SEMESTER VI

(MC603) PRODUCTION MANAGEMENT

1. COURSE OBJECTIVES:

Any technician comes across various problems in manufacturing industry. They should have basic knowledge of how to apply techniques of industrial engineering and production management in various industry related problems so that production is achieved in efficient way and also customer satisfaction. The course is designed to develop necessary competencies in the students to apply the principles of work study and production management in selecting the most economic method for execution of work resulting in improving productivity of the organization.

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**
(MC603) PRODUCTION MANAGEMENT		**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:

MC603. CO1: Describe functions of production management.
MC603. CO2: Conduct Method study and Time study for a given production process.
MC603. CO3: Develop a plant layout for a given production process
.**MC603. CO4:** Prepare a production plan based on available data.

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	1	1	1	1	1	1	2
CO2	2	1	1	1	1	1	1	1	3
CO3	2	2	2	3	2	2	2	2	3
CO4	2	3	3	2	2	2	2	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 PRODUCTIVITY			09	06	CO1
1.1 Introduction, Production and Productivity, importance and benefits of Productivity, Factors influencing productivity.					
1.2 Partial productivity measures (PPM), advantages and limitations of PPM.					
1.3 Productivity improvement techniques.					
2 WORK STUDY			21	14	CO1 CO2
2.1 Introduction, Work study procedure, Human consideration in Work Study, work content, work study as a tool to improve productivity.					
2.2 Method study Introduction, Objectives, Steps involved in Method study, Selection of job for method study.					
2.3 Recording techniques: - Operation process chart, Flow process chart, Two handed Process Chart, Multiple activity chart, SIMO chart, Flow and string diagram, Micro-motion study, Therbligs, Cycle and Chrono cycle graph, Principles of motion economy.					
2.4 Work Measurement Objectives, Steps in time study, Types of Elements, Time Study equipment's (stop watch), Methods of timing, Performance rating (**methods not to be taught**), Allowances and its types, Simple Numerical on computation of Standard time, Basic concept of Work sampling and PMTS.					
3 PLANT LAYOUT			09	06	CO1 CO3 CO4
3.1 Objectives, Importance and Advantages of Plant layout, factors influencing Plant layout.					
3.2 Types of Plant Layout- Process, Product, Fix position layout, comparisons, advantages, limitations and applications.					
4 PRODUCTION PLANNING			21	13	CO1 CO3 CO4
4.1 Introduction, scope, objectives and functions of management. Production system, Types of production systems (Job order, Batch & Continuous).					
1.2 Production Planning and control (PPC):- Introduction, Objective, Functions of PPC.					
4.3 Capacity Planning - Plant capacity, Machine capacity & Machine selection, Measures of capacity, Capacity requirement					

planning (CRP). 4.4 Brief Introduction to Aggregate planning and Master production schedule (No Numerical). 4.5 Material Requirement Planning (MRP) - Introduction, objectives. 4.6 Process Planning (P.P): - Introduction, Factors affecting P.P, Steps in P.P 4.7 Introduction to six sigma and Lean manufacturing			
5 FORECASTING 5.1 Need of Demand forecasting. 5.2 Classification of forecasting methods: - • Judgemental Techniques: -Opinion survey method, Market research, Delphi technique. • Time Series Analysis: -Moving average forecasting, Exponential smoothing method. (simple Numericals on Moving average forecasting and Exponential smoothing methodology)	15	09	CO1 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	Productivity	06	09
2	Work Study	14	21
3	Plant Layout	06	09
4	Production planning	13	21
5	Forecasting	09	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1	Case Study on Productivity	3
2	Assignments on Method Study Techniques	5
3.	Numericals & one case study on stop watch Time Study	3
4.	Plant Layout	3
5.	Problems on Forecasting Methods	5
6.	Assignment on Production Planning	3
7.	Problems on Line Balancing	3
		25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Martand Telsang	Industrial Engineering and Production management	S. Chand
2	M. Mahajan	Industrial Engineering and Production management	Dhanpat Rai
3	O.P. Khanna	Industrial Engineering and Management	Dhanpat Rai & Sons
4	ILO	Work Study	ILO Geneva

(CC 602) BUSINESS COMMUNICATION

1. COURSE OBJECTIVES:

The students will able to:

1. Use speaking, writing and presentation skills to communicate effectively.
2. Develop business etiquettes, manners, grooming and improve personal appearance
3. Improve non-verbal forms of communication.

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	
(CC 602) BUSINESS COMMUNICATION		-	-	2	2	-	-	25	25	50

3. COURSE OUTCOMES:

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

CC 602.CO1: Apply principles of effective communication in business environment

CC 602.CO2: Use ICT in business communication effectively.

CC 602.CO3: Demonstrate soft skills required in business environment.

CC 602.CO4: Prepare Technical Writing for various functions of business communication.

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	1	0	1	2	2	0	1
CO2	2	2	2	1	2	2	3	1	2
CO3	2	2	2	1	2	2	3	1	2
CO4	1	1	1	1	2	3	3	0	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Phr =Practical hours	CO = Course Outcomes	

Unit	M	Phr	CO
1 COMMUNICATION SKILLS AT WORKPLACE			
1.1 **Principles of communication in business** Importance of communication in a business organization, types of communication (formal and informal Internal and External Communication), Channels of communication: Vertical, Horizontal, Diagonal, Grapevine		04	CO1 CO2 CO3 CO4
1.2 **Modern Office technology for communication**: email communication and sending text (etiquettes, components, tips for writing effective emails, spellcheck), internet and use of social media for work (to communicate, search for information about suppliers, specifications, networking, quick feedback, e-commerce, video conferencing)			
2 SEMINARS			
2.1 **Organization of seminars and workshops** Organizers role: planning, objectives, topic selection, planning the date, time, venue, creating event organization material: creating facebook page, WatsApp group, invitations, advertisement on pamphlet, hand-outs, signage, name badges, registration form, press note, inviting key note speaker, schedule		06	CO1 CO2 CO3 CO4
2.2 **Presentation** Speakers role: Gathering relevant material, organization of the material, knowing the occasion and audience, preparing handouts for distribution, time management, interaction with audience, non-verbal communication. (Checklist of significant aspects of oral presentation to be provided)			
2.3 Role of audience Audience's role: Listening effectively and asking relevant questions, note taking			
3 TECHNICAL WRITING			
3.1 Reports **Understanding objective report writing, types of reports, parts of a formal report, illustrations** inspection reports: procedure and format, Project Report		10	CO1 CO2 CO3 CO4
3.2 Business letters Sales letters: parts of sales letter complaint letters: elements of a complaint letter adjustment letters: elements of an adjustment letter			

3.3 Tenders procedure, Preparation, Types of tenders, Single tender, limited tender, Open tenders, government e tender, structure of a tender document, tender notice, terms and conditions, payment details, specification, documents to be submitted, drafting advertisement for tender. **3.4** Generic notices, notice for meetings: purpose, format of notice for meeting, agenda, quorum and writing minutes			
4 JOB INTERVIEWS			
4**.1 Job application and resume** draft job application and resume, draft letter of acceptance and cold contact letter		06	CO1 CO2 CO4
4. 2 **Job interviews** preparing for job interview, guidelines on facing job interviews, mock interviews			
5 SOFT SKILLS **5.1Business etiquettes** Importance of business etiquettes and manners, Tips for good business etiquettes		06	CO1 CO2 CO3 CO4
5.2 Nonverbal Communication grooming, personal appearance, hygiene, deportment and body language **5.3 Interpersonal skills** Leadership skills, team work, active listening **5.4 Critical thinking** How to improve critical thinking, tips for critical thinking			
Total		**32**	-

6. COURSE DELIVERY:

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

7. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical**	**Marks 25**
	Practical Title	
1.	Modern office technology	03
2.	Seminar	03
3.	Technical writing	10
4.	Job interviews	04
5	Soft skills	05
	Total	25
No	**Class room Assignments**	
1	Email communication	
2	Power point presentation	
3.	drafting seminar invites	
4.	Drafting hand outs for seminars	
5	Drafting sales letter	
6	Drafting complaint letters	
7	Drafting adjustment letters	

8	Drafting tender notice	
9.	Filling maintenance reports	
10.	Drafting inspection reports	
11	Drafting abstract	
12	Drafting notice for meetings	
13	Drafting agenda of meetings	
14	Drafting minutes of meeting	
15	Drafting resume and job application	
16	Drafting letter of acceptance	
17	Drafting cold contact cover letter	
18	Group discussions	
19	Debates	
20	Group presentations	

8. LEARNING RESOURCES

8.1 Reference books

S. No.	Author	Title of Books	Publishers
1	P.Prasad, Rajendra k. Sharma	The functional aspects of communication skills	s.k. kataria &sons
2	Pal & Rorualling	Essentials of business communication	Sultan chand & sons
3	Grount Taylor	English conversation practice	Tata MCgraw Hill
4	R.C. Sharma & Krishna Mohan	Business Correspondence & report writing	Tata MCgraw Hill

(MC602) MECHANICAL ENGINEERING PROJECT

1. COURSE OBJECTIVES:

After learning various mechanical engineering subjects, it is time to apply this knowledge to real life situations by study, analysis and modification of prevalent processes and machines, equipment or instrument, design simple mechanical systems, identify, define & solve problems, make new products, etc. This may be done individually or in groups. This is known as Project work. Thus, it is a purposeful time bound student activity to accomplish higher level cognitive, psychomotor and affective domain learning.

2. TEACHING AND EXAMINATION SCHEME:

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
MC602		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
MECHANICAL ENGINEERING PROJECT		**-**	**-**	**6**	**6**	**-**	**-**	**50**	**50**	**100**

3. COURSE OUTCOMES:

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

MC602.CO1: Identify the need for Project

MC602.CO2: Conduct literature Survey.

MC602.CO3: Apply Engineering Knowledge for finding optimal solution.

MC602.CO4: Develop the project

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	3	1	1	2	3	3	3	2
CO2	3	1	1	2	1	3	3	3	2
CO3	3	3	3	3	2	3	3	3	2
CO4	3	2	3	3	3	3	3	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. PRODUCT MODIFICATION Any part, machine or equipment may be studied for its operating controls, energy usage, work performance in order to improve its performance, reduce cost, save energy, increase output, improve any other quality parameters, etc.					CO1 CO2 CO3 CO4
2. PROCESS MODIFICATION Any process in industry, commercial organisation or service sector may be studied for its sequence of activities, man power deployment, operating expenses, energy usage, work performance in order to improve its performance, reduce cost, save energy, increase output, improve any other quality parameters, etc.					CO1 CO2 CO3 CO4
3. LAY OUT MODIFICATION The arrangement of facilities in industry, commercial organisation or service sector may be studied for its usefulness in terms of movements of materials, men, operation & maintenance, etc in order to improve its performance, reduce cost, reduce transportation costs, increase production, improve any other quality parameters, etc.					CO1 CO2 CO3 CO4
4. PLANT MODIFICATION Study of a plant and its accessories in order to improve efficiency, reduce down time, increase production, improve any other quality parameters, etc. The plant may of any industry- Ice Plant, Cold storage, Milk Dairy, Mineral water, food processing, ore processing, water filtration, air conditioning, ventilation, etc.					CO1 CO2 CO3 CO4
5. MAKE NEW PART, MECHANISM OR PRODUCT Use creative ideas to make new object by using available materials, tools, equipment, etc. in order to reduce price, work performance, energy efficiency, etc. Make a new / modified part design or drawing with 3D modelling in computer software using any design software.					CO1 CO2 CO3 CO4
Total					

6. SPECIFICATION TABLE FOR PROJECT REVIEW

No	Project activity	Marks
1.	Selection area of project	**5**
2.	Literature survey, study of component, equipment, machine, plant, layout, etc.	**5**
3.	Defining problems, setting goals.	**10**
4.	Generating alternatives	**5**
5.	Developing a useful solution	**10**
6.	Testing a useful solution for feedback	**5**
7.	Report writing	**10**
	Total	**50**

7. PROJECT REVIEW SCHEDULE

SR.NO	REVIEW NO	WEEK OF SEMESTER
1	Review 1 (For Project Activities 1,2,3)	Second Week
2	Review 2(For Project Activities 4,5)	Seventh Week
3	Review 3(For Project Activities 5,6)	Twelfth Week
4	Review 4(For Project Activities 6,7)	Fifteenth Week

Note: In the project review assessment to be done based on

1) **Presentation made by the students showing the progress of their project.**
2) **Involvement and contribution of individual student in project group.**
3) **Innovative ideas in project.**
4) **Project Guide should strictly follow the project review schedule.**

(MC601) MACHINE DESIGN

1. COURSE OBJECTIVES:

While working in his/her field of work as a Mechanical engineer, student should have working knowledge of design principles which will assist him/her in designing simple and essential machine components as per requirements. This course will enable him to develop analytical abilities to give solutions to engineering design problems.

2. TEACHING AND EXAMINATION SCHEME:

Semester I									
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	
MC 601 MACHINE DESIGN	4	-	2	6	75	25	25	25	150

*** Note: 1)** Standard data in respect of design of shafts, keys, screw threads and springs to be provided during Theory Examination.

2) Duration of Theory Examination is 04 hours.

3. COURSE OUTCOMES:

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

MC601.CO1: Apply the steps in design of machine parts.

MC601.CO2: Select the bearing for a particular application from manufacturer's catalogue.

MC601.CO3: Use design data books and different codes.

MC601.CO4: Prepare detailed and assembly drawings of designed machine parts.

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	1	1	1	1	2	3	1
CO2	3	2	3	2	2	1	2	3	1
CO3	3	2	2	3	2	1	2	3	1
CO4	3	3	3	2	2	2	2	3	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Outcomes**			
Unit			**M**	**T hr**	**CO**
1 INTRODUCTION TO DESIGN			10	8	CO1 CO2
1.1 Machine Design philosophy and procedures					
1.2 General Considerations in Machine Design, Factor of safety and factors governing the selection of factor of safety					
1.3 Fundamentals: - Types of loads, concept of stress, strain, Stress-Strain Diagram for ductile and brittle materials, Types of Stresses, such as Tension, Compression, Shear, Bearing Pressure Intensity, Crushing, Bending and Torsion, creep Strain and Creep Curve					
1.4 Fatigue, S-N curve, Endurance limit					
1.5 Stress Concentration- Causes & Remedies Properties of Engineering Materials, Designation of materials as per IS and introduction to International Standards & advantages of Standardization, use of design data book, use of standards in design and preferred numbers series.					
1.7 Theories of Elastic Failures-maximum Principal Stress theory and maximum shear stress theory.					
2 DESIGN OF SIMPLE MACHINE PARTS			12	10	CO1 CO2 CO4
2.1knuckle joint					
2.2 Design of levers: -Right angled Bell crank Lever					
2.3 Design of C- Clamp, Offset link, arms of pulley.					
3DESIGN OF SHAFTS, KEYS AND COUPLINGS, POWER SCREWS, SPRINGS AND FASTENERS			42	36	CO1 CO2 CO3 CO4
3.1 Types of shafts, Shaft materials, Standard sizes					
3.2 Design of shafts (Hollow and solid) using strength and rigidity criteria					
3.2 ASME code of design for line shafts supported between bearings with one or two pulleys in between.					
3.3 Design of sunk keys, Effect of keyways on strength of shaft					
3.4 Design of couplings- Muff coupling, Protected type Flange Coupling.					
3.5 Thread Profiles used for Power Screws, relative merits and demerits of each					
3.6 Torque required to overcome thread friction, self-locking and overhauling conditions.					
3.7 Efficiency of power screws, types of stresses induced					
3.8 Design of Screw Jack (limited to screw, nut, Head & lever)					
3.9 Classification and applications of springs, Spring-Terminology, Materials and specifications. Stresses in springs, Wahl's correction factor, Deflection of springs, Energy stored in springs					
3.10 Design of Helical tension and compression springs subjected to uniform applied loads, Leaf springs-construction and application					

3.11 Stresses in Screwed fasteners, bolts of uniform strength.			
3.12 Design of bolted joints subjected to eccentric loading a) load acting parallel to the axis of the bolt. B) load acting perpendicular to the axis of the bolt.			
3.13 Design of parallel and transverse fillet welds, axially loaded unsymmetrical section, Merits and Demerits of screwed and welded joints.			
4 ANTIFRICTION BEARINGS			
4.1 Classification of bearings-Sliding contact and rolling contact	06	05	CO1 CO3
4.2 Terminology of Ball bearings- life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue.			
5 ERGONOMICS & AESTHETIC OF DESIGN			
5.1 Ergonomics of design- Man-Machine relationship. Design of Equipment for control, environment & safety.	05	05	CO1 CO3
5.2 Aesthetic considerations regarding shape, Size, color & surface finish.			
Total	**75**	**64**	

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 Design	08	10
2	Design of simple machine parts	10	12
3	Design of Shafts, keys and Couplings, Power Screws, Springs and fasteners	36	42
4	Antifriction bearings	05	06
5	Ergonomics & Aesthetic of design	05	05
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practicals	Marks
1.	Assignment on selection of materials for given applications [at least five applications should be covered] using design data book. List the mechanical properties of material selected. **2 Hrs**	03
2.	Design of Socket & Spigot Cotter Joint. Prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also prepare bill of materials **8 Hrs**	06

3.	Design Project: Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motoror engine etc.). By selecting suitable materials, design the shaft, key and coupling. Also select suitable Ball Bearing from Manufacture's catalogue.(Activity should be completed in a group of five to six students) **8 Hrs**	06
4.	Design a power screw. Prepare design report and CAD assembly drawing indicating overall dimensions, tolerances, and surface finish. Also prepare bill of materials. Printout of CAD assembly drawing should be attached along with the report. 8 **Hrs**	06
5.	Assignments on design of Helical Springs, Bolted joints, Welded joints [one each] with free hand sketches. (numerical problems) 6 **Hrs**	04
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	R.S.Khurmi, J.K.Gupta	A Textbook of Machine Design	S. Chand ,2014
2	V.B.Bhandari	Introduction to Machine Design	Tata Mc. Graw Hill,2002
3	R.K.Jain	Machine Design	Khanna Publications, 1998
4	Pandya & Shah	Machine Design	Dhanpat Rai & Sons, 1992
5	PSG Coimbatore	Design Data Book	PSG Coimbatore ,2000

ELECTIVES II & III

(MC614) ADVANCED MANUFACTURING

1. COURSE OBJECTIVES:

This course is designed to acquaint and motivate the student with the nature of manufacturing processes, to know about the advancements in the area of manufacturing and production processes, to get familiarized with working principles and develop a skill to perform operations on nontraditional machines, machining center, SPM, automated machines.

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**
MC614 ADVANCED MANUFACTURING		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	**-**	**2**	**5**	**75**	**25**	**25**	**25**	**150**

3. COURSE OUTCOMES:

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

MC614.CO1: Explain the fundamentals of advanced manufacturing processes

MC614.CO2: Develop process plan for machining a complex component.

MC614.CO3: Select the machines and toolings for manufacturing intricate components.

MC614.CO4: Demonstrate the operations on advanced machines.

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	1	2	1	1	1	1	2
CO2	3	3	3	2	2	3	2	2	3
CO3	3	3	2	2	2	2	2	2	3
CO4	2	2	2	2	2	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 ADVANCED CASTING PROCESSES				
Working principle, process description, advantages, limitations and applications of the following 1.1 Investment Casting 1.2 Ceramic Mould casting 1.3 Full Mould casting 1.4 Continuous Casting		15	08	CO1 CO3
2 SPECIAL WELDING PROCESSES				
3.1 Working principle, process description, advantages, limitations and applications of the following welding processes 3.1.1 Resistance welding 3.1.2SAW welding 3.1.3MIG welding 3.1.4TIG welding		15	10	CO1 CO2 CO3 CO4
3.2 Working principle, process description, advantages, limitations and applications of the following Modern welding processes: 3.2.1 Electro beam welding 3.2.2Laser welding 3.3Underwater welding technique				
3 CNC MACHINES				
2.1. Introduction 2.1.1 constructional features of CNC Machine 2.1.2 Designating Axes of CNC machine 2.1.3Automatic tool changer and tool magazine.		15	10	CO2 CO3 CO4
2.2 Introduction to CNC program 2.2.1 manual Part programming including subroutines and canned cycles.				
4 SPECIAL PURPOSE MACHINES & GEAR MANUFACTURING PROCESSES		18	12	CO1 CO2 CO3
4.1 SPM 4.1.1 Need, principles, advantages, limitations and applications.				
4.2 GEAR MANUFACTURING PROCESSES 4.2.1 Methods of gear cutting 4.2.2 Indexing and Dividing Heads 4.2.3 Different Methods of indexing 4.2.4 working principle, advantages, limitations and applications of i) Gear Hobbing ii) Gear Shaving iii) Broaching				
5 NONCONVENTIONAL MACHINING PROCESSES				
5.1 Working principle, advantages, limitations and Applications of following processes i) Wire cut EDM, ii)Electrochemical Grinding, iii) Plasma Arc Cutting, iv) Abrasive water jet machining. 5.2 Introduction to Additive manufacturing (3D Printing)		12	08	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	Advance casting processes	08	15
2	Special welding processes	10	15
3	CNC machines	10	15
4	SPM & Gear manufacturing processes	12	18
5	Nontraditional machining processes	08	12
		48	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical (5 ,6 compulsory. any four from remaining)	Marks
1	Prepare a job using any one of the casting methods	25
2	Job on Resistance welding/TIG/MIG welding	
3	Write a part program on machining center.	
4	Job on CNC machine.	
5	Manufacture a Gear using Milling machine (Group of 5)	
6	Industrial visit to observe at least one Special Purpose Machines (SPM) or special welding process and report on visit	
7	Literature review on wire cut EDM	
8	Literature review on Plasma Arc Cutting	
	Total	25

09. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	D. K. Singh	Manufacturing Engineering	Ane Book pvt ltd 2011.
2	P. N. Rao	CAD/CAM Principals and Applications	Tata McGrow Hill
3	HMT Bangalore	Production Technology	Tata McGrow Hill
4	Hajra Choudhury	Workshop Technology volume II	MPP pvt ltd
5	Pabla B. S.	CNC machines	New age international limited.2011

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	S.S. Agarwal	Advanced Manufacturing Processes	Nirali Prakashan
2	Vaibhav Rangari	Advanced Manufacturing Processes	Tech-Max
3	Divya Zindani,	Advanced Machining and Manufacturing Processes	Springer

(MC 622) AUTOMOBILE ENGINEERING

1. COURSE OBJECTIVE:

Automobile engineering has vast scope in today's world and has grown tremendously in the last few decades. The technology involved in automobile is changing rapidly with the advent of electronic controls. Global concern for environment has given impetus to the development of hybrid and electric vehicles. This course is aimed at familiarizing the student with the basic concepts of automobile, its working principle and systems.

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	
(MC 622) AUTOMOBILE ENGINEERING	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC 622.CO1: Describe the various types of automobiles.

MC 622.CO2: Demonstrate the working of different systems in an automobile.

MC 622.CO3: Troubleshoot different faults in an automobile.

MC 622.CO4: Use different tools & equipments in an automobile workshop.

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	2	1	2	2	1	2	2	1
CO3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	3	3	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**			
1 INTRODUCTION & CHASSIS CONSTRUCTION OF AN AUTOMOBILE			**M**	**Thr**	**CO**
1.1Classification of automobiles based on use, capacity, body style, Engine location. 1.2 Layout of Automobile: 4-wheel drive Automobile, 2 -wheel drive Automobile- front & rear wheel drive. 1.3 Types of chassis frames Conventional/Framed chassis Functions of chassis frame 1.4 Various loads on the frame 1.5Frame construction, Frame sections, Sub-frames 1.6 Frameless chassis/Monocoque/Unitary design			8	4	CO1
2 FUEL SYSTEMS					
2.1 Petrol fuel systems 1. Carbureted 2. Electronic fuel injection (EFI), 3. Throttle Body injection (TBI) 4. Multi point fuel injection (MPFI) 5. Gasoline direct injection (GDI) 6. Comparison of MPFI v/s Carbureted fuel system 7. Comparison of Multi point fuel injection (MPFI) v/s Throttle Body Injection (TBI), 8. Functions of various sensors and actuators, 9. Engine management system, 2.2 Diesel fuel systems 1. Individual pump system 2. Common Rail Diesel Injection (CRDI) 3. Fuel injection timing for diesel engines.			12	8	CO2 CO3
3 POWER TRANSMISSIONS, STEERING & SUSPENSION SYSTEM					CO2
3.1 Clutch: Necessity Construction and working of different types of clutches, a) Single plate clutches–diaphragm & coil spring type. b) Multi-plate clutch, Comparison between Dry & wet clutch 3.1 Construction and working of a Fluid Flywheel 3.2 Gear box: Necessity Construction and working of the following a. Sliding-mesh, constant mesh, synchromesh & Epicyclic gear boxes b. Torque convertor c. Automatic transmission d. Overdrive. e. Transfer case (4WD) 3.3 Advances in power transmission a. Automated Manual Transmission (AMT) b. Continuous Variable Transmission (CVT) c. Dual clutch Shift Gear (DSG)			28	18	CO3 CO4

3.4 Steering: Necessity a. Steering Mechanisms: Ackerman & Davis b. Steering linkage for vehicle with rigid axle & independent suspension, c. Steering gearbox – Rack & Pinion, recirculating ball, worm & worm wheel d. Steering geometry, Wheel alignment and wheel balancing e. Power steering: i) Hydraulic (Integral type) ii) Electrical 3.5 Suspension system: Necessity a. Different type of springs used in suspension: i) Leaf spring ii) Coil spring iii) Torsion bar iv) Pneumatic (Air) b. Construction and working of a shock absorber c. Types of suspension system 1) Rigid Axle suspension system i) Leaf spring suspension ii)Coil spring suspension 2) Independent suspension i)McPherson strut type, ii)Double Wishbone type, 3) Pneumatic/air suspension system			CO2 CO3 CO4
4 ELECTRICAL SYSTEM 4.1 Battery – construction, rating, charging and maintenance 4.2 Starting system- Bendix drive, solenoid shift with over-running clutch drive 4.3 Generating system-DC generator, need for cut-out, Alternator, Voltage regulator 4.4 Lighting system, Sealed beam 4.5 Air conditioning system: construction and working 4.6 Circuits for: flashers, horn, and wind screen wiper. 4.7 Trouble shooting of electrical system.	12	**7**	CO2 CO3 CO4

5 BRAKE SYSTEM, SAFETY EQUIPMENT & EMISSION CONTROLS			
a. Brake system: Necessity **1.**Construction and working of following i) Mechanical Brake – Drum and Disc ii) Hydraulic brake system- Drum and Disc iii) Pneumatic/Air brake system, iv) Air assisted hydraulic brakes, v) Vacuum assisted hydraulic brakes. 2.Working of Anti-lock Braking System (ABS) b. Safety Equipment & Emission Controls 1. Auto safety devices & Equipments: seat belts, Air bags, collapsible steering 2. Automobile Emissions: a) Effect on environment b) Catalytic converter c) Pollution control measures: BS VI norms for petrol and diesel vehicles	15	11	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	INTRODUCTION & CHASSIS CONSTRUCTION OF AN AUTOMOBILE	4	8
2	FUEL SYSTEMS	8	12
3	POWER TRANSMISSIONS, STEERING & SUSPENSION SYSTEM	18	28
4	ELECTRICAL SYSTEM	7	12
5	BRAKE SYSTEM, SAFETY EQUIPMENT & EMISSION CONTROLS	11	15
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical (any one from 1 and 4), (any one from 2 and 3), (any one from 5 and 6), and7,8,9 compulsory	Marks
1.	Dismantling and assembly of petrol engine or diesel engine	
2.	Trouble shooting of clutch.	
3.	Trouble shooting of Brakes	
4.	Dismantling and assembly of gear box.	
5.	Trouble shooting of MPFI by creating any two faults.	
6.	Troubleshooting of electrical system	
7.	Tracing of the air conditioning circuits of an automobile and identifying the different components and learning the charging procedure.	
8.	Replacement of tie rods or tie rod end of steering linkage.	
9.	Awareness on Motor Vehicles Act (expert talk / Video presentation)	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Kirpal Singh	Automobile Engineering-volume I& II	Standard Publishers Distributors
2	C.P.Nakra	Basic Automobile Engineering	Dhanpat Rai Publishing Company
3	R. K. Rajput	A textbook of Automobile Engineering	Laxmi Publications Ltd
4	Dr. A.K.Babu Er. Ajitpal Singh	Automobile Engineering	S. Chand Publications
5	Crouse and Anglin	Automotive Mechanics	TATA McGraw-Hill publishing company ltd.
6	Joseph Heitner	Automotive Mechanics	CBs publishers & distributers

9.2 Internet and Web Resources

S. No.	Author	Title of Books	Publishers
1	https://lecturenotes.in/subject/174/automobile-engineering-ae		
2	http://www.vssut.ac.in/lecture-notes.php?url=mechanical-engineering		
3	https://www.svce.ac.in/departments/auto/subjects_auto.php		
4	https://www.youtube.com		

(MC629) JIG & FIXTURES DESIGN

1. COURSE OBJECTIVES:

Through this course the students will be able to understand the importance and applications of jigs and fixtures, appreciate the use of various types of locators, clamps and other tools, get knowledge about elementary design aspects and recognize different types of jigs & fixtures as per the need of manufacturing process.

2. TEACHING AND EXAMINATION SCHEME

Semester					Examination Scheme				
Course code & course title	Periods/Week (in hours)			Total Hours	Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
MC629 JIG & FIXTURES DESIGN	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC629.CO1: Explain industrial significance of jigs and fixtures.

MC629.CO2: Select suitable locators, clamps, indexing devices and tool setting elements.

MC629.CO3: Design a jig for a given component.

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MC629.CO4: Design a fixture for a given component.

4. Mapping Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PS02
CO1	3	1	1	1	1	1	1	1	1
CO2	3	3	3	3	1	2	2	2	2
CO3	3	3	3	3	2	3	2	3	2
CO4	3	3	3	3	2	3	2	3	2

Relationship : Low – 1 Medium – 2 High – 3

5. DETAILED COURSE CONTENTS/MICRO-LESSON PLAN

M= Marks	Thr = Teaching hours			
Unit		M	Thr	CO
1. INTRODUCTION		07	05	CO1
1.1 Significance & purpose of jigs & fixtures, Definition, Advantages.				
1.2 Economic consideration				
1.3 Elements of jigs fixtures: Locating elements, clamping elements, Tool guiding & Setting elements.				
1.4 General design principles				

2. LOCATION & LOCATING DEVICES	11	07	CO1
2.1 Location: Six degrees of freedom, Duty of location system, Choice of location system, Redundant location, Six-point location principle.			CO2
2.2 Locating methods: From a plane surface, From a profile, From cylindrical surface.			
2.3 Typical locators & their applications: support/rest pads or pins, Fixed and Adjustable.			
2.4 Locators from a profile: Pins, location nests.			
2.5 Locators from a cylindrical surface: Location post, Location pot, conical locators, cylindrical locators in combination & use of diamond pin.			
2.6 Vee locators: Fixed and Sliding			
3. CLAMPING			
3.1 Principles of clamping: position, strength, productivity, operator fatigue, and work piece variation	15	08	CO1 CO2
3.2 Types of clamps: Screw clamps and use of floating pad, Strap or plateclamps, Retractable strap clamps, Swinging strap clamps, Edge clamps, Spider clamps, Pivoted clamps, pivoted strap clamps, pivoted edge clamps, pivoted two way clamps, swinging clamps, Quick action clamps (use of 'C' washer & captive 'C' washer), Cam clamps, Eccentric shaft clamp, Toggle clamp and Power clamps.			
3.3 Use of quarter turn nut; Multiple clamping; Equaliser; stacking			
4. INDEXING DEVICES AND DRILL JIG BUSHES			
4.1 Linear indexing; Rotary Indexing			
4.2 Indexing plate; Rotary Indexing Tables	18	10	CO1 CO2
4.3 Material & heat treatment for drill jig bushes			
4.4 Types of bushes: Press fit bushes and slip bushes; Headed bushes andheadless bushes; Renewable bushes; Liner bushes; Threaded bushes; Special bushes			
5. DESIGN OF JIGS & FIXTURES			
5.1 Drill jig design – Types of jigs: Plate jigs & channel jigs, Angle plate jigs, Post jig & Pot jig; Turn over jig; Leaf or latch jig; Box jig; Design procedure	24	18	CO1 CO2 CO3 CO4
5.2 Provisions for swarf removal			
5.3: Design of Milling fixture			
5.4 Use of tenons; use of cutter setting block			
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	5	07
2	Location & Locating Device	7	11
3	Clamping	8	15
4	Indexing Devices and Drill Jig Buses	10	18
5	Design of jigs & fixtures	18	24
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS

No.	Practical	Marks
1	Basic Principles	2

2	Illustration of basic elements of Jigs & Fixtures	3	**9. LEARNING RESOURCES**
3	Locating Devices	3	
4	Clamps	3	
5	Indexing Devices	2	
6	Drill Jig bushes	2	
7	Design of simple drill- jig, for a given component (Assembly & Details) (Designed Jig may be redrawn using CAD software.	5	
8	Design of simple milling fixture, for a given component (Assembly & Details) (Designed fixture may be redrawn using CAD software.	5	
	Total	25	

9.1 Text Books

Sr. No.	Author	Title of Books	Publishers
1	PH Joshi	Jigs & Fixtures	Tata McGraw Hill
2	M.H.A. Kempster	Introduction to Jig and Tool Design	The English Language Book Society, London
3	ASTME	Fundamental of tool design	Prentice Hall
4	Donaldson & Gold	Tool Design	Tata McGraw Hill

9.2. Reference books for further study

Sr. No.	Author	Title of Books	Publishers
1	Central machine Tool Institute, Bangalore	Machine Tool Design handbook	Tata McGraw Hill
2	Edward G. Hoffman	Jig and Fixture Design	Cengage

(MC631) LEAN MANUFACTURING

1. COURSE OBJECTIVE:

This course will enable the student to understand the basics of Lean Manufacturing and its different tools used in Industries. Its set of principles and processes leads to identifying and eliminating different wastes in the system. Lean Manufacturing helps in streamlining operations or manufacturing with Customer TAKT time, identifying the bottle neck areas and eliminates the same, which in turn will lead to Reduced Cycle Times.

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	OR	TW	
(MC631) LEAN MANUFACTURING	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC631.CO1: Identify value added and non-value-added activities in a workplace

MC631.CO2: Apply 5S concept to maintain a workplace. **MC631.CO3:**

Use Lean tools to make improvements in the system **MC631.CO4:** Select

Standard Work/ Best Method.

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	2	1	2	2	2	1	3
CO2	3	2	2	3	3	2	2	2	2
CO3	3	2	3	3	3	3	2	2	2
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 Outcomes

Unit	M	Thr	CO
1 INTRODUCTION TO LEAN MANUFACTURING			
1.1 History of lean manufacturing.	22	13	CO1

1.2 Lean –Meaning &Definition, Objectives of Lean Manufacturing system			CO2 CO3 CO4	
1.3 Lean Manufacturing V/s Traditional Manufacturing				
1.4 Value added Activity, Non-Value-added activity				
1.5 Internal Customer and External Customer				
1.6 Concepts of Waste, Eight Types of Wastes				
1.7 Pull System and Push system, Difference between Pull and Push system,				
1.8 Introduction to Lean Six sigma, Lean v/s Six Sigma				
2 5S ORGANIZATION SYSTEM	9	5	CO1 CO2 CO4	
2.1 "5S" Terminology				
2.2 The Concept of 5-S with Examples				
2.3 Importance of 5S in Industry / Office,				
2.4 5S Visuals control.				
2.5 5S Audit				
3 ESSENTIAL LEAN TOOLS	22	15	CO1 CO2 CO3 CO4	
3.1 Standardized Work				
3.2 KAIZEN				
3.3 One-piece Flow or Continuous flow				
3.4 Pull system and Kanban, Heijunka /Leveling				
3.5 Visual Control / Management				
3.6 TAKT Time, Cycle Time, SMED/OTS (Single Minute Exchange of Dies/One Touch Setup)				
3.7 Jidoka,/Mistake proofing / Poka Yoke				
3.8 Introduction to Total Productive Maintenance				
4 JUST IN TIME	12	8	CO1 CO3 CO4	
4.1 Introduction				
4.2 Elements of JIT: Small lot Sizes, set up Time, Pull production system, Cellular layouts, Standardization of components and work methods, Supplier network, Flexible Resources, Continuous Improvement				
4.3 Just in Time Manufacturing				
4.4 Benefits of JIT				
5 VALUE STREAM MAPPING	10	8	CO1 CO2 CO3 CO4	
5.1 Concept of VSM				
5.2 VSM Methodology, symbol used				
5.3 Current and Future State Map				
5.4 Examples of VSM				
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	No of lectures	Marks
1	Introduction to Lean manufacturing	13	22
2	5S Organisation System	05	9
3	Essential Lean Tools	14	22
4	Just in Time	08	12
5	Value Stream Mapping	08	10
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS (ANY FIVE)

No	Practical	Marks
1.	Identifying Wastes in an Industry where you had undergone training and suggest ways to improve.	
2	Set up Institute's Workshop / Office / Lab or any other workplace to 5S Standard & prepare a detailed report	
3	Case study on application of 5S in Industry.	
4	Pull System demonstration	
5	Prepare a report on implementation of Kaizen at workplace.	
6	Industry Visit to check best practices and make a Report.	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Jeffrey K. Liker	The Toyota way	McGraw Hill Professional
2	James P. Womack, Daniel T. Jones, Daniel Roos	The Machine That changed the world	Free Press, New York
3	Gopalkrishnan N.	Simplified Lean Manufacture: Elements, Rules, Tools and Implementation	PHI
4	Eric Ries	The Lean Startup	Penguin
5	Christopher Jahns, Nicolas Reinecke, Roger Moser	Lean Production	DGM Icfai Books

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	James P. Womack and Daniel T. Jones	Lean thinking	Lean enterprise Institute Cambridge
2	Mike Rother & John shook	Learning to See	Lean enterprise Institute Cambridge

(MC 617) COMPUTER NUMERICAL CONTROL MACHINES

1. COURSE OBJECTIVE:

This course comes under core technology category. The intent is to teach students concepts, principle and advances in manufacturing system. The advanced manufacturing use latest technology for machining parts with complex design features for ease and minimal or no human interference. The parts/products manufactured meet quality standards and quick response to the customer demand.

The students will learn modern manufacturing machines, their operations, tooling's, peripheral support systems like AGV, ARS and robots used on the shop floor. Students will acquire knowledge and understand skill of operating advanced machines i.e. CNC machines. The students will be industry ready on completion of this course.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(MC 617) CNC MACHINES	L	T	P	H	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC 617. CO1: Describe the Numerical Control Technology in Machine tools.

MC 617. CO2: Write part program for given component.

MC 617.CO3: Select the tooling for CNC machines

MC 617.CO4: Apply manual and computer aided part programs on machines

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	2	1	1	1	1	1
CO2	3	3	3	3	2	2	2	1	3
CO3	3	3	3	3	2	3	2	2	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 Outcomes**			
Unit			**M**	**Thr**	**CO**
1 NC TECHNOLOGY					
1.1 Automation in manufacturing industry, Automation in machine Tools.			15	08	CO1
1.2 Fundamental of NC Technology, Suitability and limitations of NC Technology					
1.3 NC manufacturing, NC/CNC machines, DNC Systems.					
1.4 Need of CNC software, Advantages and Disadvantages of NC, CNC and DNC systems.					
2 NUMERICAL CONTROL M/C TOOLS					
2.1 Basics of CNC machine construction/hardware. Classification based on (i) Feedback control: Open loop and closed loop, (ii) Control system feature: point to point, Straight line and Continuous path.			15	10	CO1 CO3
2.2 Designating axis and motion in CNC machines, CNC Tooling: need and importance; Automatic Tool changer (ATC) & Tool Magazines					
2.3 Tooling for Machining Centers; Tooling for Turning centers; Tool presetting and equipment, Flexible tooling system.					
3. MANUAL PART PROGRAMMING					
3.1 Fundamentals of part programming; Programming Formats; G and M Codes, NC words, Interpolation: Linear and Circular			15	10	CO2 CO3 CO4
3.2 Procedure for developing manual part program; Part program for point to point machining; Straight line machining; curved path/surface machining; Radius and Tool length compensation.					
3.3 Part program for Turning center and Machining center.					
4 COMPUTER ASSISTED PART PROGRAMMING					
4.1 Introduction, Types of programming Languages, Basics of APT Program, Procedure for developing APT program			15	10	CO1 CO2 CO3 CO4
4.2 APT Language structure, APT word definitions, APT program statements/Commands					
4.3 Compilation control Commands, Part program using APT statements/commands.					
5 REPETITIVE PROGRAMMING AND ADVANCED SYSTEMS					
5.1 Introduction/Meaning of repetitive programming, Importance of sub-routines, sub program, Do loops & fixed/canned cycles			15	10	CO1 CO2 CO3 CO4
5.2 Write Manual part program and APT program using sub-routines, sub program, Do loops Applicability and use of fixed cycle/canned cycle in part program					
5.3 Fundamentals of FMC / FMS, CIMS, ARS, AGV, CMM and Robot.					
Total			**75**	**48**	

6. COURSE DELIVERY:

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

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	NC technology	08	15
2	Numerical Control M/C Tools	10	15
3	Manual part programming	10	15
4	Computer aided part programming	10	15
5	Repetitive programming and Advanced Systems	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
	Practical Title	
1	Industry visits for Numerical Control System and configuration of CNC setup on shop floor.	3
2	Exercise on part program- Writing, entering and editing on CNC machines (Lathe/Machining Centre).	5
3	Industry visits for tooling for CNC Machine.	4
4	Develop a part program for lathe operation like plain turning, facing, taper turning operation. Thread cutting operation etc. Make a job on CNC turning center.	5
5	Develop a part program for milling operations like plain milling, slot milling, pocket milling, drilling etc. Make job on CNC machining center.	5
6	Visit to industries to study the application of NC/CNC technology in manufacturing operations.	3
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	P N Rao, N K Tewari, T K Kundra	Computer aided Manufacturing	Tata McGraw Hill
2	M. Adithan, M & B. S. Pabla	CNC Machines – Programming & Applications	Wiley Eastern Ltd,
3	Korem, Y. & J.B. Uri	Numerical Control of Manufacturing System	McGraw Hill.
4	Mikell P. Groover	Automation, Production systems, Computer integrated manufacturing	Pearson
5	Mikell P. Groover, Emory W. Zimmer JR	CAD/CAM Computer Aided Design and Manufacturing	Prentice Hall of India

Indian and International codes needed

S. No.	Author	Title of Books	Publishers
1	ISO Standard	G and M Codes for Machining center	Manufacture of Machine
2	ISO Standard	G and M Codes for Turning center	Manufacture of Machine

(MC 623) POWER PLANT ENGINEERING

1. COURSE OBJECTIVE:

Power generating capacity and energy consumption are direct measures of development of a nation. Different types of powerplants are set up in our country for generating power. Also, some industries set up their own captive power plants in order to be self-sufficient. Efficient operation of these powerplants with minimum impact on environment is essential for sustainable development.

After studying this course students will be able to operate and maintain various types of power plants.

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
(MC 623) POWER PLANT ENGINEERING	L	T	P	H	TH	TM	TW	PR/OR	
	03	-	02	05	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC623.CO1: Describe construction and working of power plants.

MC623.CO2: Evaluate various performance parameters of a power plant and its cycles.

MC623.CO3: Manage fuel handling & waste disposal in power plants.

MC623.CO4: Select the power plant for a given set of conditions.

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	1	1	1
CO2	3	2	2	2	2	3	1	2	2
CO3	3	2	2	2	3	3	2	2	3
CO4	3	3	3	2	3	3	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 HYDROELECTRIC POWER PLANT			12	07	CO1 CO4
1.1 Introduction					
1.2 Site selection for hydroelectric power plant					
1.3 Classification of hydroelectric power plant					
1.4 General arrangement of storage type hydroelectric power plant and its operation					
1.5 Advantages of hydroelectric power plant.					
1.6 Environmental aspect of hydroelectric power plant					
2 STEAM AND GAS TURBINE POWER PLANT			31	20	CO1 CO3 CO4
2.1 **Steam turbine power plant**					
2.1.1 **Coal based steam turbine power plant** Introduction, Steam cycles: Rankine cycle, Modified Rankine cycle, reheat cycle, Regenerating cycle, Layout of modern coal-based steam power plant, working of steam power plant, site selection for steam power plant					
2.1.2 **Coal handling system** Equipment's used for out plant, storage and in plant handling of coal. Pulverized fuel handling system- Bin system, Pulverized fuel burner- cyclone burner.					
2.1.3 **Ash handling system** Layout of ash handling plant, mechanical and Pneumatic Ash handling system.					
2.1.4 **Boiler Feed water treatment** De concentration or blow down, De aeration, Demineralization, Ion exchange process.					
2.1.5 **Pollution from thermal power plant**: Air pollution and control equipment's (cyclone separator, ESP), solid waste and thermal pollution and methods to reduce it.					
2.2 **Gas turbine power plant** Introduction, Gas turbine cycle, Classification of gas turbine power plant- working of open and close cycle gas turbine power plant, Advantages of gas turbine power plant, thermal refinement of gas turbine power plant Pollution from gas turbine power plant and its control					
2.3 **combined cycle power plant**					
Construction and working of combined cycle power plant, advantages of using combined cycle.					
3.DIESEL ELECTRIC POWER PLANT			12	8	CO1 CO3 CO4
3.1 Introduction, layout, construction and working of following subsystems: Air intake system, fuel system, exhaust system, cooling system and lubrication system					
3.2 Criteria for selection of diesel electric power plant					
3.3 Synchronizing Diesel generating power with grid supply and automatic change over.					

4.NUCLEAR POWER PLANT				
4.1 Principle of release of energy by nuclear reactor				
4.2 Nuclear fuels used in reactor.				
4.3 General component of nuclear reactor and its function	12	08	CO1 CO3 CO4	
4.4 Classification of nuclear reactor: - PWR, BWR and Breeder reactor construction and working.				
4.5 General layout of nuclear power plant				
4.6 Advantages of nuclear power plant				
4.7Pollution from nuclear power plant Radioactive pollution, waste from reactor, thermal pollution, Radiation Hazards and disposal of nuclear waste				
5. FLUCTUATING LOADS ON POWER PLANT				
5.1Introduction	08	05	CO2 CO4	
5.2 Define: load curves, terms and factors, connected load, Maximum demand, Demand factor, Average load, Peak load, Diversity factor, Plant use factor, Plant capacity factor				
5.3 Effect of variable load on power plant design and operation				
5.4 Selection of number and size of units				
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	Hydroelectric power plant	07	12
2	Steam and gas turbine power plant	20	31
3	Diesel electric power plant	08	12
4	Nuclear power plant	08	12
5	Fluctuating loads on power plant	05	08
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Collecting data regarding different types of power plant in India and their present power development status.	5
2.	Case Study on performance enhancement of any one type of power plant	4
3.	Prepare annual maintenance plan for any power plant.	4
4.	Operation of Coal Handling System (Field Visit/Video Presentation)	2
5.	Operation of Ash Handling System (Video Presentation)	2
6.	Operation and maintenance of a nuclear reactor (Video Presentation)	2
7.	Prepare report on Heat recovery system in a power plant	4
8.	Report on Field visit to power plant/ Video Presentation	2
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Arora and Domkundwar	A course in power plant engineering	DhanpatRai and Co
2	P. K. Nag	Power plant engineering	Tata McGraw Hill
3	A. Chakrabarti and M. L. Soni	A text book of Power System Engineering	DhanpatRai and Co
4	Er. R.K.Rajput	Power Plant Engineering	Laxmi Publication

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Thomas C. Elliott	Standard handbook of power plant engineering	Tata McGraw Hill

(MC626) SAFETY ENGINEERING.

1. COURSE OBJECTIVES:

With rapid advances in industrial processes, new types of risks and hazards are being increasingly introduced. Safety of life and assets has always been a top priority in any industry. Keeping this in mind, this course is designed to acquaint the students with safety norms & principles practiced in industries**.**

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**
(MC626) (SAFETY ENGINEERING)		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**
		3	**-**	**2**	**5**	**75**	**25**	**25**	**25**	**150**

3. COURSE OUTCOMES:

On successful completion of the course the students will able to:

MC626.CO1: Implement various safety practices in working environment.

MC626.CO2: Identify the causes of accident in the workplace.

MC626.CO3: Analyze the hazards at work environment

MC626.CO4: Select appropriate personal protective equipment.

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	3	2	1	2
CO2	3	3	2	2	2	2	2	2	3
CO3	3	3	2	2	2	2	2	2	2
CO4	3	3	3	2	3	2	2	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 INDUSTRIAL SAFETY AND FACTORIES ACT			11	8	**CO1 CO2**
1.1 Introduction-Safety -Goals of safety engineering.					
1.2 Need for safety. Safety and productivity.					
1.3 Safety organization- objectives, types, functions,					
1.4 Role of management, supervisors, workmen, unions, government and voluntary agencies in safety,					
1.5 Safety policy,					
1.6 Safety Officer-responsibilities& authority.					
1.7 Safety committee-need, types & advantages.					
1.8 General factories act related to safety of employees and machineries					
1.9 Introduction to National Institute for Occupational Safety and Health (NIOSH), Environmental Protection Agency (EPA) & Occupational Safety and Health Administration (OSHA)					
1.10. Introduction to ISO Standards for Safety & Environment (ISO 45001,ISO14001)					
2 ACCIDENT AND INSURANCE					
2.1 Definition of accidents, Injury,			20	10	**CO1 CO2 CO3**
2.2 Causes of accidents and factors affecting it, Unsafe act, Unsafe Condition,					
2.3 Classification of accidents,					
2.4 Accident prevention method-Engineering, Education and Enforcement.					
2.5 Accident report form;					
2.6 Benefits of Accident report forms;					
2.7 Cost of accidents					
2.8 Accident investigation –Why? When? Where? Who? & How?					
2.9 Case study on accidents investigation, Job safety analysis (JSA) 5 sigma					
2.10 Introduction to Insurance, Types and comparison.					

3. SAFETY EDUCATION & HOUSEKEEPING	12	8	
3.1 Safety Education & Training -Importance, 3.2 Various training methods, 3.3 Communication- purpose, barrier to communication. 3.4 Role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign 3.5 Housekeeping: Definition, Responsibility of management and employees, Advantages of good housekeeping, 5 s of housekeeping. 3.6 Work permit system- objectives, hot work and cold work permits. 3.7 Entry into confined spaces.			**CO1** **CO2** **CO3**
4 SAFETY IN MATERIAL HANDLING			
4.1 Classification of safety in Material Handling; 4.2 Manual Handling; kinetic method of lifting 4.3 Fall- Definitions; Causes of common fall 4.4 Types of falls and safety regarding falls. 4.5 Inbuilt safety in cranes, hoist and lift, chain pulley block, Mixers, conveyors	12	6	**CO1** **CO2** **CO3**
5 **HAZARDS IN INDUSTRY & THEIR PREVENTION**			
5.1 Fire hazards and prevention: Types of Fires and relevantExtinguishers, Fire detection sensors 5.1 Machine Hazard: Types of machine hazards Common safeguarding methods and devices; 5.2 Hazards in chemical industry: classification of hazardous chemicals; properties of flammable chemicals; 5.3 safety in storage and transportation of flammable fluids; 5.4 Types of chemical emergencies and their prevention. 5.5 Noise: Introduction to noise; Effect of noise; Remedial measures to combat noise. 5.6 Electrical hazards 5.7 Personal protection in the work environment Types of Personal protective equipment-respiratory and non-respiratory equipment.	20	16	**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	**INDUSTRIAL SAFETY AND FACTORIES ACT**	8	11
2	**ACCIDENT & INSURANCE COVERAGE**	10	20
3	**SAFETY EDUCATION & HOUSEKEEPING**	8	12
4	**SAFETY IN MATERIAL HANDLING**	6	12
5	**HAZARD IN INDUSTRY & THEIR PREVENTION**	16	20
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practicals (At least Six))	Marks
1.	Visit to the Inspectorate of Factories & Boilers /safety agency and Prepare the report on safety measures followed in the industry.	
2.	Conduct a mock drill to handle emergency situation in the Institute.	
3.	Survey a nearby market and prepare a report on safety equipment and their specification available in market.	
4.	Prepare at least one safety poster or safety display that can be used in surrounding area	
5.	Prepare a report on root cause analysis of an industrial accident.	
6.	Identify different types of fires and select appropriate fire extinguisher	
7.	Select appropriate PPE for industrial environment	
8.	Prepare an action plan for disposal of industrial waste for prevention of health hazards.	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	NaseerElahi	Industrial Safety Management	Kalpaz Publication 2006
2	H.l. kalia	Industrial Safety And Human Behavior	Aitbs Publishers, India
3	A. N. Saxena	Industrial Safety	National Productivity Council 1978

(MC630) MAINTENANCE ENGINEERING

1. COURSE OBJECTIVES:

Maintenance engineering is one of the most common disciplines of an industrial organisation. A diploma holder must have a fair knowledge of the maintenance management principles and maintenance tasks to be performed in the industry. This course is designed to impart necessary knowledge to students in maintenance engineering.

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	
MC630 MAINTENANCE ENGINEERING	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

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

MC630.CO1: Identify the various maintenance practices adopted in industries.

MC630.CO2: Prepare an estimate of given maintenance task.

MC630.CO3: Apply suitable techniques and engineering tools for maintenance work

MC630.CO4: Analyse the data acquired in condition monitoring of equipment.

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	2	2	1	1	2
CO2	3	3	2	3	2	2	1	1	3
CO3	3	3	3	3	3	2	2	3	2
CO4	3	3	3	3	3	1	2	2	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours	CO = Course Outcomes			
Units			**M**	**Thr**	**CO**
1 CONCEPT OF MAINTENANCE & ITS PRACTICES					
1.1 Introduction to concept of maintenance: Need for maintenance, Types of maintenance practices: Breakdown, preventive, predictive. Their comparison and areas of application.			15	08	CO1
1.2 Preventive maintenance: Importance of preventive maintenance, Schedules of Preventive maintenance, Preventive maintenance programming, Manpower & machine scheduling					
1.3 Shutdown maintenance: Planning for a shutdown by using PERT and CPM technique, efficient use of manpower & machinery during shut down period.					
1.4 Need for manuals and types of manual Contents of maintenance manuals, Manual writing or reporting, Maintenance practices. Systematic recording of maintenance viz. Maintaining log books and history cards.					
2 ECONOMICS OF MAINTENANCE					
2.1 Maintenance stores control, Maintenance store rooms Inventory & classification of inventory related to maintenance Standardisation of maintenance parts.			9	7	CO2
2.2 Approach to maintenance estimation. Classification of jobs, Preparation of estimates Estimating techniques and selection of estimating methods					
3 PREDICTIVE MAINTENANCE & CONDITIONING MONITORING			18	12	CO4
3.1 Importance of predictive maintenance Introduction to programming of predictive maintenance: Detection, analysis and correction Vibration as a parameter for condition monitoring:					
3.2Introduction to vibration of simple spring mass system., Terminologies used in vibration monitoring- vibration amplitudes, Displacement, Velocity, Acceleration, Use & selection of vibration amplitude parameter, Detection of defects in rolling elements bearing & gear, establishing levels of vibration, Baseline, warning & danger limits, Reference standards & charts used in defining levels.					
3.3 Instruments used in vibration monitoring: Displacement pickups, Velocity pickups, Accelerometers, Spike energy meter and Stroboscope.					
3.4 Vibration analysis. Introduction to machine signatures, Analysis of common defects using vibration monitoring instruments viz Unbalance, misalignment, looseness & Defects in Rolling Contact bearings.					
4 LUBRICATION					
4.1 Types of lubricants: Liquid, semi fluid and solid, Requirementsof lubricants, Selection of lubricants for various applications using some, available commercial grades,			12	7	CO3
4.2 Various modes of lubrication Lubrication methods: Ring type, Cup type, Wick, Circulating					

type, Grease gun, Lubrication schedules;			
5 MAINTENANCE OF MACHINES & RECONDITIONING OF COMPONENTS	21	14	CO3
5.1 Reconditioning and repair of a. Flat surfaces, b. Shafts and spindles, c. bushes, d. keys and keyway, e. Gears, f. Valves; Metal spraying, welding, grinding and re-boring for reconditioning.			
5.2 Bearings: Pulling out and installing RC bearings, maintenanceof journal bearings, Bearing lubrication. Belts & Seals: Types of oil seals, Failure of oil seals, Belt tension adjustment, care and precautions Servicing of hydraulic pistons cylinder arrangement, Servicing of hydraulic and pneumatic valves.			
5.3 Maintenance of Reciprocating air compressor-Valves, piston rings, cylinder and bearings. Trouble shooting. Centrifugal pump- Maintenance of wearing ring, stuffing box, mechanical seal, Troubleshooting.			
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	Concept of Maintenance & Practices	10	15
2	Economics of Maintenance	7	9
3	Predictive Maintenance & Conditioning Monitoring	12	18
4	Lubrication	9	15
5	Maintenance of machines & Reconditioning of components	10	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical (Minimum 08 Practicals to be conducted)**	**Marks**
1	Demonstrate use of different types of tools in maintenance work.	
2	Demonstrate mounting and dismounting of rolling contact bearing.	
3	Prepare a maintenance schedule using PERT and C.P.M. Technique.	
4	Record and analyse vibration data for condition monitoring.	
5	Prepare a maintenance estimate for a given task.	
6	Use maintenance manual to carry out a maintenance task.	
7	Do alignment of coupled shafts using dial gauges.	
8	Replace gland packaging of a gland and stuffing box provided in a machine such as centrifugal pump.	
9	Dismantle, Inspect and assemble hydraulic/pneumatic valve and cylinder.	
10	Prepare troubleshooting chart for reciprocating compressor.	
	Total	**25**

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	S.N.Bhattacharya	Installation, servicing & maintenance	S.Chand & Co
2	Sushil Kumar Srivastava	Maintenance Engineering and Maintenance	S.Chand & Co
3	Lindley R Higgins	Maintenance Engineering Handbook	Tata Mc Graw Hill publisher

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Carl A. Nelson	Millwright and Mechanics Guide	Theodore Audel & Co.

AUDIT COURSE

(AC102) INDIAN CONSTITUTION

1. COURSE OBJECTIVES:

As a proud citizen of this country every student must be aware about the Indian Constitution to appreciate the provisions available for the people of this biggest democracy in Indian Constitution so that the youth of this country plays active role in development of the country by participating in the formation of sensitive and proactive Government at national and state level. This course intends to make students aware about various constituents of the Indian Constitution.

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
(AC102) INDIAN CONSTITUTION		L	T	P	H	TH	TM	TW	PR/OR	
		2	-	-	2	-	-	-	-	-

3. Course Content

Unit 1 – The Constitution - Introduction • The History of the Making of the Indian Constitution • Preamble and the Basic Structure, and its interpretation • Fundamental Rights and Duties and their interpretation • State Policy Principles
Unit 2 – Union Government • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha
Unit 3 – State Government • Governor – Role and Power • Chief Minister and Council of Ministers • State Secretariat
Unit 4 – Local Administration • District Administration • Municipal Corporation • Zila Panchayat
Unit 5 – Election Commission • Role and Functioning • Chief Election Commissioner • State Election Commission

4. Suggested Learning Resources:

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 DD Basu Lexis Nexis; Twenty-Third 2018 edition

5. Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/