting;
- 2.2. Supply;
 - 2.2.1. Determinants of supply;
 - 2.2.2. Supply function;
 - 2.2.3. Supply elasticity.

3. PRODUCTION AND COST ANALYSIS:

- 3.1. Production function;
- 3.2. Returns to scale;

- 3.3. Production optimization;
- 3.4. Least cost input; Iso quants;
- 3.5. Managerial uses of production function;
- 3.6. Cost Concepts;
 - 3.6.1. Cost function;
 - 3.6.2. Types of Cost;
 - 3.6.3. Determinants of cost;
 - 3.6.4. Short run and Long run cost curves;
 - 3.6.5. Cost Output Decision;
 - 3.6.6. Estimation of Cost.

4. PRICING:

- 4.1. Determinants of Price;
- 4.2. Pricing under different objectives and different market structures;
- 4.3. Price discrimination;
- 4.4. Pricing methods in practice;
- 4.5. Role of Government in pricing control.

5. FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT):

- 5.1. Balance sheet and related concepts;
- 5.2. Profit & Loss Statement and related concepts;
- 5.3. Financial Ratio Analysis;
- 5.4. Cash flow analysis;
- 5.5. Funds flow analysis;
- 5.6. Comparative financial statements;
- 5.7. Analysis & Interpretation of financial statements;
- 5.8. Investments;
- 5.9. Risks and return evaluation of investment decision;
- 5.10. Average rate of return;
- 5.11. Payback Period;
- 5.12. Net Present Value;
- 5.13. Internal rate of return,

REFERENCE BOOKS:

1. Mc Guigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
2. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.
3. Samuelson. Paul A and Nordhaus W. D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
4. Paresn Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.
5. Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson SouthWestern, 4th Edition, 2001.

MODERN RAC PRACTICES

Course Code	MR 5003
Course Title	MODERN RAC PRACTICES
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives

- To acquire knowledge of various equipments & instruments used in refrigeration and air conditioning.
- To understand the working of various refrigeration valves.
- To acquire knowledge of various pressure and temperature control devices used in refrigeration and air conditioning.
- To understand the reason of faults and its remedy of RAC equipments.

Course Outcomes

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

CO1	Describe application of various RAC equipments and instruments.
CO2	Explain the working of various refrigeration valves.
CO3	Explain the working of pressure and temperature control devices.
CO4	Find the reason of faults and their remedies of RAC equipments.

Course Contents**Unit-1 Construction and working principles of the following :**

- 1.1 Two way service valve
- 1.2 Gauge manifold
- 1.3 Strainer / Dryer
- 1.4 Oil separators
- 1.5 Thermostat
- 1.6 Humidistat

Unit-2 Working principles of the following refrigeration valves:

- 2.1 Thermostatic expansion valve
- 2.2 Electronically operated expansion valve
- 2.3 Solenoid valve

Unit-3 Working principles of the following pressure and Temperature Control Devices :

- 3.1 Pressure transmitters
- 3.2 Evaporating pressure regulators
- 3.3 Condensing pressure regulators
- 3.4 Electronically controlled temperature regulators

Unit-4 Working principles of the following instruments/ Devices :

- 4.1 Electronic leak detector
- 4.2 Halide torch
- 4.3 Gas recovery Unit

Unit-5 Diagnosis of fault and repair of Window & Split A/C, Water Cooler and Refrigerator.**REFERENCE BOOKS**

1. Various Manuals of Danfors Industries (P) Ltd
2. Refrigeration Servicing Paul & Goliber
3. Refrigeration Air conditioning Althouse
Air Conditioning Installation & Maintenance Earnest Tricmi

RAC APPLICATION

Course Code	MR 50041
Course Title	RAC APPLICATION
Number of Credits	3(L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

Course Objectives

- To acquire knowledge of refrigerated ware house.
- To acquire knowledge of various type of refrigerators.
- To understand the process of ice manufacturing.
- To understand various automobile air conditioning systems.
- To acquire knowledge of hospital air conditioning system.

Course Outcomes

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

CO1	Describe about various factor influencing a refrigerated ware house.
CO2	Explain application of various types of refrigerators.
CO3	Explain the process of ice manufacturing.
CO4	Describe various automobile air conditioning systems.
CO5	Describe about requirements of hospital air conditioning.

Course Contents**1. Refrigerated warehouse practice:**

- 1.1 Location of plant
- 1.2 General plan
- 1.3 Division of refrigerated space.
- 1.4 Construction types.
- 1.5 Fire protection
- 1.6 Refrigeration requirement and distribution

2. Refrigerators:

- 2.1 Commercial and house hold refrigerators
- 2.2 Food freezers
- 2.3 Salient features of various Indian make refrigerators.
- 2.4 Frozen food locker plant.
- 2.5 Bottled beverage coolers and refrigerated vending machine.
- 2.6 Drinking water coolers of various types.
- 2.7 Salient features of Indian make drinking water coolers

3. Ice manufacture:

- 3.1 Ice plant components
- 3.2 Refrigeration equipment
- 3.3 Ice storage
- 3.4 Lay-out of a typical ice-plant
- 3.5 Flake, cube and dry ice.
- 3.6 Ice making machines:-continuous, flake, and soft.

4. Automotive Air Conditioning:

- 4.1 General arrangement of air conditioning equipment for car and bus.
- 4.2 Rear and front end air conditioning system

- 4.3 Types of compressors
- 4.4 General arrangement of equipments on railroad passenger car.

5. Hospital Air Conditioning:

- 5.1 Infection problem
- 5.2 Air quality, cleaning, movement and zoning
- 5.3 Air conditioning systems
 - 5.3.1 Limited system
 - 5.3.2 Total system
 - 5.3.3 Room A/C
- 5.4 Design Criteria
 - 5.4.1 Administrative Department
 - 5.4.2 Diagnostic and treatment facilities
 - 5.4.3 Nursery
 - 5.4.4 Operation rooms
 - 5.4.5 Isolation rooms
 - 5.4.6 Service Department

REFERENCE BOOKS:

- 1 ISHRAE Handbooks ISHRAE Publications
- 2. ASHRAE Handbooks ASHRAE Publications

SEMESTER SCHEME-2020-21

HVAC SYSTEM CONTROL

Course Code	MR 50042
Course Title	HVAC System Control
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PE

Course Objectives

- To understand the purpose of control.
- To understand electric & safety controls.
- To acquire knowledge of capacity controls for residential & commercial systems.

Course Outcomes

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

CO1	Explain the purpose of control.
CO2	Define various electric and safety control devices.
CO3	Explain various capacity controls for residential air conditioning systems.
CO4	Explain various capacity controls for commercial air conditioning systems.

Course Contents**Unit- 1 Introduction :**

- 1.1 Elementary control system
- 1.2 Purpose of control
- 1.3 Control actions
- 1.4 Energy source for control system
- 1.5 Low voltage control

Unit- 2 Electric & Safety Controls :

- 2.1 Starting relays
 - 2.1.1 Current relay
 - 2.1.2 Potential relay
 - 2.1.3 Thermal (hot wire) relay
- 2.2 Over load protector
 - 2.2.1 Two point
 - 2.2.2 Three point
- 2.3 High pressure cut out
- 2.4 Low pressure cut out
- 2.5 Oil pressure failure switch

Unit- 3 Control of mechanical refrigeration :

- 3.1 Capacity control requirement
- 3.1 Suction pressure control of compressor
- 3.1 Temperature control of compressor
- 3.1 Control of multiple compressor
- 3.1 Various methods of compressor capacity control
- 3.1 Control of distribution
 - 3.2.1 Liquid refrigerant
 - 3.2.2 Chilled water
 - 3.2.3 Air

Unit- 4 Control of Residential Air Conditioning :

- 4.1 Control of chilled water coil
- 4.2 Control of d-x coil
- 4.3 Control of year round central a/c unit
- 4.4 Control of heat pump

Unit- 5 Control of Commercial Central Fan Cooling System :

- 5.1 Types of cooling equipments
- 5.2 Control of system using cold water cooling coil
- 5.3 Control of system using d-x cooling coil
- 5.4 Proportional control of multistage compressor
- 5.5 Control of air washer system
- 5.6 Control of dehumidifying systems
- 5.7 Control of systems requiring reheat
- 5.8 Control of out door air dampers

References:

- 1. Control Systems for HVAC
- 2. Automatic Control of Heating & A/C
- 3. Principles of Refrigeration

Roger W. Haines
John E. Haines
Roy J. Dossat

SEMESTER SCHEME-2020-21

FIRE PREVENTION AND PROTECTION

Course Code	MR 50051
Course Title	Fire Prevention and Protection
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	NIL
Course Category	PE

Course Objectives

- To understand the various terminology used in fire protection and fire safety.
- To understand the various method of fire extinguishment and various extinguishing media.
- To acquire knowledge of active fire protection measures
- To acquire knowledge of first aid firefighting equipments.
- To acquire Knowledge of fire safety management

Course Outcomes

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

CO1	Define terms related to fire protection and fire safety.
CO2	Explain various methods of fire extinguishment and extinguishing media
CO3	Explain various air fire safety and protection measures.
CO4	Explain various fire safety management in different occupancies.

Course Contents**Unit- 1.Introduction:**

- 1.1 Combustion process
- 1.2 Triangle of fire
- 1.3 Nature of flame
- 1.4 General terminology

Unit- 2. Methods of Fire Extinguishment & Extinguishing Media:

- 2.1 Starvation
- 2.2 Smothering/ Blanketing
- 2.3 Cooling
- 2.4 Classification of Fires
- 2.5 Extinguishing Agents
 - 2.5.1 Water
 - 2.5.2 Foam & Foam Making Compounds
 - 2.5.3 Halogenated Agents
 - 2.5.4 Carbon di-oxide
 - 2.5.5 Inert gases
 - 2.5.6 Dry Chemical Powders

Unit- 3. Active Fire Protection Measures:

- 3.1 Fire Detection and Alarm Systems
 - 3.1.1 Heat detectors
 - 3.1.2 Smoke Detectors
 - 3.1.3 Optical Detectors
 - 3.1.4 Flame Detectors
- 3.2 General Requirements for Automatic Fire Detection & Alarm systems
- 3.3 Water Based Fixed Fire Extinguishing Systems
 - 3.3.1 Hydrant Systems- External & Internal
 - 3.3.2 Sprinkler Systems

Unit-4. First Aid Fire Fighting Equipments:

- 4.1 General
- 4.2 Type of Extinguishers
 - 4.2.1 Water Type Extinguishers

- 4.2.2 Foam Extinguishers
- 4.2.3 Dry Powder Extinguishers
- 4.2.4 CO2 Extinguishers
- 4.2.5 Halon/ Halon Alternative Type Extinguishers

Unit-5. Fire Safety Management for Various Classes of Occupancies:

- 5.1 Classes of Occupancies
- 5.2 Fire Safety Management
- 5.3 Fire Safety Measures in Health Care Facilities

REFERENCE BOOKS :

1. Handbook on Building Fire Codes :G.B.Menon
2. National Building Code of India :Bureau of Indian Standards

SEMESTER SCHEME-2020-21

ELECTRICAL MACHINES

Course Code	MR 50052
Course Title	Electrical Machines
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	PE

Course Objectives

To understand the working and application of transformer.

- To understand the working and application of D C Generator.
- To understand the working and application of D C Motors.
- To understand the working and application of induction motors.

Course Outcomes

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

CO1	Explain the working and application of transformer.
CO2	Explain the working and application of D C Generator.
CO3	Explain the working and application of D C Motors.
CO4	Explain the working and application of induction motors.

Course Contents**Unit-1 Transformer:**

- 1.1 Construction of single phase and three phase transformer
- 1.2 Principle of operation
- 1.3 E.M.F equation
- 1.4 Transformation ratio
- 1.5 Types of transformer
- 1.6 Cooling methods of transformers
- 1.7 Open circuit and short circuit test
- 1.8 Autotransformer

Unit-2 D.C. Generator:

- 2.1 Construction of D.C machine
- 2.2 Principle of D.C generator
- 2.3 Excitation methods
- 2.4 Types of D.C generator (series, shunt and compound)
- 2.5 E.M.F equation

Unit-3 D.C Motor

- 3.1 Principle of D.C motor
- 3.2 Concept of back E.m.f
- 3.3 Torque, speed and power relations
- 3.4 Characteristics of D.C motor
- 3.5 Starters for D.C. motors
- 3.6 Speed control of D.C motor

Unit-4 Induction Motors:

- 4.1 Construction and working principle of single phase induction motor
- 4.2 Slip
- 4.3 Torque slip characteristics
- 4.4 Speed control of 3-phase induction motor
- 4.5 Star Delta and D.O.L starter
- 4.6 Construction and working principle of single phase induction motor
- 4.7 Types of single phase induction motor (split phase, capacitor, shaded pole, repulsion)
- 4.8 Industrial application

REFERENCE BOOKS:

- | | |
|---|--------------|
| 1. Electrical engineering (Hindi & English) | K.D.Sharma |
| 2. Electrical engineering | D.R Nagpal |
| 3. Electrical machines | J.B.Gupta |
| 4. Electrical technology | B.L. Theraja |

SEMESTER SCHEME-2020-21

ADVANCE REFRIGERATION –II LAB

Course Code	MR 5006
Course Title	Advance Refrigeration –II Lab
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To determine working of thermoelectric refrigerator.
- To understand the concept of solar refrigeration.
- To understand the working hermetic sealing of a reciprocating compressor.
- To understand working & performance investigation of a cooling tower.

- **Course Outcomes:**

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

CO1	Describe the working of a thermoelectric refrigerator.
CO2	Explain the concept of solar refrigeration.
CO3	Explain constructional detail of hermetically sealed compressors.
CO4	Explain constructional detail and performance investigation of cooling tower.

Course Contents

S.No.	Topics for Practice
1	Study of thermoelectric refrigeration system.
2	Study of solar refrigeration system.
3	Study of hermetically sealed type reciprocating compressor.
4	Study of semi sealed type reciprocating compressor.
5	To determine bypass factor of an evaporator.
6	Study of constructional detail of a cooling tower
7	To determine effectiveness of a cooling tower.
8	To calculate friction losses and pressure drop through different expansion devices.

References:

- | | |
|---|--------------------|
| 1. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 2. Principles of Refrigeration | Roy J.Dossat |
| 3. Refrigeration and Air Conditioning | C.P.Arora |
| 4. Refrigeration & Air Conditioning | Ballaney |
| 5. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |

ADVANCE AIR CONDITIONING-II LAB

Course Code	MR 5007
Course Title	Advance Air Conditioning-II Lab
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	NIL
Course Category	PC

Course Objectives

- To understand types and working of a different types of fans.
- To measure sound level in a room.
- To understand the working of vibration & sound control systems.
- To understand use of various measuring instruments.
- To understand the working of heating equipments.

Course Outcomes

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

CO1	Describe working of fan and measuring their flow capacities.
CO2	Describe and understand the use of measuring instruments.
CO3	Explain various types of heating equipments.
CO4	Describe sound and vibration isolation systems.

Course Contents

S.No.	Topics for Practice
1	Study of various types of fans and measuring their air flow rates.
2	Study of various types of heating equipment and calculating their heating capacities.
3	Measurement of sound from different sources.
4	Study of various sound absorbing materials and their applications.
5	Study of various vibration isolation materials and equipments.
6	Study and measurement of temperature with thermocouple.
7	Study and measurement of pressure with pitot tube.
8	Study and measurement of humidity at different places.
9	Study of solar heating/cooling system.

References

- | | |
|---|--------------------|
| 1. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |
| 2. Modern Air Conditioning Practice | Norman C.Harris |
| 3. A Course in Refrigeration & Air Conditioning | Domkundwar & Arora |
| 4. Refrigeration & Air Conditioning | Althouse A.D. |

MODERN RAC PRACTICES LAB

Course Code	MR 5008
Course Title	Modern RAC Practices Lab
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	NIL
Course Category	PC

Course Objectives

- To understand the process of detecting refrigerant leak in the refrigeration system.
- To understand the process of recovery of refrigerant, vacuuming and pressure testing in the refrigeration system.
- To understand the process of refrigerant charging in the refrigeration system.
- To understand the wiring and installation process of refrigeration & air conditioning equipments.

Course Outcomes

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

CO1	Find the refrigerant leakage in the refrigeration system.
CO2	Describe process of vacuuming and pressure testing in the refrigeration system.
CO3	Describe the process of refrigerant charging in the refrigeration system.
CO4	Describe the wiring and installation process of refrigeration and air conditioning equipments.
CO5	Understand servicing procedure of air conditioners.

Course Contents

S.No.	Topics for Practice
1	Various methods of locating refrigerant leak.
2	Removing air from refrigeration system, flushing the system and pressure testing.
3	Charging the system through low sides and high side.
4	Recovering the refrigerant from system.
5	Servicing various types of air conditioners like window, hi wall, cassette etc.
6	Rewiring and installation of refrigerator and fault finding.
7	Rewiring and installation of window air conditioner and fault finding.
8	Rewiring and installation of water cooler and fault finding.

References

- | | |
|---|------------------|
| 1. Refrigeration Servicing | Paul & Goliber |
| 2. Refrigeration Air conditioning | Althouse |
| 3. Air Conditioning Installation & Maintenance | Earnest Tricomi. |
| 4. Refrigeration and Air Conditioning Theory and Practice | Pradhan & Soni |

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR
SEMESTER SCHEME-2020-21



VI SEMESTER
(SESSION 2021-2022 & ONWARDS)

ENTREPRENEURSHIP AND START-UPS

Course Code	MR 6111(Same in All Branches of Engg.)
Course Title	Entrepreneurship and Start-ups
Number of Credits	4 (L-3 ,T-1, P-0)
Prerequisites (Course code)	None
Course Category	HS

COURSE LEARNING OBJECTIVES:

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.

LEARNING OUTCOME:

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

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Productor Service Development
7. Business Plan Creation

COURSE CONTENTS:**1. INTRODUCTION TO ENTREPRENEURSHIP AND START-UPS**

- 1.1. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- 1.2. Types of Business Structures,
- 1.3. 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 FOR ENTREPRENEURS ,BANKRUPTCY, AND SUCCESSION AND HARVESTING STRATEGY

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step by-Step Guide for Building a Great Company	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	Eric Ries	Penguin UK ISBN-978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN-978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Chris Tensen	Harvard business ISBN:978-142219602

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- <https://www.fundable.com/learn/resources/guides/startup>
- <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatehstructure/>
- <https://www.finder.com/small-business-finance-tips>
- <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

PROJECT MANAGEMENT

CourseCode	MR 62001(Same in All Branches of Engg.)
CourseTitle	Project Management
NumberofCredits	3(L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

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 OUTCOMES

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

CO1	Understand the importance of projects and its phases.
CO2	Analyze projects from marketing, operational and financial perspectives.
CO3	Evaluate projects based on discount and non-discount methods.
CO4	Develop network diagrams for planning and execution of a given project.
CO5	Apply crashing procedures for time and cost optimization.

COURSE CONTENTS**1. CONCEPT OF A PROJECT:**

- 1.1. Classification of projects
- 1.2. Importance of project management
- 1.3. The project Life cycle
- 1.4. Establishing project priorities (scope-cost-time)
- 1.5. Project priority matrix
- 1.6. Work break down structure.

2. CAPITAL BUDGETING PROCESS:

- 2.1. Planning -Analysis-Selection-Financing-Implementation-Review.
- 2.2. Generation and screening of project ideas
- 2.3. Market and demand analysis
- 2.4. Demand forecasting techniques.
- 2.5. Market planning and marketing research process
- 2.6. Technical analysis

3. FINANCIAL ESTIMATES AND PROJECTIONS:

- 3.1. Cost of projects
- 3.2. Means of financing
- 3.3. Estimates of sales and production-cost of production
- 3.4. Working capital requirement and its financing
- 3.5. Profitability project , cash flow statement and balance sheet.
- 3.6. Breakeven analysis.

4. BASIC TECHNIQUES IN CAPITAL BUDGETING:

- 4.1. Non discounting and discounting methods
- 4.2. pay-back period
- 4.3. Accounting rate of return
- 4.4. Net present value
- 4.5. Benefit cost ratio
- 4.6. Internal rate of return.
- 4.7. Project risk.
- 4.8. Social cost benefit analysis and economic rate of return.
- 4.9. Non-financial justification of projects.

5. PROJECT ADMINISTRATION:

- 5.1. Progress payments,
- 5.2. Expenditure planning,
- 5.3. Project scheduling and network planning,
- 5.4. Use of Critical Path Method (CPM),
- 5.5. Schedule of payments and physical progress,
- 5.6. time-cost trade off.
- 5.7. Concepts and uses of PERT
- 5.8. Cost as a function of time,
- 5.9. Project Evaluation and Review Techniques
- 5.10. Cost mechanisms.
- 5.11. Determination of least cost duration.
- 5.12. Post project evaluation.
- 5.13. Introduction to various Project management softwares.

REFERENCE BOOKS

- 1.Project planning, analysis, selection, implementation and review –Prasannachandra–Tata McGraw Hill
- 2.Project Management – the Managerial Process– Clifford F. Gray & Erik W. Larson-McGrawHill
- 3.Project management- David I Cleland- McGraw Hill International Edition, 1999
- 4.Project Management– Gopala krishnan– Mcmillan India Ltd.
- 5.Project Management- Harry – Maylor – Peason Publication

RENEWABLE ENERGY TECHNOLOGIES

CourseCode	MR 62002(Same in All Branches of Engg.)
CourseTitle	Renewable Energy Technologies
NumberofCredits	3 (L:3, T:0, P:0)
Prerequisites	NIL
CourseCategory	OE

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 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 a location.

COURSE CONTENTS**1. INTRODUCTION:**

- 1.1. World Energy Use;
- 1.2. Reserves of Energy Resources;
- 1.3. Environmental Aspects OF Energy Utilisation;
- 1.4. Renewable Energy Scenario in India and around the World;
- 1.5. Potentials; Achievements/ Applications;
- 1.6. Economics of renewable energy systems.

2. SOLAR ENERGY:

- 2.1. Solar Radiation;
- 2.2. Measurements of Solar Radiation;
- 2.3. Flat Plate and Concentrating Collectors;
- 2.4. Solar direct Thermal Applications;
- 2.5. Solar thermal Power Generation
- 2.6. Fundamentals of Solar Photo Voltaic Conversion;
- 2.7. Solar Cells;
- 2.8. Solar PV Power Generation;
- 2.9. Solar PV Applications.

3. WIND ENERGY:

- 3.1. Wind Data and Energy Estimation;
- 3.2. Types of Wind Energy Systems;
- 3.3. Performance; Site Selection;

- 3.4. Details of Wind Turbine Generator;
- 3.5. Safety and Environmental Aspects.

4. BIO-ENERGY:

- 4.1. Bio mass direct combustion;
- 4.2. Bio mass gasifiers;
- 4.3. Bio gas plants;
- 4.4. Digesters;
- 4.5. Ethanol production;
- 4.6. Bio diesel;
- 4.7. Cogeneration;
- 4.8. Bio mass Applications.

5. OTHER RENEWABLE ENERGY SOURCES:

- 5.1. Tidal energy;
- 5.2. Wave Energy;
- 5.3. Open and Closed OTEC Cycles;
- 5.4. Small Hydro Geothermal Energy;
- 5.5. Hydrogen and Storage;
- 5.6. Fuel Cell Systems;
- 5.7. Hybrid Systems.

REFERENCE BOOKS

1. Non-Conventional Energy Sources, Rai. G. D., Khanna Publishers, New Delhi, 2011.
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN SponLtd.,UK,2 006.
3. Solar Energy, Sukhatme. S. P., Tata Mc Graw Hill Publishing CompanyLtd. ,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, G N Tiwari and M K Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment A Policy Analysis for India ,NH Ravindranath, U K Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, R A Ristinen and J J Kraushaar, second edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, J W T widell and A D Weir, ELBS, 2006.

PRODUCT DESIGN

Course Code	MR 63001(Same in All Branches of Engg.)
Course Title	Product Design
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

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 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 modelling and embodiment principles in product design and development process.

COURSE CONTENTS**1. DEFINITION OF A PRODUCT**

- 1.1. Types of product;
- 1.2. Levels of product;
- 1.3. Product-market mix;
- 1.4. New product development (NPD) process;
- 1.5. Idea generation methods;
- 1.6. Creativity;
 - 1.6.1. Creative attitude;
 - 1.6.2. Creative design process;
- 1.7. Morpho logical analysis;
- 1.8. Analysis of inter-connected decision areas;
- 1.9. Brain storming.

2. PRODUCT LIFECYCLE;

- 2.1. The challenges of Product development;
- 2.2. Product analysis;
- 2.3. Product characteristics;
- 2.4. Economic considerations;
- 2.5. Production and Marketing aspects;
- 2.6. Characteristics of successful Product development;
- 2.7. Phases of a generic product development process;
- 2.8. Customer need identification;
- 2.9. Product development practices and industry-product strategies.

3. PRODUCT DESIGN

- 3.1. Design by evolution;

- 3.2. Design by innovation;
- 3.3. Design by imitation;
- 3.4. Factors affecting product design;
- 3.5. Standards of performance and environmental factors;
- 3.6. Decision making and iteration;
- 3.7. Morphology of design (different phases);
- 3.8. Role of aesthetics in design.

4. INTRODUCTION TO OPTIMIZATION IN DESIGN

- 4.1. Economic factors in design;
- 4.2. Design for safety and reliability;
- 4.3. Role of computers in design;
- 4.4. Modeling and Simulation;
- 4.5. The role of models in engineering design;
- 4.6. Mathematical modeling;
- 4.7. Similitude and scale models;
- 4.8. Concurrent design;
- 4.9. Six sigma and design for six sigma;
- 4.10. Introduction to optimization in design;
- 4.11. Economic factors and financial feasibility in design;
- 4.12. Design for manufacturing;
- 4.13. Rapid Proto typing (RP);
- 4.14. Application of RP in product design;
- 4.15. Product Development versus Design.

5. DESIGN OF SIMPLE PRODUCTS DEALING WITH VARIOUS ASPECTS OF PRODUCT DEVELOPMENT;

- 5.1. Design Starting from need till the manufacture of the product

REFERENCE BOOKS

- 1.Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, TataMc Graw–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, Pears on education.

DISASTER MANAGEMENT

Course Code	MR 63002(Same in All Branches of Engg.)
Course Title	Disaster Management
Number of Credits	3 (L: 3, T: 0 ,P :0)
Prerequisites	NIL
Course Category	OE

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 OUTCOMES:

- 1.1. After competing this course, student will be:
- 1.2. Acquainted with basic information on various types of disasters
- 1.3. Knowing the precautions and awareness regarding various disasters
- 1.4. Decide first action to be taken under various disasters
- 1.5. Familiarised with organization in India which are dealing with disasters
- 1.6. Able to select IT tools to help in disaster management

COURSE CONTENTS**1. UNDERSTANDING DISASTER**

- 1.1. Understanding the Concepts and definitions of Disaster,
- 1.2. Hazard,
- 1.3. Vulnerability,
- 1.4. Risk,
- 1.5. Capacity-Disaster and Development,
- 1.6. Disaster management.

2. TYPES, TRENDS, CAUSES, CONSEQUENCES AND CONTROL OF DISASTERS

- 2.1. Geological Disasters (earth quakes, landslides, tsunami, mining);
- 2.2. Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hailstorms, avalanches, droughts, cold and heat waves)
- 2.3. Biological Disasters (epidemics, pest attacks, forest fire);
- 2.4. Technological Disasters (chemical, industrial, radiological, nuclear)
- 2.5. Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
- 2.6. Global Disaster Trends
- 2.7. Emerging Risks of Disasters
- 2.8. Climate Change and Urban Disasters.

3. DISASTER MANAGEMENT CYCLE AND FRAME WORK

- 3.1. Disaster Management Cycle
- 3.2. Paradigm Shift in Disaster Management.
- 3.3. Pre-Disaster
- 3.4. Risk Assessment and Analysis,
- 3.5. Risk Mapping,
- 3.6. Zonation and Micro zonation,
- 3.7. Prevention and Mitigation of Disasters,

- 3.8. Early Warning System
 - 3.8.1. Preparedness,
 - 3.8.2. Capacity Development;
 - 3.8.3. Awareness.
- 3.9. During Disaster
 - 3.9.1. Evacuation
 - 3.9.2. Disaster Communication
 - 3.9.3. Search and Rescue
 - 3.9.4. Emergency Operation Centre
 - 3.9.5. Incident Comm and System
 - 3.9.6. Relief and Rehabilitation
- 3.10. Post-disaster
 - 3.10.1. Damage and Needs Assessment,
 - 3.10.2. Restoration of Critical Infra structure
 - 3.10.3. Early Recovery Reconstruction and Redevelopment;
 - 3.10.4. IDNDR, Yokohama Strategy, Hyogo Frame-work of Action.

4. DISASTER MANAGEMENT IN INDIA

- 4.1. Disaster Profile of India
- 4.2. Mega Disasters of India and Lessons Learnt.
- 4.3. Disaster Management Act 2005
- 4.4. Institutional and Financial Mechanism,
- 4.5. National Policy on Disaster Management,
- 4.6. National Guidelines and Plans on Disaster Management;
- 4.7. Role of Government (local, state and national),
- 4.8. Non-Government and Inter Governmental Agencies

5. APPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DISASTER MANAGEMENT

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

REFERENCES

- 1.Publications of National Disaster Management Authority (NDMA) on Various Templates and Guide lines for Disaster Management
- 2.Bhandani, R. K., An over view on natural & man-made disasters and their reduction, CSIR, New Delhi
- 3.Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
- 4.Alexander, David, Natural Disasters, Kluwer Academic London
- 5.Ghosh, G. K. ,Disaster Management, APH Publishing Corporation
- 6.Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

INDIAN CONSTITUTION

CourseCode	MR 6333(Same in All Branches of Engg.)
CourseTitle	Indian Constitution
NumberofCredits	0 (L:2,T:0;P:0)
Prerequisites(Coursecode)	None
CourseCategory	AU

COURSE CONTENT

1. THE CONSTITUTION –

- 1.1. Introduction
- 1.2. The History of the Making of the Indian Constitution
- 1.3. Preamble and the Basic Structure, and its interpretation
- 1.4. Fundamental Rights and Duties and their interpretation
- 1.5. State Policy Principles

2. UNION GOVERNMENT

- 2.1. Structure of the Indian Union
- 2.2. President– Role and Power
- 2.3. Prime Minister and Council of Ministers
- 2.4. Lok Sabha and Rajya Sabha

3. STATE GOVERNMENT

- 3.1. Governor– Role and Power
- 3.2. Chief Minister and Council of Ministers
- 3.3. State Secretariat

4. LOCAL ADMINISTRATION

- 4.1. District Administration
- 4.2. Municipal Corporation
- 4.3. Zila Panchayat

5. ELECTION COMMISSION

- 5.1. Role and Functioning
- 5.2. Chief Election Commissioner
- 5.3. State Election Commission

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L.Fadia	Sahitya Bhawan; New edition(2017)
3.	Introduction to the Constitution of India	D D Basu	Lexis Nexis; Twenty-Third 2018 edition

SUGGESTED SOFTWARE / LEARNING WEBSITES:

1. <https://www.constitution.org/cons/india/const.html>
2. <http://www.legislative.gov.in/constitution-of-india>
3. <https://www.sci.gov.in/constitution>
4. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

SEMESTER SCHEME-2020-21

AIR CONDITIONING SYSTEM DESIGN

Course Code	MR 6001
Course Title	Air Conditioning System Design
Number of Credits	4 (L: 4, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the heat load calculation for air conditioning applications.
- To understand the heat load calculation for air cooling applications.
- To acquire knowledge of methods of duct designing.

Course Outcomes:

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

CO1	Calculate heat load for various air conditioning applications
CO2	Calculate heat load for various air cooling applications
CO3	Design a duct system for air conditioning , cooling and ventilation system.

Course Contents**Unit-1 Air Conditioning Load Estimating :**

- 1.1 Building survey and load estimate
- 1.2 Design conditions
- 1.3 Heat storage, diversity and stratification
- 1.4 Solar heat gain through glass
- 1.5 Heat and water vapour flow through structure
- 1.6 Infiltration and ventilation
- 1.7 Internal and system heat gain
- 1.8 Applied psychrometry
- 1.9 Equipment selection

Unit-2 Evaporative Cooling System Design :

- 2.1 Design conditions
- 2.2 Sensible heat load calculation
- 2.3 Determination of air quantity
- 2.4 Selection of blower, motor, pump, cooling media
- 2.5 Determination of wetted surface area

Unit-3 Duct Design :

- 3.1 Different methods of duct design
 - 3.1.1 Equal friction
 - 3.1.2 Static regain (concept only)
 - 3.1.3 Velocity reduction(concept only)
- 3.2 Zoning
- 3.3 Total resistance in duct system
- 3.4 Duct designing for air conditioning
- 3.5 Duct designing for air cooling
- 3.6 Duct designing for ventilation

References:

1. Refrigeration & Air Conditioning C.P. Arora
2. Carrier hand book Carrier Air Conditioning Company
3. ASHRAE Standards ASHRAE Publications

REFRIGERATION SYSTEM DESIGN

Course Code	MR 6002
Course Title	Refrigeration System Design
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	PC

Course Objectives:

- To understand the heat load calculation for refrigeration applications.
- To acquire knowledge of refrigerant piping design.
- To acquire knowledge of water piping design.

Course Outcomes:

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

CO1	Calculate heat load for various refrigeration applications
CO2	Design a refrigerant piping system
CO3	Design a water piping system.

Course Contents**Unit-1 Refrigeration Load Calculation:**

- 1.1 Cooling load
- 1.2 Equipment running time
- 1.3 Survey of different loads
 - 1.3.1 Wall gain load
 - 1.3.2 Air change load
 - 1.3.3 Product load
 - 1.3.4 Miscellaneous loads
- 1.4 Calculating refrigeration load for cold storage

Unit-2 Refrigerant Piping Design:

- 2.1 Design principles
- 2.2 Friction loss
- 2.3 Oil return
- 2.4 Pipe sizing
 - 2.4.1 Liquid line design
 - 2.4.2 Suction line design
 - 2.4.3 Discharge line design
 - 2.4.4 Condenser to receiver piping design
- 2.5 Refrigerant piping layouts

Unit-3 Water Piping Design :

- 3.1 Water piping design
 - 3.1.1 Once through
 - 3.1.2 Recirculating
- 3.2 Pipe friction losses
- 3.3 Piping diversity
- 3.4 Pump selection
- 3.5 System accessories
 - 3.5.1 Expansion tank
 - 3.5.2 Strainer
 - 3.5.3 Thermometer
 - 3.5.4 Gauges
 - 3.5.5 Air vents
- 3.6 Water piping layouts
 - 3.6.1 Air washer
 - 3.6.2 Condenser and cooling tower

3.6.3 Evaporator and AHU/FCU

References:

- | | |
|-------------------------------------|----------------------------------|
| 1. Refrigeration & Air Conditioning | C.P. Arora |
| 2. Principles of Refrigeration | Roy J Dossat |
| 3. Carrier Hand Book | Carrier Air Conditioning Company |

SEMESTER SCHEME-2020-21