SEMESTER V

(TR501) INDUSTRIAL TRAINING

1. COURSE OBJECTIVES:

The students need to have industry exposure, where they can experience real life situations related to Man, machine and materials. It is a Training programme designed to expose & prepare the students for the Industrial work situation. This exposure and hands on experience, will further encourage the students to take up the industrial projects and enhance their prospects for better employment in their relevant fields.

2. TEACHING AND EXAMINATION SCHEME

Semester V									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(TR501) INDUSTRIAL TRAINING	-	-	-	15	-	-	70	30	GRADE

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

TR501.CO1: Explain the organizational structure, plant layout and process flow of an industrial organization.

TR501CO2: Demonstrate interpersonal skills to achieve the desired objectives.

TR501CO3: Operate various machines, equipments, tools etc. wherever possible and applicable.

TR501CO4: Prepare technical documents related to the work undertaken or observed.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	1	2	1	1	2	2	2	2
CO2	2	2	1	2	1	2	2	1	3
CO3	3	3	2	2	2	2	3	2	2
CO4	3	2	2	3	2	2	3	2	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
			M	**Thr**	**CO**
Students are required to study and have hands-on experience wherever possible in the following areas (depending on availability): 1. Company Profile 2. Organizational Structure 3. Company Product Range 4. Manufacturing Facilities Available /Services provided 5. Plant / Facility Layout 6. Operations / Production Processes 7. Production Planning and Control 8. Detail study of Latest Equipment/ Technologies Used 9. Stores Functions 10. Material Handling Systems/ Equipments 11. Quality Management Systems / Functions 12. Maintenance and Repair Practices 13. Safety Practices / Safety Equipments 14. Utilities 15. Logistics 16. Sales and Marketing 17. Ethics, Statutory Rules and Regulations followed 18. Product Design and Development 19. Any other area specific to the Industry providing Training				CO1 CO2 CO3 CO4	

6. COURSE DELIVERY:

The Course will be delivered through placement of the students in various industries

7. TERM WORK & PRACTICALS

Evaluation Scheme					
TW				**PR/OR**	TOTAL Marks
Attendance Marks*	Industrial Mentor's assessment Marks	Institute Mentor's assessment Marks	Training Report	Report Assessment & Seminar/Viva	
10	**20**	**20**	**20**	**30**	**100**

* 01 mark shall be deducted for every Absence (with or without permission).

Daily Dairy:

The daily dairy should-be maintained in a book. It should reflect the day to day activities performed by the student (including task, men and materials involved). It should be counter signed by the Industry Mentor. It will become the basis for writing reports on the complete training.

Training Report

The training report should be submitted by the training students should include the following salient points- Certificate from institute, Certificate of training from company, detailed write up as per daily dairy, detailed drawings, working drawings, photographs, safety precautions, techniques for work minimization on site, organizational chart, Importance of project to the society, special methods/techniques/equipment should be separately high lightened, including environmental aspects. The report should be informative and technical, typed with double spacing on good quality bond paper and bound. Assessment of Training Report be based on Knowledge, Presentation and Quality of contents and Sketches.

Note:

a. Student/s undergoing Industrial Training shall follow Rules and Regulations of the Industry.

b. Industrial Training will generally be organized and conducted in accordance with Industrial Training Manual duly prescribed by the Board.

8. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS

Unit No	Name of the Unit	Teaching Hours	Marks
1	**PR/OR**	**08 weeks**	**30**
2	**TW**		**70**
	Total	**08 weeks**	**100**

Note:

1. For Industrial training Grades will be awarded based on marks scored as follows:

80% and above Marks – Grade 'A'
60% to 79% Marks – Grade 'B'
40% to 59% Marks – Grade 'C'
Marks below 40% - Grade 'D'

2. TW and PR/OR shall be separate heads of passing. Student has to secure minimum Grade 'C' for passing.

(CC601) INDUSTRIAL ORGANISATION AND MANAGEMENT

1. COURSE OBJECTIVES:

Management is the basic need of any organization. Organization consists of multiple activities which are to be systematically managed for effective output. The course covers various principles related to organization and management. The areas covered are finance, human resource, project management etc. After completion of the course, the student will be acquainted with management and other related aspects so that he/she will be able to apply this knowledge in order to achieve the organizational goals.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
CC601 INDUSTRIAL ORGANISATION AND MANAGEMENT	3	-	-	3	75	25	-	-	100

3. COURSE OUTCOMES

On successful completion of the course, the student will be able to:

CC601.CO1: Describe types of business organizations.

CC601.CO2: Apply the principles of managing Men, Machines, and Materials in an industry.

CC601.CO3: Evaluate financial status of an industrial organization.

CC601.CO4: Develop problem solving skills in project management**.**

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	2	0	0	0	0	1	0	0	2
CO2	2	1	1	1	1	2	2	0	3
CO3	3	2	1	2	3	3	2	0	3
CO4	3	3	2	2	2	3	3	2	3

Relationship: Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS/ MICRO-LESSON PLAN

M=Marks	**Thr= Teaching hours**	**CO= Course Outcomes**			
Unit			**M**	**Thr**	**CO**
1. BUSINESS ORGANIZATION **1.1** Types of business organizations: Individual proprietorship, Partnership, Joint Stock Companies: Private Ltd and Public Ltd, Co-operative societies, Public sector **1.2** Structure of business organization: Line organization, Functional Organisation, Line and staff organization, Project organization			10	6	CO1 CO2
2. BUSINESS MANAGEMENT **2.1 :** Concept of management and administration, management as an art and science, evolution and growth of scientific management- contribution of F.W Taylor. **2.2** Basic functions of management: planning, organizing, staffing, directing, controlling. Other functions: forecasting, coordinating and decision- making. **2.3** Functions in Industry: Basics of Procuring, store- keeping, material handling, production, packing and forwarding, marketing and sales, supervision, research and development. **2.4** Supervisory skills required in industry			16	9	CO1 CO2 CO3
3. BASICS OF FINANCE **3.1** Sources of finance **3.2** Cost Concepts: Necessity of costing, elements of cost: material, Labour and expense; prime cost, overhead cost, total cost, And break- even analysis. **3.3** Materials management: Inventory control-standard order, reserve stock, reorder point, lead time. Economic order quantity, ABC Analysis. Introduction to Just in time (JIT) system **3.4** Depreciation: Definition and causes. Methods of calculating depreciation charges: Straight Line Method, Diminishing Balance Method, Sinking Fund method .(Simple Numericals) **3.5** Obsolescence- definitions and reasons. **3.6** Introduction to GST.			18	13	CO1 CO2 CO3 CO4
4. HUMAN RESOURCE MANAGEMENT **4.1** Functions of Personnel Department**:** Human resource planning, selection and recruitment, training, promotion and transfer, welfare of employees. **4.2** Industrial Relations**:** Employer-employee relations, trade union, settlement of disputes of employees, collective bargaining,			21	14	CO1 CO2 CO3 CO4

conciliation, arbitration, grievance handling mechanism. **4.3** Wages and Incentives**:** Factors influencing wages, types of wage plans – time rate and piece rate, Incentive – objectives and types, individual and group incentive plan, characteristics of a good wage or incentive plan, difference between incentive and wage. **4.4** Industrial Acts: Introduction to the following Industrial Acts: Industrial Disputes Act 1947/1956; The Indian Factories Act 1948 The Workmen's Compensation Act 1923			
5. PROJECT MANAGEMENT **5.1** Introduction to Project Management **5.2** Network Analysis (Introduction to basic concepts with simple Numericals) CPM- Critical Path Method: Definition, network diagrams, critical path, advantages PERT- Programme Evaluation and Review Technique: Definition, network diagrams, advantages. Comparison of PERT and CPM.	10	6	CO1 CO2 CO3 CO4
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**Business Organization**	**6**	**10**
2	**Business Management**	**9**	**16**
3	**Basics of Finance**	**13**	**18**
4	**Human Resource Management**	**14**	**21**
5	**Project Management**	**6**	**10**
	Total	**48**	**75**

8. LEARNING RESOURCES

Text Books

S.No	Author	Title of Book	Publisher
1	O.P. Khanna	Industrial Engineering and Management	DhanpatRai Publications
2	T.R.Banga ,S.C. Sharma	Industrial Organisation and Engineering Economics	Khanna Publishers
3	Awate,Chunawala, Patel,Bhandarkar, Sriniwasan	Industrial Organisation and Management	Vrinda Publication
4	Martand Telsang	Industrial Engineering and Production Management	S.Chand& Company Ltd

1. COURSE OBJECTIVES:

Today Entrepreneurship is given importance by the government to bring the youth of our country to overcome the problem of unemployment and bring them in the main stream of global business to strengthen Indian economy by Make in India philosophy. Government has announced various financial schemes for young youth and women to support them for setting up an enterprise. To fulfill this, youth are to be prepared for setting an enterprise. The students undergoing this course will be able to develop entrepreneurial traits and confidence within themselves and choose entrepreneurship as a career to brighten their future.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(CC502) ESSENTIALS OF ENTREPRENEURSHIP DEVELOPMENT	L	T	P	H	-	-	PR/OR	TW	25
	-	-	2	2	-	-	-	25	

3. COURSE OUTCOMES:

CC502.CO1: Recognize the type of entrepreneur and enterprises.

CC502.CO2: Describe basic financial & legal aspects of business.

CC502.CO3: Conceptualize a business idea.

CC502.CO4: Develop the project report for new enterprise.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	1	0	0	0	2	3	2	0	2
CO2	2	0	0	0	0	3	2	0	2
CO3	0	1	2	0	0	0	2	0	2
CO4	3	2	2	0	2	0	2	0	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS

M=Marks	Phr= Practical hours	CO – Course Outcomes			
Unit			M	Phr	CO
1.INDIAN BUSINESS ENVIRONMENT					
1.1 Introduction to Entrepreneurship Development (EDP) 1.2 Brief details of following terms : India GDP, IIP data, Govt. business policies, Environmental policy, Effects of global policies, Anti-dumping duty, Effects of national budgeton start-ups and businesses.				4	CO1
2. VARIOUS TYPES OF BUSINESSES					
2.1 Brief details of following businesses: Cyclical and Non-cyclical business, Seasonal and Non-seasonal business, Monopoly and Duopoly business, Concept base business, Commodity and Non-commodity business, Asset light business, b2b and b2c business, 2.2 Difference between Subsidiary and Associate company				6	CO1
3. SELECTION OF BUSINESS					
3.1 Types of Sectors, Steps in sectoral analysis, factors to pick up a Sector, Data collection of Sectors. 3.2 Terminologies: Sector rotation, Gross block addition. 3.3 Steps to read Outline of balance sheet, profit-loss statement, cash flow statement. 3.4 Data analysis on following factors: i) Market growth ii) Sector consolidation. 3.5 Brief details of following: Profitability, Effect of Govt policies, Pricing power, Debt, working capital, return on capital employed, Cash conversion cycle, Companies with peer group.				4	CO1 CO2
4 SETTING UP OF BUSINESS					
4.1 Various Govt depts. and organization supporting business ideas. 4.2 Methods to raise capital (difference between Banks and NBFC). 4.3Factors in machine, material, manpower procurement, advertising, product specialty, 4.4 Micro, Small and Medium Enterprises (MSME), Govt support for MSME, Private Limited and Public Limited Enterprises, 4.5 Goods & Service Tax(GST), Registering for GST and go ahead, 4.6Various income tax slabs, 4.7Application for various utility connections, various permissionsrequired to set up business.				10	CO1 CO2 CO3

5. EXPANSION OF BUSINESS			
5.1 Types of investors: angel investors, venture capitalist, promoters. 5.2 Terminology: 5.2.1 EPS, EPS growth, P/E ratio, 5.2.2 Market capital, paid up capital, authorized share capital, 5.2.3Corporate governance, Related party transactions, business insiders, assets and inventory turnover, break even analysis, brown field and green field expansion. 5.3 Listing start up on stock exchange &Govt support. 5.4 Business report writing, Reading of Red Herring prospectus		8	CO1 CO2 CO3 CO4
Total	25	32	

6. COURSE DELIVERY:

Videos / Lectures/ Practicals /Expert lectures / Industry visits/ documentaries/movies

Suggested expert talk on

- various Govt schemes
- GST
- Financial literacy
- Any relevant topic

7. SPECIFICATION TABLE FOR PRACTICALS

Unit No.	**Topic**	**Teaching Hours/ Semester**
1	**Indian business environment**	**4**
2	**various types of businesses**	**6**
3	**selection of business**	**9**
4	**Setting up of business**	**9**
5	**Expansion of business**	**4**
TOTAL		**32**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICAL HOURS

No	**Classroom Assignments**	**Marks**
1.	Prepare a Case Study on leading enterprise or small-scale unit	**6**
2.	Prepare a report on various government schemes for startup.	**4**
3.	Prepare SWOT analysis for a new business idea.	**5**
4.	Prepare Project Report for a new business idea.	**10**
	OR	
1.	Preparing a project report on basis of draft Red Herring prospectus	**25**

9. LEARNING RESOURCES

S.No.	Author	Title of Books	Publisher
1.	Sharadjawadekar, shobhadodlani,	Business entrepreneurship	Suvicharprakashanmandalpune,
2.	S.S. Khanna	Entrepreneurship development	S. Chand & Co. Ltd, New Delhi,
3.	Vasant Desai	Management of small-Scale Industry in India	Himalaya Publishing House
4.	DilipSarwate	Entrepreneurial development Concepts and practices	Everest Publication House, Pune
5.	CB Gupta and P Srinivasan	Entrepreneurship Development	S. Chand and Sons, New Delhi

https://ncert.nic.in/ncerts/l/leac203.pdf
https://ncert.nic.in/ncerts/l/leac204.pdf
https://www.wirc-icai.org/images/publication/IND-AS-BOOK.pdf
https://cma.org.sa/en/Awareness/Publications/booklets/Booklet_4.pdf
https://www.icsi.edu/media/portals/25/IPO.pdf
https://old.mu.ac.in/wp-content/uploads/2017/01/FINANCIAL-STATEMENT-ANALYSIS.pdf
https://ncert.nic.in/textbook/pdf/jess202.pdf
https://dea.gov.in/sites/default/files/
https://dea.gov.in/monthly-economic-report-table
https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/0HSIE_F.PDF
https://ncert.nic.in/textbook/pdf/lebs202.pdf
https://www.oecd.org/industry/inv/investmentfordevelopment/33806126.pdf
https://www.youtube.com/watch?v=NV8Ew6PcQhY
file:///C:/Users/User/Downloads/1-s2.0-S0970389617304664-main.pdf

(MC 501) THEORY OF MACHINES

1. COURSE OBJECTIVES:

This course will enable the student to understand the basic concepts related to mechanisms and machines. The mechanisms, which form the basis for machines, are built from linkages, gears, cams and followers, belt drives, etc. As a technician, one should have the necessary knowledge and skills about the mechanisms, their fabrication and operation. This course deals with the study of different mechanisms and their applications. Laboratory practice will help in consolidating the theory learnt.

2. TEACHING AND EXAMINATION SCHEME

Semester V									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
MC 501 THEORY OF MACHINES	L	T	P	H	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	-	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC 501.CO1: Describe different machine elements and mechanisms.

MC 501.CO2: Develop cam profile for a given application.

MC 501.CO3: Select suitable mechanisms and mechanical drives for given application.

MC 501.CO4: Perform analysis of mechanical drives, dynamometers, brakes and rotating masses.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	1	1	1	1	1	2	2	1
CO2	3	3	3	1	1	1	2	2	1
CO3	3	2	3	2	3	2	2	3	2
CO4	3	3	3	3	3	2	2	3	2

Relationship : Low-1 Medium -2 High -3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours	CO = Course Outcomes			
Unit			**M**	**Thr**	**CO**
1.KINEMATICS OF MACHINES					
1.1 Definition: Kinematics, Dynamics, Statics, Kinetics, kinematic link, kinematic pair and its types, constrained motion and its types, kinematic chain and its types, degrees of freedom, mechanism, inversion, machine and structure			12	08	CO1 CO3
1.2 Common mechanisms – Bicycle free wheel sprocket mechanism, Geneva mechanism, Ackerman steering gear mechanism, Foot operated air pump mechanism					
2.CAMS AND FOLLOWERS			15	08	CO1 CO2 CO3
2.1 Concept, definition and application of cams and followers					
2.2 Classification of cams and followers					
2.3 Follower motions and their displacement diagrams – Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation					
2.4 Drawing of profile of radial cam with reciprocating knife edge and roller followers with and without offset for the above motions					
3.FLYWHEEL, GOVERNOR AND BALANCING			18	10	CO1 CO3 CO4
3.1 Definition of Piston effort, Crank effort					
3.2 Crank effort diagram of Single cylinder four stroke cycle I. C. engine					
3.3 Function of flywheel					
3.4 Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance					
3.5 Function of governor					
3.6 Classification of centrifugal governor					
3.7 Construction and working of Watt and Porter governors					
3.8 Terminology of governors: Sensitiveness, Stability, Isochronism, Hunting of governor, Governor effort and power					
3.9 Comparison between flywheel and governor (No mathematical treatment and Numericals)					
3.10 Need for balancing					
3.11 Balancing of revolving masses in a single plane (Analytical and graphical methods)					
4.POWER TRANSMISSION DEVICES			15	12	CO1 CO3 CO4
4.1 Introduction: Types of drives – Belt, chain and gear drives					
4.2 Belt drives: Flat belt, V-belt and their applications, Types of belt drive – Open and Crossed, Belt materials, Law of belting, Angle of lap, Calculation of belt length (No derivation of formula), Belt slip and creep, velocity ratio, Ratio of tensions on tight and slack sides for flat belt and V-belt, Effect of centrifugal tension on power transmission, Condition for maximum power transmission, Initial tension (Simple numericals)					

4.3 Chain drive: Introduction, Types of chains, Comparison of belt and chain drives			
4.4 Gear drives: Introduction, Spur gear terminology, Law of gearing, Types of gears and their selection for different applications, Gear trains – Simple and Compound, Train value and Velocity ratio for Simple and compound gear trains (Simple Numericals)			
5.BRAKES AND DYNAMOMETERS			
5.1 Definition, classification and comparison of brakes and dynamometers	15	10	CO1 CO3 CO4
5.2 Construction and working of brakes: (i) Block brakes – Single block, double block, (ii) Band brakes, (iii) Disc brake, (iv) Internal expanding shoe brake, (v) Hydraulic brake			
5.3 Concept of self-locking and self-energizing brakes			
5.4 Calculation of braking effort and braking torque for block brakes and band brakes only			
5.5 Construction and working of dynamometers: Absorption type – Prony brake dynamometer, Rope brake dynamometer, Belt transmission dynamometer			
5.6 Procedure to measure brake power using rope brake dynamometer (No Numericals on dynamometers)			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and hand outs

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	Kinematics of machines	08	12
2	Cams and followers	08	15
3	Flywheel, governor and balancing	10	18
4	Power transmission devices	12	15
5	Brakes and dynamometers	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical (Nos. 1 & 4 compulsory and any four from nos. 2, 3, 5, 6,7,8 & 9)	Marks
1	Mini project on inversions of kinematic chains (Four bar chain, Single Slider crank chain, Double slider crank chain)	05
2	Find the ratio of time of cutting stroke to the time of return stroke for quick return motion of a shaper	04
3	Sketch and describe working of bicycle free wheel sprocket mechanism	04
4	Draw the profile of radial cam for the given motion of follower (At least three problems)	04
5	Determine the radius of rotation of flyball for different speeds of governor and draw a graph of radius of rotation versus speed	04
6	Comparison of power transmission systems	04
7	Dismantling and assembly of mechanically operated braking mechanism for two wheelers	04
8	Determination of brake power using rope brake dynamometer	04
9	Determine graphically balancing of several masses rotating in a single plane	04
	Total	**25**

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	R. S. Khurmi and J. K. Gupta	Theory of Machines	Eurasia Publishing House Pvt. Ltd.
2	S. S. Rattan	Theory of Machines	McGraw Hill Education (India) Pvt. Ltd.
3	P. L. Ballaney	Theory of Machines and Mechanism	Khanna Publishers
4	A. Ghosh and A. K. Mallik	Theory of Mechanisms and Machnies	Affiliated East West Press Pvt. Ltd.

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Thomas Bevan	Theory of Machines	C. B. S. Publishers
2	Shah and Jagdish Lal	Theory of Machines	Metropolitan Book
			Co. Pvt. Ltd.
3	J. E. Shigley	Theory of Machines and Mechanisms	McGraw Hill
4	P. C. Sharma, Purohit	Theory of Machines	PHI

9.3 Internet and Web Resources

S. No.	URL	Title	Publishers
1	https://swayam.gov.in/	SWAYAM Platform	MHRD/ AICTE
2	https://onlinecourses.nptel.ac.in/	NPTEL courses	IITs and IISc

AUDIT COURSE

(AC101) ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

1. COURSE OBJECTIVES:

This course aims at imparting basic principles of thought process, reasoning and inferencing by human being. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogis, science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course thus focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system.

2. TEACHING AND EXAMINATION SCHEME

Semester	V								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks		Total Marks
		L	T	P	H	TH	TM	TW	PR/OR	
(AC101) Essence of Indian Knowledge and Tradition		2	-	-	2	-	-	-	-	-

Course Content:

Basic Structure of Indian Knowledge System:

(i) वेद, (ii) उपवेद (आयुवेद, धनुवेद, गन्धवेद, स्थापत्य आदद) (iii) वेदांग (शिक्षा, कल्प, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उपाङ्ग (धर्म सिि, रीतांसा, पुराण, तकमिास)

- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

S. No.	Title of Book	Author	Publication
1.	Cultural Heritage of India- Course Material	V. Sivaramakrishna	Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2.	Modern Physics and Vedant	Swami Jitatmanand	Bharatiya Vidya Bhavan
3.	The wave of Life	Fritzof Capra	
4.	Tao of Physics	Fritzof Capra	
5.	Tarkasangraha of Annam Bhatta, Inernationa	V N Jha	Chinmay Foundation, Velliarnad, Amaku,am
6.	Science of Consciousness Psychotherapy and Yoga Practices	RN Jha	Vidyanidhi Prakasham, Delhi, 2016

ELECTIVES-I

(MC604) COMPUTER AIDED DESIGN AND MANUFACTURING

1. COURSE OBJECTIVES:

The market driven economy demands frequent changes in product design to suit the customer needs. With the introduction of computers, the task of incorporating frequent changes as desired is becoming simpler. Similarly, the concept of manufacturing has undergone significant revolutionary change. Main change lies in the replacement of conventional Machines and Equipments with Computerized Numerically Controlled Machines and process of equipments. This has resulted in the enormous saving in the areas of manufacturing, it is essential that Diploma holders should be exposed to basic concepts of Computer Aided Design and Manufacturing using various CAD software & CNC machines programming.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
MC604 COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	H	TH	TM	PR/ OR	TW	150
	3	-	2	5	75	25	25	25	

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC304.CO1: Describe CAD/CAM, Robotics and Automation principles.

MC304.CO2: Apply the concepts of CAD/CAM in industry.

MC304.CO3: Develop Geometric model for machine component.

MC304.CO4: Prepare Part program for machine component.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	1	1	1	1	1	2	1	2	2
CO2	2	2	3	2	2	3	2	2	2
CO3	1	3	3	3	1	2	1	3	1
CO4	2	3	3	3	2	3	1	2	3

Relationship: Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Outcomes**			
Unit			**M**	**Thr**	**CO**
1 INTRODUCTION TO CAD/CAM					
1.1 Computers in industrial manufacturing. Product Cycle,			10	05	CO1
1.2 CAD/CAM hardware: - basic structure, CPU, Memory, I/O devices,					
1.3 Storage devices and system configuration.					
1.4 Introduction to Group Technology and its need.					
1.5 Need of graphic standards.					
2 GEOMETRIC MODELLING					
2.1 Requirement of geometric modelling,			15	12	CO1
2.2 Types of geometric models.					CO2
2.3 Solid modelling- Primitives & Boolean operations, Types of Solid modelling Techniques: Constructive solid geometry (CSG) method, sweep methods.					CO3
2.4 Transformations: Types of transformation, Numericals of 2nd and 3rd order only.					
2.5 Classification of surface, free form surfaces, (No numerical treatment)					
3 INTRODUCTION TO COMPUTER NUMERICAL CONTROL			15	10	CO1
3.1 Introduction - NC, CNC, DNC,					CO2
3.2 Advantages of CNC, The coordinate system in CNC,					
3.3 Motion control system - point to point, straight line, Continuous path					
4 PART PROGRAMMING					
4.1 Fundamentals, manual part programming, NC –Words,			15	09	CO1
4.2 Programming format, part programming					CO2
4.3 Use of subroutines and do loops,					CO3
4.4 Simple programs on Turning and Milling operations.					CO4
5 ROBOTICS &AUTOMATION					
5.1 Introduction, physical configuration, basic robot motions,					
5.2 Technical features such as - work volume, precision and speed of movement, Load carrying capacity, range, repeatability & accuracy			20	12	CO1 CO2
5.3 Introduction to robot applications – Material transfer, machine loading, welding, spray coating, processing operation, assembly, inspection.					
5.4 Basic elements of automated system, Levels of automation					
5.5. Introduction to Flexible manufacturing cell (FMC), Flexible manufacturing system (FMS), Automated guided vehicles (AGV's), Automated retrieval and storage systems (AR/AS), FMS application,					
5.6 Introduction to Computer Integrated Manufacturing System (CIMS), Role of CIMS in modern industry, Schematic diagram of CIMS					
		Total	**75**	48	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, and exercises.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	Introduction to CAD/CAM	05	10
2.	Geometric Modelling	12	15
3.	Introduction to computer numerical Control	10	15
4.	Part Programming	09	15
5.	Robotics &Automation	12	20
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical (Any 4 from 1,2,5,6,7 & any one from 3 &4)
1	Assignment on CAD for 3D drafting using CAD software
2.	Write a part program using subroutines do loops for turning and milling components
3	Manufacturing a component on CNC Lathe.
4.	Manufacturing a component on CNC Machining centre.
5.	Report writing on visit to industry having CAD CAM facility.
6.	Report writing on visit to industry having robot Application.
7.	Report writing on visit to Industry having Automation in manufacturing

9. LEARNING RESOURCES

S. No.	Author	Title of Books	Publication & Year
1.	P.N.Rao	CAD/CAM Principles and Applications	Tata McGraw-Hill
2.	RadhaKrishna P. & Subramanyam	CAD/CAM/CIM	Wiley Eastern Ltd
3.	B.S.Pabla and M.Adithan	CNC	Machine New age International(P)Ltd
4.	Groover M.P. & Zimmers Jr	Computer Aided design and manufacturing	Prentice hall of India
5.	Lalit narayan,M. Rao	Computer Aided design and manufacturing	PHI

(MC612) PLC IN AUTOMATION

1. COURSE OBJECTIVES:

The subject is classified under automation technology group. The advancement of both knowledge and technique has resulted in the development of PLC's in process industry. Programmable Logic controller works as a brain of automation system, which can be programmed for desired functions for controlling different machines. Therefore, there is demand for persons having automation knowledge with skill of PLC Programming.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(MC612) PLC IN AUTOMATION	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC612.CO1: Describe the various components of PLC.

MC612.CO2: Select different types of input and output for PLC.

MC612.CO3: Develop Ladder Logic Program for a given application.

MC612.CO4: Demonstrate installation and troubleshooting of PLC.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	1	1	1	1	2	2	1
CO2	3	3	1	1	1	1	2	2	3
CO3	3	3	3	3	1	2	2	3	3
CO4	3	3	3	3	2	3	2	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Outcomes**			
Unit			**M**	**Thr**	**CO**
1 AUTOMATION			09	04	CO1
1.1 Introduction Need of automation, Advantages of automation, Requirements of automation.					
1.2 Application areas Process industries, Buildings, Robotics, Infrastructure, Aerospace, railways, Automobiles, Telecom, Electrical distribution, Medical.					
2 PLC FUNDAMENTALS			15	12	CO1 CO2
2.1 Introduction Evolution of PLC in automation, Difference between Relay control and PLC Control, Advantages, Disadvantages, PLC Vs PC. Different PLC's available in market (Rating, Memory, cost, programming language, performance)					
2.2 Block diagram and description of different parts: CPU – Function, scanning cycle, speed of execution Power Supply- Function Memory- Function and Organisation of ROM and RAM					
2.3 Input and Output Modules Input Modules – Function, different input devices used with PLC (Only name and their Uses) Output Modules- Function, different output devices used with PLC (Only name and their Uses) Fixed and Modular PLCs and their types. Concept of Sink/Source, set/ reset, latch/unlatch					
3 PLC PROGRAMMING			21	13	CO1 CO2 CO3
3.1 Introduction Ladder Diagrams, Flowcharting as a Programming method.					
3.2 Basic Logic Circuits Ladder diagram for basic logic circuits, (AND, OR, NAND, NOR, XOR)					
3.3 Basic PLC Functions PLC Timer Functions, PLC Counter Functions, Register Basics					
3.4 Intermediate Functions Arithmetic Functions, number comparison and number conversion functions					
3.5 Data Handling Functions PLC SKIP, MASTER CONTROL RELAY Functions, JUMP, PLC MOVE Function, PLC FIFO Function. Simple Programming examples using ladder programming language based on logical, comparison, timer, counter, data handling and miscellaneous instruction.					
Unit 4 PLC APPLICATIONS			21	12	CO1 CO2 CO3
4.1 Ladder Programming PLC Applications Block Diagram and Simple Ladder programming for following applications: i) Control of Pneumatic Cylinder: Logical control with and without Latching, Sequential control ii) Elevator Control					

M = Marks	Thr = Teaching hours	CO = Course Outcomes			
Unit			**M**	**Thr**	**CO**
iii) Conveyor Control iv) Bottle Filling Control v) Stepper motor control					
Unit 5 PLC INSTALLATION AND TROUBLE SHOOTING			09	07	CO1 CO2 CO3 CO4
5.1 PLC Installation PLC Installation: Enclosures, racks, master control relay, grounding, noise suppression, maintenance guidelines.					
5.2 PLC troubleshooting PLC troubleshooting - input and output troubleshooting using module LED status, troubleshooting of ladder program.					
		Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	Automation	04	09
2	PLC Fundamentals	12	15
3	PLC Programming	13	21
4	PLC Applications	12	21
5	PLC Installation and trouble shooting	07	09
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical** (1 TO 5,10,11 compulsory and Any two from 6 to 9)	Marks
1.	Write a Ladder program to verify functions of logic gates by using PLC.	**25**
2.	Write a Ladder Program for start stop using two inputs.	
3	Write a Ladder Program using Output Interlocks	
4	Write a Ladder Program for Traffic control using timer functions.	
5	Write a Ladder Program for pulse counting using Limit switch/proximity sensor.	
6	Write a Ladder Program for PLC based application using Conveyor system.	
7	Write a Ladder Program for PLC based application using Elevator system.	
8	Write a Ladder Program for PLC based application for bottle filling	
9	Write a Ladder program for sequencing of cylinders	
10	Install PLC with input output devices.	
11	Troubleshoot a given PLC configuration.	
	Total	

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	John W. Webb & Ronald Reis	Programmable Logic Controllers	Prentice Hall of India
2	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall India
3	Madhuchand A. Mitra & Samarjit Sen Gupta	Programmable Logic Controllers and Industrial automation	Penram International Publishing

9.2Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Petruzella	Programmable Logic Controller	McGgraw Hill
2	Gary Dunning	Introduction to Programmable Logic Control	Cengage Learning
3	V.R Jadhav	Programmable Logic Controllers	Khanna Publishers
4	W. Bolton	Programmable Logic Controllers	Elsvier India;

9.3 Internet and Web Resources

Websites:

www.plctutor.com

www.plcs.net

www.abb.co.in

Students may download the catalogue of PLC from websites of reputed manufacturers such as SIEMENS, FATEK, DELTA, OMRON and ALLEN-BRADLLEY to learn the latest developments.

(MC615) FIBER RE-INFORCED POLYMERS

1. COURSE OBJECTIVE:

The course is introduced with an objective of providing the knowledge of Fibre reinforced polymers (FRP) and its used in advanced engineering structure. The course is structured to provide adequate technical knowledge about FRP that includes types of matrix resins and reinforcements, various processing and post processing methods, various kinds of inspection tests on raw materials and finished products, repair techniques, handling and safety in FRP manufacture.

2. TEACHING AND EXAMINATION SCHEME

Semester V									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(MC615) FIBER REINFORCED POLYMERS	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to: **MC615.CO1:**

Describe processes for manufacturing FRP components. **MC615.CO2:** Select

different types of resins and fibres

MC615.CO3: Manufacture FRP components.

MC615.CO4: Maintain FRP Components.

4. Mapping Course Outcomes with Program Outcomes

Relationship : 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	2	1	1	2	1	1	1	1
CO2	3	2	2	2	2	2	2	1	2
CO3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	2	2	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**

Unit	**M**	**Thr**	**CO**
1. INTRODUCTION TO COMPOSITES	09	05	CO1 CO2
1.1 Definition of composites			
1.2 Constituent phases			
1.3 Classification of composites			
1.4 Types of matrices and reinforcements			
1.5 General characteristics of fibre reinforced composites			
1.6 Fiber reinforced polymer composites			
1.7 Main features, benefits and drawbacks of composites			
1.8 Applications of FRP in various industries.			
2. FIBRES REINFORCEMENTS AND ORGANIC MATRICES	18	12	CO1 CO2
2.1 Types of fibres and their development 2.1.1 Organic fibres 2.1.2 Glass fibres 2.1.3 Boron fibres 2.1.4 Silicon fibres 2.1.5 Carbon fibres 2.1.6 Sic based fibres 2.1.7 Continuous mono-crystalline filaments 2.1.8 Whiskers 2.1.9 Kevlar fibres. 2.1.10 Introduction to Nano fibres			
2.2 Fibres surface treatments for glass fibres, carbon fibres, Kevlar fibres.			
2.3 Introduction to Organic matrices			
2.4 Resin structure			
2.5 Characteristics and applications of Thermosetting matrix systems 2.5.1 Unsaturated polyester resins 2.5.2 Vinyl ester resins 2.5.3 Epoxy resins 2.5.4 Phenolic resins			
2.6 Characteristics and applications of Thermoplastic matrix materials.			
2.7 Fillers and other additives, pigments & release agents.			
2.8 Accelerators, Promoters and catalysts.			
3. COMPOSITE MANUFACTURING PROCESSES	15	10	CO1 CO2 CO3
3.1 Introduction			
3.2 Reinforcement shapes			
3.2 Introduction to mould making			
3.3 Resin matrix processes and associated tools, equipments and consumables 3.3.1 Contact moulding 3.3.2 Spray up moulding 3.3.3 Autoclaving 3.3.4 Resin transfer moulding 3.3.5 Vacuum assisted resin injection/transfer moulding 3.3.6 Injection moulding 3.3.7 Rotational moulding 3.3.8 Centrifugal casting 3.3.9 Filament winding 3.3.10 Pultrusion 3.3.11 Compression moulding			

3.3.12 Sandwich construction			
3.4 Pre pegs and sheet moulding compounds(SMC)			
4. POST PROCESSING METHODS, INSPECTION AND QUALITY CONTROL	15	09	CO1 CO2 CO3 CO4
4.1 Introduction			
4.2 Various post processing methods 4.2.1 Cutting 4.2.2 Trimming 4.2.3 Machining 4.2.4 Joining 4.2.4.1Mechanicalfastening 4.2.4.2Adhesivebonding 4.2.4.3 Lamination 4.2.4.4 Painting and coating			
4.3 Raw material inspection tests 4.3.1 Resin gel time 4.3.2 Resin viscosity 4.3.3 Resin peak exotherm temperature 4.3.4 Resin and hardener refractive index test			
4.4 Tests on finished composites 4.4.1 Non-destructive tests 4.4.1.1Visual 4.4.1.2Taptest 4.4.1.3Ultrasonic methods 4.4.1.4X-rayimaging 4.4.1.5Thermography 4.4.1.6Barcol hardness test 4.4.1.7Hydrostatictests 4.4.2 Other destructive tests 4.4.2.1 Pipe burst test. 4.4.2.2 Fire endurance test			
5. DESIGN CRITERIA, REPAIR AND MAINTENANCE, HANDLING, DISPOSAL AND SAFETY IN FRP MANUFACTURE	18	12	CO1 CO2 CO3 CO4
5.1 Design criteria in FRP product manufacture 5.2Factorsinfluencingdesign 5.3Selectionofrawmaterials 5.4Selectionofprocesses.			
5.5 Repair and maintenance of FRP components 5.5.1Tools and materials required. 5.5.2 Identification of defects as per required standard.egISO14692 5.5.3Repair procedure for superficial damage– external and internal 5.5.4Major damage–Reject or repair as per manufacturer's recommendation.			
5.6 Handling, disposal and safety in FRP manufacture 5.7.1Precautions in handling raw materials and finished products. 5.8Disposal of wastes developed during manufacture of FRP 5.9Safety precautions during FRP manufacture			
Total	75	48	-

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	Introduction to composites	05	09
2	Fiber reinforcements and Organic matrices	12	18
3	Composite manufacturing processes	10	15
4	Post processing methods, Inspection and quality control	09	15
5	Design criteria, Repair and maintenance, Handling, disposal and safety in FRP manufacture	12	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical (1,2,8,Any one from 3,4,5,Any one from 6 & 7) Note: Practicals 3 to 7 to be performed either in institute orindustry	Marks
1.	Identification of tools used in FRP repair and in fabrication.	
2.	Identify different resins and reinforcement fibers used in FRP manufacture.	
3.	Fabricate a panel using hand layup technique.	
4.	Fabricate a panel using vacuum assisted resin injection.	
5.	Fabricate a component using bag moulding and autoclave.	
6.	Carry out a glass fiber skin repair job.	
7.	Carryout an edge repair to a glass fiber panel.	
8.	Explain the procedure for carrying out FRP repair.	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	F.L. Matthews andD.Rawlings	Composite materials: Engineeringand science	WoodheadPublishingLtdCambridge,England
2	G Lubin	"Hand Bookof Composites",2ndEd	VanNostrandReinhold,NewYork,1982.
3	L.Holloway	HandBookofCompositesforEngineers	Technomic,Lancaster,Pa,1994.
4	KrishanK.Chawla	Compositematerials:Science andEngineering	

9.2 Internet and Web Resources

S. No.	Author
1	www.google.com
2	www.youtube.com

(MC 621) REFRIGERATION AND AIR CONDITIONING

1. COURSE OBJECTIVE:

Refrigeration and air conditioning is a very important subject and finds application in a large number of areas that include human comfort, industrial air conditioning, medical and healthcare, defence and spacecraft, transportation, agriculture, metallurgy, cryogenics, etc. Mechanical engineering diploma holders play an important role in the component selection, operation, maintenance and performance evaluation of R & AC systems. Through this course students will be able to understand the processes, equipments and systems of Refrigeration and Air conditioning for attaining knowledge of component selection, operation and maintenance.

2. TEACHING AND EXAMINATION SCHEME

Semester VI									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(MC621) REFRIGERATION & AIR CONDITIONING	03	00	02	05	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC 621.CO1: Describe working principles and construction of Refrigeration and Air Conditioning systems.

MC 621.CO2: Select various components and controls used in refrigeration and air conditioning.

MC 621.CO3: Use various charts and tables of refrigeration and air conditioning.

MC 621.CO4: Analyze performance of refrigeration and air conditioning systems.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO1	3	1	1	1	3	2	2	2	1
CO2	3	3	1	2	2	3	2	3	2
CO3	3	3	3	3	3	2	1	3	2
CO4	2	3	3	3	3	2	1	3	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours	CO = Course Outcomes			
Unit			**M**	**Thr**	
1 BASICS OF REFRIGERATION					
1.1 Definition of refrigeration 1.2 Necessity of refrigeration 1.3 Methods of refrigeration 1.3.1 Vapour compression refrigeration 1.3.2 Vapour absorption refrigeration 1.4 Unit of refrigeration, refrigerating effect, coefficient of performance 1.5 Major applications of refrigeration for domestic, commercial and industrial use			09	06	CO1
2. REFRIGERATION SYSTEMS & REFRIGERANTS					
2.1 Vapour compression cycle: Principle, components & working. 2.1.1 Representation on p-h and T-s diagrams of wet compression, dry compression, calculation of C.O.P. (for simple saturated cycles) 2.1.2 Effect of superheating and undercooling 2.1.3 Effect of suction pressure and discharge pressure. 2.1.4 Methods of improving COP of system 2.1.5. Introduction to cascade refrigeration systems and its applications. 2.2 Vapour absorption refrigeration, properties of ideal absorbent 2.2.1 Principle, components and working of aqua-ammonia system (simple and practical) 2.2.2 Comparison of vapour absorption system with vapour compression system 2.2.3 Advantages of vapour absorption refrigeration system over vapour compression refrigeration system 2.3 Refrigerants 2.3.1 Classification of refrigerants, Classification based on toxicity and flammability. 2.3.2 Desirable properties of an ideal refrigerant 2.3.3Nomenclature of refrigerants (limited to CFC, HCFC, HFC and Inorganic) 2.3.4 Ozone depletion potential (ODP), Global warming potential (GWP), Acceptable exposure limit (AEL), Eco friendly refrigerants 2.3.5 Important properties of commonly used refrigerants: Ammonia, R-22, R-32, R134-a, R290, R404a, R502, R600, R1234yf .			20	14	CO1 CO2 CO3 CO4
3 REFRIGERATION SYSTEM COMPONENTS					
3.1 Components of vapour compression refrigeration system 3.2 Classification of refrigerant compressors 3.3 Construction, working and applications of following: (a) hermetic compressor (b) reciprocating open type compressor (c) screw compressor (d) centrifugal compressor (e) Rotary compressor 3.4 Classification of condensers			16	10	CO1 CO2

3.4.1 Description of air cooled, water cooled and evaporative condensers 3.4.2 Comparison of air cooled and water-cooled condensers 3.5 Different types of expansion devices, Construction, working and applications of following: (a) capillary tube (b) thermostatic expansion valve (c) high side float valve (d) low side float valve 3.6 Classification of evaporators, Construction, working and applications of following: (a) Bare tube evaporator. (b) finned tube evaporator (c) shell and tube evaporator (d) flooded evaporators (e) dry expansion evaporator			
4. PSYCHROMETRIC PROCESSES, HUMAN COMFORT & COOLING LOAD ESTIMATION 4.1 Definition and necessity of air conditioning 4.2 Properties of air, Dalton's law of partial pressures 4.3 Psychometric chart 4.4 Psychometric processes, Bypass factor, Apparatus dew point, concept of sensible heat factor 4.5 Adiabatic mixing of air streams 4.6 Simple numerical using Psychometric chart 4.7 Comfort conditions 4.7.1 Thermal exchange of body with environment 4.7.2 Factors affecting human comfort 4.7.3 Effective temperature and comfort chart 4.8 Components of cooling load- sensible heat gain and latent heat gain sources.	15	09	CO1 CO2 CO3 CO4
5. AIR CONDITIONING SYSTEMS & AIR DISTRIBUTION (No Numericals) 5.1 Classification of A.C. systems 5.2 Industrial and commercial A.C. systems 5.3 Summer, winter and year-round A.C systems 5.4 Central and unitary A.C. systems 5.4.1 Air conditioning equipment: Air handling unit, air washer, humidifier, dehumidifier, filter, heating and cooling coils 5.4.2 Construction, working and applications of different types of fans and blowers 5.5 Applications of A.C systems 5.6 Air distribution systems 5.6.1 Requirements of good room air distribution. 5.6.2 Definitions of Draft, Throw, Drop, Spread, Entrainment ratio. 5.6.3 Duct systems: Perimeter loop system, extended plenum system, radial duct system, reducing plenum system. 5.6.4 Duct material, requirement of duct material, losses in ducts. 5.6.5 Air distribution outlets 5.6.5.1 Types of supply air outlets: Grille, slot diffuser, Ceiling diffuser. Perforated panel. 5.6.5.2 Factors to be considered in selecting supply air outlets	15	09	CO1 CO2 CO3

Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	Basics of Refrigeration	06	09
2	Refrigeration Systems and Refrigerants	14	20
3	Refrigeration System Components	10	16
4	Psychometric Processes, Human Comfort and Cooling Load Estimation	09	15
5	Air Conditioning Systems and Air Distribution	09	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical (5,6,10,11 compulsory and Any 04 from remaining practicals to be conducted)**	**Marks**
1.	Demonstration of domestic refrigerator in view of construction, operation and controls used	25
2.	Demonstration of window / split air conditioner in view of construction, operation and controls used	
3.	Demonstration of various controls on refrigeration systems that include LP/HP cut outs, thermostat, overload protector, solenoid valve	
4.	Identification of components of hermetically sealed compressor.	
5.	Trial on refrigeration test rig.	
6.	Trial on A.C. test rig	
7.	Visit to repairs and maintenance workshop or video presentation to get demonstration of various tools and charging procedure	
8.	Visit to an ice plant/ cold storage plant	
9.	Visit to central A.C. plant in view of ducting system, insulation system and air distribution system.	
10.	Troubleshooting of domestic refrigerator/ window a c / split a c	
11.	Selection criteria for vapour compression refrigeration system components for the following applications: Water cooler, Ice plant, cold storage, domestic refrigerator	
	Total	

9. LEARNING RESOURCES

9.1Text Books

S.No.	Title of Book	Author	Publisher
1	A Textbook of Refrigeration and Air Conditioning	R.S. Khurmi, J.K. Gupta	S. Chand & Company, New Delhi
2	Refrigeration and Air Conditioning	R. K. Rajput	S.K.Kataria & Sons, New Delhi
3	A textbook of Refrigeration & Air Conditioning (For Polytechnic Students)	R. K. Rajput	S.K.Kataria & Sons, New Delhi
4	Basic refrigeration and air conditioning	Ananthanarayanan	Tata McGraw Hill
5	A Course in Refrigeration & Air Conditioning	Arora, S. Domkundwar	Dhanpat Rai & Sons, New Delhi
6	Elements of Heat Engines Vol III	R.C. Patel, C.J. Karamchandani	Acharya Book Depot, Vadodara