PROGRAMME CURRICULUM

AND

SYLLABI OF

DIPLOMA PROGRAMME IN

MECHANICAL ENGINEERING

UNDER RATIONALISED SEMESTER SYSTEM

(IMPLEMENTED FROM ACADEMIC YEAR 2020-2021)

BOARD OF TECHNICAL EDUCATION, GOA STATE

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SYLLABUS STRUCTURE FOR MECHANICAL ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

(GC101) Communication Skills

1. COURSE OBJECTIVE :

The course aims to develop Communication skills in English by improving students' ability to write ,speak, listen and read effectively. Emphasis is also laid on students' personality development, helping them to build their confidence in interpersonal / group communication.

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**
(GC101) Communication Skills		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		-	**-**	**02**	**32**	**-**	**-**	**25**	**25**	**50**

3 . COURSE OUTCOMES:

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

GC101.CO1 Understand the essentials of effective Communication.

GC101CO2 Develop reading. writing, speaking , listening and effective presentation skills.

GC101.CO3 Select the appropriate mode of Communication .

GC101.CO4 Demonstrate reading. writing, speaking , listening and effective presentation skills.

4.Mapping Course Outcomes with Program Outcomes

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

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Phr = Practical hours**	**CO = Course Outcomes**	

Unit	**M**	**Phr**	**CO**
1 UNIT NAME: FUNDAMENTALS OF COMMUNICATION SKILLS	**-**		**CO1 CO2 CO3 CO4**
1.1 **Communication Skills fundamentals** Definition, communication process, importance of Communication Skills, essentials of effective communication		01	
1.2 **Types of communication**: verbal Communication and Nonverbal communication (Body language, facial expressions, gestures, eye contact, posture, dress and grooming/personal appearance, deportment, personal hygiene) Paralinguistic (Volume, pace, pitch, pauses)		02	
1.3 **Barriers to communication:** physical barriers, psychological barriers and cultural barriers		01	
2. Unit: PRESENTATION SKILLS			
2.1 Presentations: Methods and style of presentation, Importance, planning a presentation, venue selection, audience awareness (age, gender, profession background, educational and social background) time and duration, audio visual aids (OHP, LCD projector, flip charts, white/black/green board, computer, microphone)		**02**	**CO2 CO3 CO4**
2.2 Public speaking: preparatory steps, tips for good beginning and end, delivery style, techniques for a good speech (repetition, signs, pictures, humor), body language		**02**	
3 UNIT: TECHNICAL Writing			**CO1 CO2 CO4**
3.1 Report **writing** Functions and parts of a report, Qualities of a good report, and types: Report on any institute function, Accident report, Industrial visit Report		04	
3.**2 Business letters** Principles of effective letter writing, parts of a business letter, formats (Full block style, Semi block style, modified block style) Routine/ Generic letters (letter to the heads of the institute, letter to the heads of various departments/sections of the institute) Types of letters: Enquiry Letter, Quotation, Purchase Order, Letter of Complaint		06	
3.3 **Job application** Tips for a good C.V and a Resume		02	

4 UNIT GRAMMAR	-		
4.1 Fundamentals of English writing Subject verb agreement, homonyms, homophones, homographs, articles, Punctuation, synonyms, fundamentals of sentence construction		**02**	**CO1** **CO2** **CO4**
4.2 Paragraph Writing: Developing Topics (the main idea), body (supporting sentences), conclusion, proof reading		**02**	
UNIT V: LANGUAGE WORKSHOP **5.1 Reading Skills** strategies to use for building vocabulary and reading fluencies (read extensively, identify new words, use of dictionary, online dictionary apps), reading comprehension, pronunciation, debate, role play,	-	08	**CO1** **CO2** **CO4**
5.2 Listening Skills How to listen effectively, listening comprehension			
5.3 Speaking skills speech, group discussion			
5.4 Writing skills précis writing, comprehension			
Total		**32**	

6. COURSE DELIVERY:

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

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	NO of lectures	Marks
1	Fundamental of Communications skills	04	-
2	Presentation Skills	04	-
3	Technical Writing	12	-
4	Grammar	04	-
5	Language workshop	08	-
	Total	32	25

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical
1.	**Practical Title: Fundamental of Communications skills**
i.	Comprehension
ii.	Précis writing
iii.	Self-Introduction
2	**Practical Title: Presentation Skills**
iv.	Extempore speech
v.	Presentation on any given Topic
3	**Practical Title: Technical Writing**
vi.	Accident Report
vii.	Report on Institute function
viii.	Industrial visit report
ix.	Generic letters to the heads of various department/ Sections of the institute
x.	Inquiry letter
xi.	Quotation

xii.	Purchase or supply order
xiii.	Complaint letter
xiv.	Job application
4	**Grammar**
xv.	Exercises in subject – verb agreement
xvi.	Exercises in use of preposition
xvii.	Exercises in use of Homophones, homonyms, homographs
xviii.	Exercises in use of punctuation
xix.	Exercises relating to correcting the sentences
xx.	Paragraph writing
5	**Language workshop**
xxi.	Exercises to improve Reading skills
xxii.	Exercises to improve Writing skills
xxiii.	Group discussion
xxiv.	Listening comprehension

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R. C. Sharma & Krishna Mohan	Business Correspondence and Technical Writing	Tata McGraw Hill
2	P. Prasad, Sharma, K. Rajendra	The Functional aspects of communication skills	S.k. Kataria& sons
3	SanjayKumar,Pushpa Lata	Communication Skills	Oxford University Press
4	A.K.Jain,A.M.Shaikh&Pravin S R Bhatia	Professional communication Skills	S.Chand
5	Wren & Martin	High School English Grammar & Composition	S. Chand, N. Delhi

10.Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Raul R. Timm	How to make winning presentations	Sneha Printers
2	Dale Carnegie, Training CPI	Stand and Deliver, How to become a masterful communicator and public speaker	Cox & Wyman, UK
3	John Seely	The Oxford Guide to Effective Writing and speaking	Oxford University Press

Autobiographies, self-help books, Audio speeches given by famous personalities

Internet and Web Resources

https://www.grammarly.com/

https://www.bbc.co.uk/programmes/articles/5QFnVy3xzT5htTh13cmP2P8/teacher-resources

https://Ted.com

Videos and Multimedia Tutorials

https://you.tu.be/AykYRO5d_II

(GC102) Engineering Mathematics I

1. COURSE OBJECTIVE:

1. The course is aimed at providing mathematical knowledge, developing computational skills and reasoning. It also helps students to think logically and in systematic manner so as to grasp mathematical concepts easily. It helps to build analytical thinking which play an important role in solving real world problems in all scientific discipline.

2.TEACHING AND EXAMINATION SCHEME

Semester	**I**							
Course code & course title		**Periods/Week (in hours)**			**Total hours**	**Examination Scheme**		
						Theory Marks	**Term Work**	**Total Marks**
(GC102) Engg.Maths I		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**
		4	**2**	**-**	**96**	**75**	**25**	**25**	**125**

3.COURSE OUTCOMES:

GC102.CO1. Understand the basic mathematical concepts for Engineering applications.

GC102.CO2. Identify and use appropriate formulae for solving practical engineering problems

GC102.CO3. Apply formulae of algebra, geometry, trigonometry and calculus for solving problems.

GC102.CO4 . Co-relate mathematical formulae to practical problems.

4.Mapping Course Outcomes with Program Outcomes:

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

Relationship :Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

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

Unit	**Marks**	**Thr**	**CO**
1 MATHEMATICS FUNDAMENTAL	**8**	**6**	**CO1**
1.1 **Polynomials: Types** of polynomials, addition subtraction, (no question to be asked), Multiplication and division of polynomials	3	2	
1.2 **: Algebraic equations:**Different types of equations and their geometric meaning(line,circle parabola only) ,equations with one, two and three variables and solving equations with two and three variables Quadratic equations and nature of their solutions	3	2	
1.3: Logarithm: Definition of log, log with base 'e' and base'10' Properties of log, log and antilog , problems using definition and properties of log.	2	2	
2.STRAIGHT LINES AND CIRCLES	15	14	**CO1, CO4**
2.1: Straight line: Intercept, slope, intersection of lines Equations of line: 1. Slope intercept form, slope point form, two points form, parallel and perpendicular lines, angle between lines Perpendicular distance of a point from line	8	7	
2.2: Circle: circle as a locus, Centre, diameter, chord of a circle Equations of circle: Centre radius form, diameter form, general form and sums	7	7	
3. TRIGONOMETRY			**CO1, CO3**
3.1: Angle and measurement, degree and radians and conversion and related sums, arc length and area of sector and sums **3.2:** Trigonometric ratios and identities 3.3: Trigonometric ratios of compound and allied angles 3.4: Product formulae sinA$\pm$sinB, cosA$\pm$cosB **3.5:** Sum and difference formulae **3.6:** Multiple angle 2A, and their trigonometric ratios, **3.7**: Sine rule, Cosine rule in triangle, solution of triangle	12	15	
4 : MENSURATION	10	6	**CO1, CO4**
4.1: Areas of 2D figures like quadrilaterals, circle triangle etc (no questions to be asked) **4.2:** Surface area and volumes of cube, sphere, cylinder, cone, (no question to be asked)			

Surface areas and volumes of prism, pyramid, **4.3**: Frustum of cone, pyramid and their surface areas and volumes. **4.4:** Simpson's 1/3 rd rule for area and volume			
5 :CALCULUS	30	23	**CO1, CO2, CO3, CO4**
5.1:Limits 5.1.1 : Pre requisite : Sets , intervals, relation and function (no questions to be asked) 5.1.2 : Limit of a function , algebraic properties of limits 5.1.3: Limits of algebraic, trigonometric, exponential, logarithmic functions	7	6	
5.2 : Derivatives 5.2 .1: Derivative definition by first principle (no question to be asked) 5.2.2: Standard formulae, Algebraic properties of derivative (u±v) etc. 5.2.3: Derivatives of algebraic, trigonometric, exponential, logarithmic functions 5.2.4: Derivative of product of functions (uv rule). 5.2.6: Derivative of quotient of functions (u/v rule) 5.2.7: Derivative of composite functions 5.2.8: Derivative of parametric functions 5.2.9: Derivative of implicit functions 5.2.10 : Logarithmic differentiations 5.2.11: Second order derivatives (no question to be asked)	15	12	
5.3 : Applications of derivatives 5.3.1: Application to the geometry: i) derivative as a slope of a tangent ii) to find equations of tangent and normal at given point on the curve 5.3.2: Application to the Linear motion:i) displacement, velocity,acceleration 5.3.3: Application to the rate measure i) to find rate change in area and volume etc 5.3.4 : Maxima and minima	8	5	
Total	**75**	**64**	

6. COURSE DELIVERY:

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

7. SPECIFICATION TABLE FOR THEORY

Unit No	**Unit**	**Number of lectures**	**Marks**
1	**Mathematics Fundamental**	06	8
2	**Straight line and circle**	14	15
3	**Trigonometry**	15	12

4	**Mensuration**	06	10
5	**Calculus**	23	30
	Total	**64**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

- Tutorial books should be maintained by students (5 marks)
- Two home assignments per semester (5 marks)

  The Two assignments each comprises of thirty questions which includes 15 short questions and fifteen long questions. First assignment will cover fifty percent of syllabus

  and second assignment will cover remaining portion of syllabus

- Topic-wise class assignment (15 marks)

  Class assignment comprises of ten short and ten long questions.

9. LEARNING RESOURCES

Text Books

S. No.	Title of Books	Author	Publishers
1	Mathematics for Polytechnic Students(Basic Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
2	Mathematics for Polytechnic Students(Engineering Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
3	S.B. Gore, M.B.Patil, S.P. Pawar	Applied Mathematics	Vrinda Publications

Reference Books for further study

S. No.	Title of Books	Author	Publishers
1	Applied Mathematics I	Dr. U.B.Jangam, K.P. Patil, Nalini Kumthekar	Nandu Printers& Publishers pvt. Ltd. Mumbai
2	Applied Mathematics for Polytechnics	H.K. Dass	CBS Publishers and distributers Pvt.Ltd. ,Pune
3	Set Theory and related topics	Seymour Lipschutz	McGraw-Hill

(GC103) APPLIED PHYSICS-I

1.COURSE OBJECTIVE :

On successful completion of the course, Students completing the Applied Physics I course will be able to demonstrate competency and understanding of the basic concepts found in, Units and Dimensions, Kinematics of motion in one dimension Force Work Power and Energy, Circular Motion and Gravitation, Properties of Matter and Heat and will be able to utilize the knowledge to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge

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**
(GC103) Applied Physics I		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		03	**0**	**02**	**80**	**75**	**25**	**25**	**-**	**125**

3.COURSE OUTCOMES:

GC103.CO1: Understand the Fundamental concepts of physical quantities, Force, Power, Energy, Motion, Matter and heat transfer used in Engineering applications.

GC103.CO2: Explain the concepts of Dimensions, Work, Power , Energy ,Motion, properties of matter and heat transfer

GC103.CO3: Apply the Knowledge of Physical quantities, Types of motions, Force, work ,Power, properties of matter and heat transfer in Engineering applications

GC103. CO4: Analyze different types of Physical quantities, motions, properties of matter, and modes of heat transfer

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
	Basic & Discipline Specific Knowledge	**Problem Analysis**	**Design and Devlopment of Solutions**	**Engg. Tools, Experimentatn& Testing**	**Engg. Practices for Society,Sustainability& Environment**	**Project Management**	**Life -long Learning**
CO 1	3	1	1	3	2	0	3
CO 2	3	1	2	3	0	0	3
CO 3	3	1	2	2	0	1	1
CO 4	1	1	2	2	0	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Outcomes**			
Unit	**Thr**	**M**	**CO**
1 UNIT NAME: UNITS AND DIMENSIONS	**08**	**12**	**CO1, CO2, CO3, CO4**
1.1 Fundamental and Derived units ,			
1.2 Different system of units, SI unit conversion from one system to other,			
1.3 Principle of Homogeneity,			
1.4 Dimensions, dimensional formula,			
1.5 dimensonal correctness of given equation using dimensions			
1.6 least count of vernier calliper and screw gauge			
1.7 zero errors-- in case of vernier calliper and screw gauge			
1.8 Types of error.			
2. UNIT NAME: MOTION IN ONE DIMENSION, FORCE, WORK,POWER AND ENERGY	**10**	**16**	**CO1, CO2, CO3, CO4**
2.1 Distance and displacement,			
2.2 Scalar and Vectors			
2.3**,** Speed and Velocity, Uniform Velocity, ,			
2.4 Uniform acceleration,acceleration due to gravity			
2.5 Equation of motion ($v=u+at$, $v^2=u^2+2as$, $s=ut+1/2at^2$)(no derivation)			
2.6 Motion under gravity. Force and its unit.			
2.7 Work and its unit. Energy, law of conservation of energy,			
2.8. Kinetic and Potential energy equation and examples.			
3. UNIT NAME: Uniform Circular Motion and Gravitation	**10**	**16**	**CO1, CO2, CO3, CO4**
3.1 Unifrom circular motion,			
3.2 Definition angular displacement,angular velocity, ,			
3.3 Conversion from rpm to rad/sec,$v=r\omega$, tangential velocity, radial acceleration			
3.4 Centripetal force and centrifugal force, examples,			
3.5 Banking of roads,superelevation, expression for angle of banking			
3.6 Newtons law of gravitation, acceleration due to gravity ,			
3.7 Expression for acceleration due to gravity. Escape velocity, Critical velocity, and periodic time definition and expression (no derivation)			
3.8. Sattellite, types(Geosationary,communication remote sensing)			
4. UNIT NAME: PROPERTIES OF MATTER	**10**	**16**	**CO1, CO2, CO3, CO4**
4.1 Elasticity ,			
4.2 Stress, Strain,Hooke's law,			
4.3 Youngs Modulus,			
4.4 Bulk Modulus, Rigidity Modulus,			
4.5 Stress v/s Strain graph			
4.6 Yield point, breaking stress,factor of safety, ,			
4.7 Surface tension definition and example			
4.8. Adhesive and cohesive force, application,			
4.9 liquid miniscus and angle of contact, capillarity,			
4.10 Expression for surface tension (no derivation), applications. viscocity,			
4.11 Definition velocity gradient, newtons law of viscocity, terminal velocity,stokes law,			
4.12 Streamline flow and turbulent flow,critical velocity, application of viscocity.			
5. UNIT NAME: HEAT	**10**	**15**	**CO1, CO2,**
5.1 Statements of boyles law,charles law,gay lussacs law			

5.2 General gas equation,specific heat definition and unit, Latent heat definition and unit			**CO3, CO4**
5.3 Modes of transfer of heat, conduction, convection and radiation,			
5.4 Conduction of heat through a metall rod,			
5.5 Variable and Steady state			
5.6 law of thermal conductivity (With Derivation)			
5.7 Applications of thermal conductivity, ,			
5.8. Thermal expansion of solids			
5.9 linear expansion,superficial expansion,			
5.10 Cubical Expansion			
5.11 Realtion betwenn α,β,γ (no derivation)			
5.12 Engineering applications of expansion of solids.			

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	UNITS AND DIMENSIONS	8	12
2	MOTION IN ONE DIMENSION, FORCE, WORK AND ENERGY	10	16
3	UNIFORM CIRCULAR MOTION AND GRAVITATION	10	16
4	PROPERTIES OF MATTER	10	16
5	HEAT	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS

No	Practicals	Marks
1.	Basic Conversion Techniques from one system of units to the other	25
2.	Use of Vernier callipers to find the Volume of Hollow cylinder, Block	25
3.	Use of Screw gauge to find the cross-sectional area of a wire and thickness of a clip	25
4.	To find the Coefficient of Viscosity of a given liquid by stokes method	25
5.	To Find the coefficient of Thermal Conductivity by Searle's Method	25
6	To Find the Surface Tension of a given liquid by capillary rise method	25
7	To Find Young's Modulus by Searles Method	25
8	To Find acceleration due to gravity by simple pendulum method.	25
	Total (Average)	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	B G Dhande	Applied Physics of Polytechnics	Pune Vidyarthi Griha Prakashan
2	Bhandarkar	Applied Physics of Polytechnics	Vrinda publication
3	R K Gaur and S L Gupta	Engineering Physics	Dhanpat Rai & Sons Delhi
4	Dr. Vasudev R Bhagwat	A Text Book of Applied Physics for Polytechnics	Broadway Publishing House
5	B L Thereja	Engineering Technology	S. Chand

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Halliday D and Resnick	Physics Part I-II	Wiley Eastern Ltd.
2	Satish k. Gupta	ABC of Physics I&II	Modern Publisher
3	Saxena HC and Singh Prabhakar	Applied Physics Vol I & II	S. Chand Publisher

(GC104) Applied Chemistry

1. COURSE OBJECTIVE:

Chemistry is the branch of Science which deals with the study of composition, properties and changes in matter. An understanding of the basic concepts of Applied Chemistry, chemical principles and chemical properties of materials is essential to all the engineers. The emphasis is on applying the knowledge of principles of chemistry in all the fields of engineering wherein students appreciate the significance of chemistry in day to day life. The subject develops in students the habit of scientific enquiry, the ability to investigate cause and effect relationship & the ability to interpret & analyze the results.

2. TEACHING AND EXAMINATION SCHEME

Semester	**I**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits (Hours)**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GN104) Applied Chemistry		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	**-**	**2**	**80**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

GC 104.CO1: Understand the fundamental concepts of Atomic Structure, electrochemistry, water quality, corrosion and polymers.

GC 104.CO2: Explain the process of Chemical bonding, water softening, electroplating, corrosion control and polymerization

GC 104.CO3: Relate the principles of Chemical Bonding, Electrolysis, water hardness for domestic and Industrial applications and properties of polymers.

GC 104.CO4: Distinguish between types of Chemical bonding, Water softening methods, corrosion control methods, different processes of metal coating and different polymers.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimenting& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	3	2	1	1	2	1	1
CO2	2	3	2	1	3	1	2
CO3	3	2	2	2	3	1	2
CO4	3	2	2	2	2	1	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**Mks**	**Thr**	**CO**
UNIT 1.0 : ATOMIC STRUCTURE AND CHEMICAL BONDING			**15**	**10**	CO1 CO2 CO3 CO4
1.1 Atomic Structure 1.1.1 Fundamental particles and their characteristics. 1.1.2 Energy levels - Definition & designation 1.1.3 Sub Energy levels- Definition & designation					

1.1.4 Orbital – Concept & shape (s and p only) **1.2** Quantum numbers 1.2.1 Designation, definition, values.			
1.3 Electronic distribution (Elements from atomic Number 1-20) 1.3.1 Bohr – Bury's laws for distribution of electrons in shells (1st three laws only) 1.3.2 Aufbau Principle. for distribution of electrons in sub-shells 1.3.3 Pauli's Exclusion Principle. 1.3.4 Hund's Rule of maximum multiplicity 1.3.5 Orbital Electronic Configuration of elements (from atomic numbers 1 to 20 only).			
1.4 Chemical Bonding 1.4.1 Lewis and Longmuir concept of stable configuration. 1.4.2 Electrovalent - Bond - Concept Formation of Electrovalent Compound (NaCL & MgO) 1.4.3 Covalent Bond – Concept Formation of Colvalent Compounds (Cl_2, O_2, N_2) 1.4.4 Co-ordinate Bond - Concept Formation of Co-ordinate Compounds (O_3) 1.4.5 Properties of Electrovalent, Colvalent & Co-Ordinate compounds.			
UNIT 2.0 : WATER	**15**	**10**	CO1 CO2 CO3 CO4
2.1 Hardness of Water 2.1.1 Soft and Hard Water - Concept Soap Test (Chemical Equation not expected) 2.1.2 Causes of Hardness 2.1.3 Types of Hardness 2.1.4 Degree of Hardness & Units of Hardness (mg/L & ppm)			
2.2 Disadvantages of Hard Water 2.2.1 Domestic Purpose Drinking, cooking, Washing & Bathing. 2.2.2 Industrial Purpose (Paper Industry, Textile & Dyeing Industry, Sugar Industry, Bakery & Concrete Making) 2.2.3 Boilers- Steam Generation Purpose. Sludge formation – causes & Disadvantages (No chemical equation expected)			
2.3 Water Softening 2.3.1 Zeolite and Ion Exchange process of water softening			
2.4 Desalination of water 2.4.1 Electrodialysis & Reverse Osmosis process. 2.4.2 pH- Concept, pH scale & Importance of pH			
UNIT 3.0 : ELECTROCHEMISTRY	**12**	**08**	CO1 CO2 CO3
3.1 Electrolytic dissociation			

3.1.1 Arrhenius theory of Electrolytic dissociation 3.1.2 Factors affecting degree of Ionization- nature of solute, nature of solvent, concentration of solution and temperature.			CO4
3.2 Electrolysis 3.2.1 Mechanism of Electrolysis. Ionization Reactions Reactions at cathode, Activity series of Cations. Reactions at Anode, Activity series of Anions. 3.2.2 Electrolysis of Molten NaCl using Carbon Electrodes. Aqueous NaCl using Platinum Electrodes. Aqueous $CuSO_4$ using Platinum Electrodes. Aqueous CuSO4 using copper Electrodes.			
3.3 Electrochemical series – Definition and Significance			
UNIT 4.0 : CORROSION AND ITS CONTROL	**25**	**14**	CO1 CO2 CO3 CO4
4.1 Dry /Direct Chemical corrosion 4.1.1 Definition 4.1.2 Oxidation corrosion 4.1.3 Corrosion due to other gases.			
4.3 Types of Electrochemical corrosion. 4.3.1 Galvanic Cell corrosion 4.3.2 Concentration cell corrosion(Metal ion concentration & differential Aeration)			
4.4 Corrosion Control Protection of metals by: 4.4.1. Using Pure Metals & Metal alloys 4.4.2 Proper designing 4.4.3 Modifying the environment (De- aeration, Deactivation, Dehumidification, Alkaline neutralization) 4.4.4 Cathodic protection (Sacrificial anode and Impressed current cathodic protection) 4.4.5 Metal Coating (Galvanizing, Tinning, Metal-Spraying, Electroplating & powder coating)			
UNIT 5: POLYMERS	**08**	**06**	CO1 CO2 CO3 CO4
5.1 Concept of Monomers & Polymers **5.2**Polymerization- Definition. 5. 2.1 Addition polymerization-Definition. 5.2.2 General equation of polymerization of :- Ethylene to Polyethylene. Vinyl chloride to Polyvinylchloride Tetra fluoro ethylene to Poly tetra fluoroethylene(PTFE) 5.2.3 Condensation Polymerization-Definition 5.2.4 General Equation for formation of Phenol formaldehyde Resin.			

5.3 Plastics. 5.3.1 Types of plastic (Thermosetting and Thermo softening), Examples 5.3.2 Properties and applications of Poly-ethylene, PVC, polystyrene, Nylons, Bakelite & silicones.			
5.4 Rubber 5.4.1 Natural Rubber 5.4.2 Drawbacks of Crude rubber. 5.4.3 Vulcanization of Rubber (General Equation) 5.4.4 Rubber examples. 5.4.5 Properties of Synthetic Rubber & related applications.			

8. COURSE DELIVERY:

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

9. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**ATOMIC STRUCTURE AND CHEMICAL BONDING**	10	15
2	**WATER**	10	15
3	**ELECTROCHEMISTRY**	08	12
4	**CORROSION & IT'S CONTROL**	14	25
5	**POLYMERS**	06	08
	Total	**48**	**75**

10. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical
	Practical Title
1.	Double Acid-Base Titration using Phenolphthalein.
2.	Acid- Base titration using Methyl orange.
3.	Redox Titration of $KMnO_4$ soln., $FeSO_4$ soln. and Oxalic acid
4.	Determination of degree of Hardness by E.D.T.A method.
5.	Determination of Total Alkalinity of water sample.
6.	Determination of Chloride content of water sample by Mohr's method.
7.	pH- Metric titration.
8.	Conduct metric Titration.
9.	Determination of Conductivity of water samples from different water body sources.
10.	Corrosion Susceptibility of Aluminum to Acid or Base.
11.	Determination of pH of different food items.
	Total Marks: 25
	No Class room Assignments

*** Any TEN of the above.**

****Term Work Assessment Scheme**:1. Performance:15 marks (Carrying out experiment, Readings, Calculations and Results)
2.Knowledge :05 Marks(Theory of the experiment)
3. Journal : 05 Marks

11. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	M.M. Uppal	Text book of Engg. Chemistry	Khanna Publisher
2	V.P.Mehta	Text book of Engg. Chemistry	Jain Bros. Delhi
3	S.N Narkhede	Textbook of Engg. Chemistry	Niraj Prakashan
5	S S Dara	A Textbook of Engg. Chemistry	S Chand & Co
4	P.C. Jain and M.Jain	Engg. Chemistry.	Dhanpat Rai Publishing Co.

(GC105) Basic Engineering Practice (Electronics& Comp.)

1. COURSE OBJECTIVE:

The students will be able to acquire knowledge about safety aspects, firefighting, first-aid and carpentry, fitting, plumbing skills. The students will learn proper ways of using various hand tools, measuring devices in acquiring these skills and will also interpret simple electrical drawings/circuit diagrams.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(GC 106)	L	T	P	H	TH	TM	PR/OR	TW	
Basic Engineering Practice	0	0	5	80	-	-	50	100	150

3. COURSE OUTCOMES:

PART A

On successful completion of the course, the student will be able to:
GC106.CO1. Understand safety procedures to be followed in carpentry, fitting, and plumbing.
GC106.CO2. Identify various tools used for carpentry, fitting, and plumbing.
GC106.CO3: Demonstrate basic working skills in carpentry, fitting and plumbing.

GC106.CO4: Plan & execute a job/activity using job drawing.

PART B

On successful completion of the course, the student will be able to:
GC106.CO1. List the safety measures.to be observed in electrical workshop.
GC106.CO2. Identify various electrical tools, fittings used for electrical measurements & troubleshooting.
GC106.CO3: Distinguish between single phase and three phase supply.

GC106.CO4: Plan & execute a job/activity from electrical circuit drawing.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

PART A

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	2	1	1	3	2	2	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-3

PART B

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	3	1	1	2	2	1	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | Hr = Practical Hours | CO = Course Outcomes

Unit	M	Hr	CO
1 General Safety, Housekeeping, Fire Fighting & First Aid	10	06	
1.1Introduction to General Safety aspects of engineering workshop 1.2 Meaning and importance of housekeeping. 1.3 Fire hazards, fire triangle, types of fire extinguishers – selection and use. 1.4Basic knowledge of first aid with specific inputs on cuts, burns, electric shocks, artificial respiration, handling emergencies.			CO1
2 Fitting Workshop Practice	30	18	
2.1 Introduction to the trade. 2.2 Introduction to various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools 2.3 Types of files and filing methods. 2.4 Drill bits and drilling Processes, using portable and pillar drilling machine. 2.5 Operations performed in fitting shop such as measuring, marking, chipping, filing, grinding, sawing, drilling			CO1 CO2 CO3

2.6 Threading using taps and dies.			
3 Carpentry Workshop Practice	20	18	
3.1 Introduction to carpentry 3.2 Types of wood and its characteristics, forms of wood, defects in timber and its identification, wood working hand tools 3.3 Wood working processes. 3.4 Different types of joints and their usage. 3.5 Introduction to wood working machines: 3.6 Lathe 3.7 Circular saw 3.8 Band saw 3.9 Wood planner 3.10 Universal wood working machine			CO1 CO2 CO3
4 Electrical Workshop Practice	30	32	
4.1 Brief introduction to power distribution and Electrical Safety. 4.2 Use of different hand tools used in electrical trade 4.3 Collection of details of motors and transformers. 4.4Introduction to Control Panel and its various sections/components. 4.5 Making of wire joints. 4.6Measurement of current, voltage, frequency and Power Consumption. 4.7 Connecting and starting of Induction Motor & Measurement of its speed. Changing of Direction of rotation of induction motor. 4.8 Introduction to commonly used electrical Fittings (Domestic & Industrial). 4.9Wiring of Simple Electric Circuit (Bulb & plug point and switches) on wooden board 4.10 Study, connection & use of Energy Meter 4.11Testing of components using Series test lamp & Multimeter 4.12Study of Fuses & practice replacement of Fuse 4.13 Study & Troubleshooting of Tube Light			CO1 CO2 CO3 CO4
5 Plumbing	10	06	
5.1Plumbing tools, pipe fittings and method of joining pvc pipes. 5.2 Use of spirit level and plumb bob. 5.3 Minor repairs and replacement of fittings. 5.4 Reading of plumbing drawings. *[Note: Plumbing restricted to domestic plumbing and pvc piping.]*			CO1 CO2 CO3
Total	**100**	**80**	

6. COURSE DELIVERY:

The Course will be delivered through workshop practical sessions in mechanical and electrical workshops.

7. SPECIFICATION TABLE FOR PRACTICALS/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of hrs.**	**Marks**
1	General Safety, Housekeeping, Fire Fighting & First Aid	06	10
2	Fitting Workshop Practice	18	30
3	Carpentry Workshop Practice	18	20
4	Electrical Workshop Practice	32	30
5	Plumbing	06	10
	Total	80	100

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Hrs.
1	**General Safety, Housekeeping, Fire Fighting & First Aid**	**06**
a	Demonstration on use of Safety Measures while working in Workshop and use of safety signs.	03
b	Demonstration on use of First Aid and Artificial Respiration procedure ,Training on fire and emergency services (using video presentation /fire and safety expert talk)	03
2	**Fitting Workshop Practice**	**18**
a	Identification of various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools	03
b	Identification of various types of files and demonstration on filing methods.	03
c	Identification of various types of Drill bits, taps, dies and Drilling machines such as portable and Pillar Drilling machine.	03
d	Job involving filing, marking, cutting operation on MS Flat.	06
e	Job involving Drilling and Tapping operation on MS flat.	03
3	**Carpentry Workshop Practice**	**18**
a	Identification of various types of woods and wood working hand tools	03
b	Identification of various types of Carpentry joints and their usage.	03
c	Introduction to wood working machines such as wood working Lathe, Circular saw ,Band saw, Wood planner, Universal wood working machine	03
d	Job involving marking, measuring, planning, sawing, chiseling, joint preparation and assembly of wooden blocks.	06
e	Preparation of job on wood working lathe.	03
4	**Electrical Workshop Practice**	**32**
a	Measurement of Single Phase and Three Phase supply Voltage using multimeter.	02
b	Identification of various hand tools used in electrical trade.	02
c	Measurement of electric circuit parameters using Ammeter, Voltmeter, Frequency meter, Wattmeter.	04
d	Making of Straight and T wire joints.	02
e	Testing of electrical components such as Choke, starter, Fuse, Switch using Series Test lamp and Multimeter	02
f	Starting of induction motor using DOL Starter	02
g	Reversal of direction of rotation of Three phase induction motor	02
h	Identification of commonly used electrical fittings.	02
i	Wiring of simple electrical circuit using bulb and socket.	04
j	Measurement of Energy using Energy Meter.	02
k	Identification of Different types of Fuses and their replacement in circuit.	02
l	Testing of various components and connection of Tube light circuit.	02
m	Collecting Name plate Details of Motors and Transformers and operating and controlling speed of motor from Control panel.	04
5	**Plumbing**	**06**
a	Identification of Plumbing tools and pipe fittings , Reading of plumbing drawings, methods of joining PVC pipes, use of spirit level and plumb bob in piping.	03
b	To carry out minor repairs and replacement of fittings.	03

9. LEARNING RESOURCES

TEXT BOOKS

S. No.	Author	Title of Books	Publishers
1	N. Sesha Prakash	Manual of Fire Safety	CBS Publishers and Distributers
2	S.K. Hajara-Chaudhary	Workshop Technology	Media Promoters
3	B.S. Raghuwanshi	Workshop Technology-	Dhanpat Rai and sons, New Delhi
4	R K Jain-	Production Technology	Khanna Publishers, New Delhi
5	H. S .Bawa	Workshop Technology	Tata McGraw Hill Publishers, New Delhi
6	Kent	Mechanical Engineering Hand book	John Wiley and Sons, New York
7	B.L. Theraja	Fundamentals of Electrical Engineering and Electronics	S. Chand – New Delhi

REFERENCE BOOKS FOR FURTHER STUDY

S. No.	Author	Title of Books	Publishers
1	CIMI- Central Instructional Media Institute Madras	Turner – Trade Theory – Ist and IInd Year	Wiley Eastern Ltd. New Delhi

(GC106) Basic Engineering Practice (Mech & Elect.)

1. COURSE OBJECTIVE:

The students will be able to acquire knowledge about safety aspects, firefighting, first-aid and carpentry, fitting, plumbing skills. The students will learn proper ways of using various hand tools, measuring devices in acquiring these skills and will also interpret simple electrical drawings/circuit diagrams.

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	PR/OR	TW	
(GC 106) Basic Engineering Practice	0	0	5	80	-	-	50	75	125

3. COURSE OUTCOMES:

PART A

On successful completion of the course, the student will be able to:
GC106.CO1. Understand safety procedures to be followed in carpentry, fitting, and plumbing.
GC106.CO2. Identify various tools used for carpentry, fitting, and plumbing.
GC106.CO3: Demonstrate basic working skills in carpentry, fitting and plumbing.

GC106.CO4: Plan & execute a job/activity using job drawing.

PART B

On successful completion of the course, the student will be able to:
GC106.CO1. List the safety measures.to be observed in electrical workshop.
GC106.CO2. Identify various electrical tools, fittings used for electrical measurements & troubleshooting.
GC106.CO3: Distinguish between single phase and three phase supply.

GC106.CO4: Plan & execute a job/activity from electrical circuit drawing.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

PART A

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	2	1	1	3	2	2	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-3

PART B

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	3	1	1	2	2	1	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Hr = Practical Hours** | **CO = Course Outcomes**			
Unit	**M**	**Hr**	**CO**
1 General Safety, Housekeeping, Fire Fighting & First Aid		06	
1.1Introduction to General Safety aspects of engineering workshop 1.2 Meaning and importance of housekeeping. 1.3 Fire hazards, fire triangle, types of fire extinguishers – selection and use. 1.4Basic knowledge of first aid with specific inputs on cuts, burns, electric shocks, artificial respiration, handling emergencies.			CO1
2 Fitting Workshop Practice		18	
2.7 Introduction to the trade. 2.8 Introduction to various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools 2.9 Types of files and filing methods. 2.10 Drill bits and drilling Processes, using portable and pillar drilling machine. 2.11 Operations performed in fitting shop such as measuring, marking, chipping, filing, grinding, sawing, drilling 2.12 Threading using taps and dies.			CO1 CO2 CO3
3 Carpentry Workshop Practice	20	18	
3.10 Introduction to carpentry 3.11Types of wood and its characteristics, forms of wood, defects in timber and its identification, wood working hand tools 3.12 Wood working processes. 3.13 Different types of joints and their usage. 3.14 Introduction to wood working machines: a. Lathe b. Circular saw c. Band saw d. Wood planner e. Universal wood working machine			CO1 CO2 CO3
4 Electrical Workshop Practice	30	32	
4.1 Brief introduction to power distribution and Electrical Safety. 4.2 Use of different hand tools used in electrical trade 4.3 Collection of details of motors and transformers. 4.4 Introduction to Control Panel and its various sections/components. 4.5 Making of wire joints. 4.6Measurement of current, voltage, frequency and Power Consumption. 4.7 Connecting and starting of Induction Motor & Measurement of its speed. Changing of Direction of rotation of induction motor. 4.8 Introduction to commonly used electrical Fittings (Domestic & Industrial). 4.9Wiring of Simple Electric Circuit (Bulb & plug point and switches) on wooden board 4.10 Study, connection & use of Energy Meter 4.11Testing of components using Series test lamp & Multimeter 4.12Study of Fuses & practice replacement of Fuse 4.13 Study & Troubleshooting of Tube Light			CO1 CO2 CO3 CO4
5 Plumbing		06	

5.1 Plumbing tools, pipe fittings and method of joining pvc pipes. 5.2 Use of spirit level and plumb bob. 5.3 Minor repairs and replacement of fittings. 5.4 Reading of plumbing drawings. *[Note: Plumbing restricted to domestic plumbing and pvc piping.]*			CO1 CO2 CO3
Total		**80**	

6. COURSE DELIVERY:

The Course will be delivered through workshop practical sessions in mechanical and electrical workshops.

7. SPECIFICATION TABLE FOR PRACTICALS/ MACRO-LESSON PLAN

Unit No	Unit	Number of hrs.	Marks
1	General Safety, Housekeeping, Fire Fighting & First Aid		10
2	Fitting Workshop Practice		30
3	Carpentry Workshop Practice		20
4	Electrical Workshop Practice		30
5	Plumbing		10
	Total		100

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Hrs.
1	**General Safety, Housekeeping, Fire Fighting & First Aid**	**06**
a	Demonstration on use of Safety Measures while working in Workshop and use of safety signs.	03
b	Demonstration on use of First Aid and Artificial Respiration procedure ,Training on fire and emergency services (using video presentation /fire and safety expert talk)	03
2	**Fitting Workshop Practice**	**18**
a	Identification of various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools	03
b	Identification of various types of files and demonstration on filing methods.	03
c	Identification of various types of Drill bits, taps, dies and Drilling machines such as portable and Pillar Drilling machine.	03
d	Job involving filing, marking, cutting operation on MS Flat.	06
e	Job involving Drilling and Tapping operation on MS flat.	03
3	**Carpentry Workshop Practice**	**18**
a	Identification of various types of woods and wood working hand tools	03
b	Identification of various types of Carpentry joints and their usage.	03
c	Introduction to wood working machines such as wood working Lathe, Circular saw ,Band saw, Wood planner, Universal wood working machine	03
d	Job involving marking, measuring, planning, sawing, chiseling, joint preparation and assembly of wooden blocks.	06
e	Preparation of job on wood working lathe.	03
4	**Electrical Workshop Practice**	**32**
a	Measurement of Single Phase and Three Phase supply Voltage using multimeter.	02
b	Identification of various hand tools used in electrical trade.	02
c	Measurement of electric circuit parameters using Ammeter, Voltmeter,	04

	Frequency meter, Wattmeter.	
d	Making of Straight and T wire joints.	02
e	Testing of electrical components such as Choke, starter, Fuse, Switch using Series Test lamp and Multimeter	02
f	Starting of induction motor using DOL Starter	02
g	Reversal of direction of rotation of Three phase induction motor	02
h	Identification of commonly used electrical fittings.	02
i	Wiring of simple electrical circuit using bulb and socket.	04
j	Measurement of Energy using Energy Meter.	02
k	Identification of Different types of Fuses and their replacement in circuit.	02
l	Testing of various components and connection of Tube light circuit.	02
m	Collecting Name plate Details of Motors and Transformers and operating and controlling speed of motor from Control panel.	04
5	**Plumbing**	**06**
a	Identification of Plumbing tools and pipe fittings , Reading of plumbing drawings, methods of joining PVC pipes, use of spirit level and plumb bob in piping.	03
b	To carry out minor repairs and replacement of fittings.	03

9. LEARNING RESOURCES

TEXT BOOKS

S. No.	Author	Title of Books	Publishers
1	N. Sesha Prakash	Manual of Fire Safety	CBS Publishers and Distributers
2	S.K. Hajara-Chaudhary	Workshop Technology	Media Promoters
3	B.S. Raghuwanshi	Workshop Technology-	Dhanpat Rai and sons, New Delhi
4	R K Jain-	Production Technology	Khanna Publishers, New Delhi
5	H. S .Bawa	Workshop Technology	Tata McGraw Hill Publishers, New Delhi
6	Kent	Mechanical Engineering Hand book	John Wiley and Sons, New York
7	B.L. Theraja	Fundamentals of Electrical Engineering and Electronics	S. Chand – New Delhi

REFERENCE BOOKS FOR FURTHER STUDY

S. No.	Author	Title of Books	Publishers
1	CIMI- Central Instructional Media Institute Madras	Turner – Trade Theory – Ist and IInd Year	Wiley Eastern Ltd. New Delhi

(GC201) ENGINEERING MATHEMATICS II

1. COURSE OBJECTIVE:

The course is aimed at providing mathematical knowledge, developing computational skills and reasoning. It also helps students to think logically and in systematic manner so as to grasp mathematical concepts easily. It helps to build analytical thinking which play an important role in solving real world problems in all scientific discipline.

2. TEACHING AND EXAMINATION SCHEME

Semester	**II**								
Course code & course title		**Periods/Week (in hours)**			**Total hours**	**Examination Scheme**			
						Theory Marks		**TERM WORK**	**Total Marks**
(GC201) Engineering Mathematics II		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**
		4	**2**	**-**	**96**	**75**	**25**	**25**	**-**	**125**

3.COURSE OUTCOMES:

GC201.CO1: Understand the basic principles of Matrices ,Integration, Determinants and Vectors in engineering problems.
GC201.CO2: Interpret the formulae to solve problems of Matrices ,Integration, Determinants and Vectors.
GC201.CO3: Apply appropriate mathematical methods for solving engineering problems.
GC201.CO4: Analyse the knowledge of Matrices ,Integration, Determinants and Vectors for various Engineering applications.

4. Mapping Course Outcomes with Program Outcomes

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

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

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

Unit	**Marks**	**Thr**	**CO**
1 .DETERMINANTS AND MATRICES	**15**	**12**	**CO1, CO2, CO4**
1.1 **Determinants**: Definition & order of determinant, value of determinant, properties of determinants(no question), Cramer's rule for solving equations with two & three variables	7	4	
1.2 **Matrices**: - Definition & order of matrix, types of matrices, Equality of matrices, addition & subtraction, multiplication of matrices, adjoint & inverse of a matrix , solution of linear	8	8	

equations with two & three variables using matrices			
2 .INTEGRATION	20	22	**CO1, CO2, CO4**
Definition, Standard Formulae, properties of Integration for sum, difference and scalar multiplication, integration of algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, composite function, Integration by substitution, integration by partial fraction, integration by parts			
3 .DEFINITE INTEGRALS	10	08	**CO3**
Definition of definite integral and Properties of definite integral ,integration by parts Applications:Area under the curves & lines and area between the curves and Volumes (simple problems)			
4 .VECTORS	15	12	**CO1, CO2, CO4**
Definition of scalars & vectors, equality of vectors, Addition & subtraction of vectors, triangle, parallelogram laws for addition, position vector, dot product & cross product and their properties and applications, relation between dot and cross product and scalar triple product and applications			
5 .STATISTICS / COMPLEX NUMBERS	15	10	**CO3**
Statistics : **(ME and Allied courses only)** 5.1:Measures of central Tendency -mean, median, mode for ungrouped & grouped data 5.2:Measures of dispersion –Range, mean deviation, standard deviation, variance, coefficient of variation 5.3: Corrected mean and relation between standard deviation and mean.			**CO3**
5.Complex Numbers (electronics and Allied courses only) 5.1:Definition of complex number and Argand diagram, equality of complex numbers, 5.2:powers of 'i' ,complex conjugates, 5.3:Addition& subtraction of complex nos. Multiplication& division of complex nos. 5.4: Modulus and argument of a complex number 5.5:Polar form & exponential form of complex no. 5.6: De Moivre's theorem., nth root of complex nos. 5.7:Hyperbolic, exponential, circular functions			
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 (GC201)

Unit No	Unit	Number of lectures	Marks
1	**Determinants & Matrices**	12	15
2	**Integration**	22	20
3	**Definite Integrals**	08	10
4	**Vectors**	12	15
5	**Statistics /Complex Number**	10	15
	Total	**64**	**75**

- Tutorial books should be maintained by students (5 marks)
- Two home assignments per semester (5 marks)

  The Two assignments each comprises of thirty questions which includes 15 short questions and fifteen long questions. First assignment will cover fifty percent of syllabus

  and second assignment will cover remaining portion of syllabus
- Topic-wise class assignment (15 marks)

  Class assignment comprises of ten short and ten long questions.

9. LEARNING RESOURCES

Text Books /reference books

S. No.	Title of Books	Author	Publishers
1	Mathematics for Polytechnic Students(Basic Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
2	Mathematics for Polytechnic Students(Engineering Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
3	Applied Mathematics	S.B. Gore, M.B.Patil, S.P. Pawar	Vrinda Publications

Reference Books for further study

S. No.	Title of Books	Author	Publishers
1	Applied Mathematics I	Dr. U.B.Jangam, K.P. Patil, Nalini Kumthekar	Nandu Printers& Publishers Pvt. Ltd. Mumbai
2	Applied Mathematics for Polytechnics	H.K. Dass	CBS Publishers & Distributers Pvt. Ltd. Pune
3	Advanced Engineering mathematics	H.K. Dass	S. Chand

(GC 202) APPLIED PHYSICS- II

1. COURSE OBJECTIVE:

On successful completion of the course, Students completing the Applied Physics II course will be able to demonstrate competency and understanding of the basic concepts found in, Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light and Optics and Sound, and will be able to utilize the knowledge to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge.

2.TEACHING AND EXAMINATION SCHEME

Semester	**II**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GC202) Applied Physics- II		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		03	**0**	**02**	**80**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

GC202.CO1: Understand the Fundamental Concepts of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound.
GC202.CO2: Explain the basic principles of Electrostatics, Current Electricity, Electromagnetism and Electro Magnetic Induction, Light , Optics and sound.
GC202.CO3: Apply the knowledge of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound to specific applications.
GC202.CO4: Compute various parameters in the field of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound.

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
	Basic & Discipline Specific Knowledge	**Problem Analysis**	**Design and Devlopment of Solutions**	**Engg. Tools, Experimentatn & Testing**	**Engg. Practices for Society,Sustain ability& Environment**	**Project Management**	**Life -long Learning**
CO 1	3	3	1	1	2	0	3
CO 2	3	3	1	1	2	0	2
CO 3	3	2	3	3	3	1	1
CO 4	2	2	2	3	1	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

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

Unit	**M**	**Thr**	**CO**
1 UNIT NAME: ELECTROSTATICS	**12**	**8**	**CO1, CO2, CO3, CO4**
1.1 Coulomb's law, Electric field,			
1.2 Electric field Intensity, Electric lines of force and properties			
1.3 Electric potential, Definition of Absolute potential			
1.4, Potential difference, Potential of sphere,			

1.5 Potential of earth.			
1.6 Capacitance,			
1.7 Capacitors in Parallel Derivation of Expression			
1.8. Capacitor in series Derivation Of Expression			
2. UNIT NAME: CURRENT ELECTRICITY	**20**	**12**	**CO1, CO2, CO3, CO4**
2.1 Definition of Electric Current and its Unit, Ohm's Law, Resistance,			
2.2 Factors on which resistance depends, Specific resistance. Effect of temperature on resistance Temperature coefficient of resistance,			
2.3 Resistances in Series and parallel			
2.4 EMF and Internal resistance of cell			
2.5 General Equation of ohm's law.			
2.6. Wheatstone's Network and Principle of Meter Bridge			
2.7 Principle of Potentiometer (Vα L) and Applications to compare EMF of given cells by single cell method and sum difference method			
2.8 Determination of Internal resistance of a cell using potentiometer.			
2.9 Electric Power and Electric Energy, KWh			
2.10 Calculation of Energy bills			
2.11 Heating Effect of Electric current. Joule's law.			
2.12 Applications in house hold appliances			
3. **UNIT NAME: ELECTROMAGNETISM AND EM INDUCTION**	**16**	**10**	**CO1, CO2, CO3, CO4**
3.1 Magnet, Magnetic field, Magnetic flux, and magnetic flux density and its unit			
3.2 Magnetic effect of Current, Oersted's Experiment, Right hand Thumb Rule, Biot Savart law			
3.3 Magnetic field at the center of the coil (no derivation), Magnetic field due to coil (Qualitative discussion only			
3.4 Electromagnet. Force acting on a current carrying conductor placed in magnetic field and expression (no derivation)			
3.5 Fleming's left-hand rule. Electromagnetic Induction. Faraday's Experiment			
3.6. Faraday's laws Lenz's law. Self-Induction and Mutual Induction.			
3.7 Transformer Principle.			
3.8 Step up and Step-down transformer.			
3.9 Induction Heating			
3.10 Induction heater and uses			
4. **UNIT NAME: LIGHT AND OPTICS**	**16**	**10**	**CO1, CO2, CO3, CO4**
4.1 Frequency Range of Infrared, ultraviolet and visible light and their uses			
4.2 Reflection, Refraction, Snell's law, refractive index.			
4.3 Refraction through glass slab and prism.			
4.4 Total Internal reflection applications in optical fibers.			
4.5 Advantages of optical fibers. LASER, sources and applications.			
4.6. Luminous Intensity, Intensity of Illumination			
4.7 Inverse square law of Illumination (No derivation)			
4.8 Principle of Photometry, X rays,			
4.9 Production of X Rays by Coolidge tube			
4.10 Properties and applications			
5. **UNIT NAME: SOUND**	**11**	**08**	**CO1, CO2, CO3,**
5.1 Sound as longitudinal wave,wavelength,frequency,time period, amplitude,			

5.2 Free vibration force vibration,resonance, examples,			**CO4**
5.3 Echo reverberation ,pitch loudeness,intensity of sound,			
5.4 Ultrasonic waves, Piezo electric effect, Principle of Production of ultra-sonics waves			
5.5 Application of Ultra sonics in finding depth of sea,			
5.6. Detection of flaws in metal, soldering, Drilling,			
5.7 Ultrasonic Cleaning			
5.8Ultrasound for medical purposes.(Just Uses)			

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	ELECTROSTATICS	8	12
2	CURRENT ELECTRICITY	12	20
3	ELECTROMAGNETISM AND EM INDUCTION	10	16
4	LIGHT AND OPTICS	10	16
5	SOUND	8	11
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS

No	Practicals	Marks
1.	Specific Resistance by Ammeter Voltmeter Method	25
2	Specific Resistance by Meter Bridge Method	25
3	To Verify the Series Law of Resistance by Meter Bridge Method	25
4	To Verify the Parallel Law of Resistance by Meter Bridge Method	25
5	To Compare the emf of two cells by single cell method	25
6	To find the internal resistance of a cell by Potentiometer Method	25
7	To find the velocity of sound by Resonance Tube method	25
8	To find the Refractive index	25
	Total (Average)	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	B G Dhande	Applied Physics of Polytechnics	Pune Vidyarthi Griha Prakashan
2	Bhandarkar	Applied Physics of Polytechnics	Vrinda publication
3	R K Gaur and S L Gupta	Engineering Physics	Dhanpat Rai & Sons Delhi
4	Dr. Vasudev R Bhagwat	A Text Book of Applied Physics for Polytechnics	Broadway Publishing House
5	B L Thereja	Engineering Technology	S. Chand

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Halliday D and Resnick	Physics Part I-II	Wiley Eastern Ltd.
2	Satish k. Gupta	ABC of Physics I&II	Modern Publisher
3	Saxena HC and Singh Prabhakar	Applied Physics Vol I & II	S. Chand Publisher

(GC203) ENVIRONMENTAL STUDIES

1. COURSE OBJECTIVE:

Environment is the nurturing force upon which we depend. It decides our well being, our health & quality of our life. The environment is deteriorating at an alarming rate due to increasing human activity and can be saved only by timely human action. The aim of Environmental studies is to sensitize the students towards the need to conserve & protect natural resources & biological support systems. With the aim to develop an attitude of concern for the environment the students will learn to choose environmentally friendly options for sustainable development and live in harmony with nature.

2. TEACHING AND EXAMINATION SCHEME :

Semester	**I**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GC203) Environmental Studies		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		04	**-**	**-**	**64**	**75**	**25**	**-**	**-**	**100**

3. COURSE OUTCOMES:

GC203.CO1: Understand the role and importance of various elements of Environment.
GC203.CO2: Identify the concerns related to the natural resources, ecosystems, biodiversity, pollution and social issues of environment.
GC203.CO3: Develop sensitivity towards Environmental issues.
GC203.CO4: Co-relate causes affecting the environment & biodiversity.

4. Mapping Course Outcomes with Program Outcomes :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentation	Engg. Practices for Society,Sustainability	Project Management	Life -long Learning
CO1	2	1	1	0	3	2	2
CO2	2	1	1	0	3	2	2
CO3	1	1	1	0	3	2	2
CO4	1	1	2	0	3	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**Mks**	**Thr**	**CO1, CO3, CO4**
UNIT 1.0 : Multidisciplinary Nature of Environmental Studies	**09**	**08**	
1.1 Environmental studies : Definition , Scope and Importance			
1.2 Need for Public Awareness			
1.3 Environment & Human Health			
1.4 Environmental Ethics			
1.5 Value Education			
1.6 From Unsustainable to Sustainable Development : Concept and Guidelines			
1.7 Concept of Environmental Audit (EA) Environment Impact Assessment (EIA)			
1.8 Ecological Foot Prints			
UNIT 2.0 : ECOSYSTEM AND BIODIVERSITY	**15**	**13**	**CO1, CO2, CO3, CO4**
2.1 Ecosystem 2.1.1Concept, Structure & functions of ecosystem (Function of producer, consumer and decomposer) 2.1.2 Food chain & Food web- Concept & Examples 2.1.3 Energy flow in Ecosystem 2.1.4 Ecological Pyramids (Inverted & Upright) Pyramid of Number, Biomass & Energy. 2.1.5 Ecological Succession (Primary & Secondary Succession) 2.1.6 Study of Ecosystem: characteristic features structure and functions) Terrestrial(Forest, Grassland, Desert) Aquatic(Pond, River & Ocean)			
2.2 Biodiversity 2.2.1 Definition of Biodiversity 2.2.2. Types of Diversity (Genetic, Species & Ecosystem) 2.2.3. Value of Biodiversity (Consumptive , Productive, Social ,Aesthetic Moral & Optional value) 2.2.4 India as a Mega- diversity Nation 2.2.5 Biogeographical classification of India 2.2.6 Extinct, Endangered, Threatened & Endemic Species -Examples (of India) 2.2.7 Threats to Biodiversity (Habitat loss, Poaching of Wild life & Man Wildlife Conflict) 2.2.8 Reasons for loss of Biodiversity 2.2.9 Conservation of Biodiversity (Insitu & Exsitu conservation)			
UNIT 3.0 : NATURAL RESOURCES	**18**	**15**	**CO1, CO2, CO3, CO4**
3.1 <u>Forest Resource</u> 3.1.1 Direct & Indirect value of Forest 3.1.2 Deforestation-causes & effects 3.1.3 Forest Management **3.2** <u>Water Resource</u> 3.2.1 Water as a scarce Resourc 3.2.2Use and over exploitation of surface and ground water 3.2.3 Need for Water Conservation			

3.2.4 Construction of dams- Benefits and draw backs (Rehabilitation & Resettlement of people) 3.2.5 Rain water Harvesting. 3.2.6 Watershed Management 3.2.7 Conflicts over water in India **3.3** Energy Resource 3.3.1 Renewable & Non-Renewable sources of Energy 3.3.2 Growing Energy Needs. 3.3.3 Alternate Source of Energy (Solar ,Wind, Bio, Geothermal, Hydro & Nuclear Energy)				
3.4 Food Resource 3.4.1 Sources of Food 3.4.2 World Food Problems (Undernourishment & Malnourishment) 3.4.3 Changes caused by agriculture & overgrazing 3.4.5 Effects of modern agriculture on environment (use of synthetic fertilizers & synthetic pesticides in agriculture) **3.5** Mineral Resource 3.5.1 Types of Minerals 3.5.2 Use & Overexploitation of Minerals 3.5.3 Environmental Impact of Mining. **3.6** Land Resource 3.6.1 Pattern of Land Utilization (In India and World) 3.6.2 Land Degradation – Causes & Control Measures				
UNIT 4.0 : ENVIRONMENTAL POLLUTION- Sources , Effects & Control Measures	**24**	**20**		
4.1 Air Pollution 4.1.1 Definition, sources of air pollution(Primary and Secondary air pollutants with examples) 4.1.2 Effects on human health, animals, plants & Materials 4.1.3 Control of Air Pollution. 4.1.4 Removal of Particulate matter 4.1.5 Principles & Application of Control Equipments (Gravity and Inertial Separators, Cyclones, Filters, Electrostatic precipitators, Wet scrubbers) 4.1.6 Removal of Gaseous Pollutants (Combustion, Adsorption, Absorption) 4.1.7 Global Issues Definition, Cause & effects of Green House effect & Global Warming. Ozone layer Depletion, Acid Rain.				**CO1, CO2, CO3, CO4**
4.6 Noise Pollution :- 4.6.1 Definition. 4.6.2 Sources of Noise Pollution 4.6.3 Effects of Noise Pollution on Human health (Noise Induced hearing loss, Physiological & Psychological Effects) 4.6.4 Control of Noise Pollution.				

4.7. Nuclear Pollution / Radioactive Pollution:- 4.7.1 Definition 4.7.2. Sources of nuclear Pollution (Natural & Man made) 4.7.3. Effects of Nuclear Pollution 4.7.4. Control of Nuclear Pollution 4.7.5.Disposal of Nuclear waste (Low, Medium & High activity waste) 4.7.6 Nuclear Accidents & Holocaust – case study			
4.8 Solid Waste Pollution. Definition: Refuse, Garbage Sources of Solid waste Types of solid waste (MSW, HW, BMW & EW) Effects of Consumerism Segregation of Solid waste at source Treatment of MSW (Open dumping, Land filling, incineration & composting) Waste Utilization (Reuse, Reclaim & Recycle) Solid waste Management System – Flow sheet diagram **4.9** Role of an Individual in Prevention of Pollution.			
UNIT 5.0 : **SOCIAL ISSUES & ENVIRONMENT**	**09**	**08**	**CO2, CO3, CO4**
5.1 Environmental Legislation Article 47 & Article 51-A(g)of the constitution on Environment. 5.1.1 Protection Functions of Ministry of Environment and Forest Govt. of India Objectives & Functions of Central & state pollution Control Boards Environmental Protection Act. Air (Prevention & Control of Pollution) Act. Water (Preventation & Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Motor vehicle Act.			
5.2 Social Issues 5.2.1Women & Child Welfare 5.2.2 Role of IT in Environment & Human Health 5.2.3 AIDS 5.2.4 Population Growth & Variation among Nations 5.2.5 Human Rights			

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	**MULTI-DISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES**	08	09
2	**ECOSYSTEM AND BIODIVERSITY**	13	15
3	**NATURAL RESOURCES**	15	18
4	**ENVIRONMENTAL POLLUTION**	20	24
5	**SOCIAL ISSUES & ENVIRONMENT**	08	09
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Erach Bharucha	Textbook of Environmental Studies	Universities Press (India) Private Ltd.
2	Dr. Suresh K. Dhameja	Environmental studies	S.K. Kataria & Sons
3	Y. Anjaneyulu	Introduction to Environmental Science	B.S Publications
4	S. Deswal & A. Deswal	A Basic Cource in Environmental Studies	Dhanpat Rai & Co.
5	P. Meenakshi	Elements of Environmental Science and Engineering	Prentice Hall of India (PHI)

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Pandya and Camy	Environmental Engineering	Tata McGraw Hill
2	Asthana D.K. and Asthana Meera	Environmental Problems and Solutions	S. Chand & Co.
3	Gilbert M. Masters	Introduction to Environmental Engineering and Science.	Prentice Hall of India (PHI)
4.	M N Rao & HVN Rao	Air Pollution	Tata McGraw Hill

FIELD ACTIVITIES (OPTIONAL)

1. Visit to Selaulim/ Anjunem Dam.
2. Visit to show Hill cuttings, mining areas.
3. Visit to show Rain water harvesting project / Vermicomposting plant / watershed management project. (Krishi Vigyan Kendra – Old Goa)
4. Visit to Garbage treatment plant.

*__On Completion of visit Report to be submitted.__

(GC204) ENGINEERING DRAWING

1. Course Objective: Drawing is a graphical language of engineering field. Engineering technician irrespective of his/her field of operation in an industry is expected to possess a thorough understanding of drawing, which includes visualization of objects and the proficiency in reading and interpreting a wide variety of engineering drawings. It is the skill, which translates an engineering idea into lines and dimensions. Besides this he/she is also expected to possess a certain degree of drafting skills- depending upon his/her job.

2. **TEACHING AND EXAMINATION SCHEME:**

Course Code & Course Title	**Periods/ Week (In Hours)**			**Total Hours**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
(GC204)	**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
Engineering Drawing	-	-	5	80	-	-	50	50	**100**

3. Course Outcomes:

On successful completion of the course the student will be able to:
GC204.CO1: Understand different methods of projection, sectioning of solids and development of surfaces.
GC204.CO2: Select the relevant procedural methods for preparing Engineering Drawing.
GC204.CO3: Draw Isometric views and orthographic projection of full and sectioned objects and development of surfaces
GC204.CO4: Examine and Interpret Engineering Drawings

4. Mapping Course Outcomes with Program Outcomes

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	Basic and discipline specific knowledge	Problem analysis	Design & development of solution	Engg tools exptn and & testing	Engg Practice for society,sustainability and environment	Project management	Lifelong learning
CO1	3	2	1	3	1	1	1
CO2	3	1	2	3	1	2	2
CO3	2	2	2	3	1	2	2
CO4	2	2	2	2	1	2	3

5. Detailed course Contents/ Micro lesson plan

M=Marks Prhr= Teaching Hrs CO=Course Outcomes

Unit	Mark	Prhr	CO
1. Introduction 1.1 Importance of engineering drawing as a means of communication. 1.2 Planning of drawing sheet as per SP 46(latest revision) 1.3 Indian standard practices of laying out and folding of drawing 1.4 Different types of lines used in engineering drawing. 1.5 Importance of scale in Engineering Drawings. 1.6 Lettering 1.7 Methods of dimensioning, Dimensioning terms and notation -use of SP 46(latest revision), General rules for dimensioning, Dimensioning of cylinder, holes, arcs of circle, narrow space, angles, countersunk hole, taper.	05	05	CO2
2. Geometrical construction & Engineering Curves 2.1Construction of an Equilateral and Isosceles triangle, Square, Regular pentagon & Regular hexagon given length of a side using general method of construction 2.2Construction of Engineering curves like: Ellipse- by focus & directrix method and arcs of circles method Parabola- by focus & directrix method and rectangle method Hyperbola- Focus and directrix method 2.3 Cycloid- by generating circle rolling on a straight line 2.4 Involutes of a circle. 2.5 Draw normal & tangents to the above curves from given point on the curve Curves to be explained with the help of applications.	05	15	CO2
3. Orthographic projection 3.1 Definitions of various terms associated with orthographic projections. Planes of projections. Concept of Quadrants. 3.2 First and third angle method of projection. 3.3 Projection of points 3.4Projection of lines Parallel to both Principal planes	18	30	CO1, CO2, CO3, CO4

Parallel to one and Perpendicular to other Principal plane. Inclined to one plane and parallel to other plane. 3.5 Projection of planes:Triangle, Square, circle when inclined to one principal plane & perpendicular to other plane. 3.6 Projection of solids: Cylinder, cone. Right regular solids such as (i) Prism: Square& Pentagonal (ii) Pyramid: Triangular & Square. Projections of above mentioned solids when axis is inclined to one principal plane & Parallel to other principal plane. 3.7 Conversion of simple pictorial views into orthographic views. *Problems where one end of the line is in one quadrant & other end in other quadrant and traces are to be excluded.* *Problems where apparent shape of plane are given, true shape & slope angle are to be drawn are excluded.*			
4. Section of solids Development of lateral surfaces **4.1** Concept of sectioning planes, Auxiliary planes and true shape of section. 4.2 Drawing section of solids like square prism, square pyramid, cylinder and cone with sectioning plane inclined to one principal plane and Perpendicular to the other principal plane (Axis of solid perpendicular to one principal plane and parallel to the other) 4.3Concept and importance of surface development in the engineering field. Methods of development of surfaces-Radial & Parallel line method. Development of surfaces for solids like square prism, square pyramid, cylinder and cone. *Development of solids standing on its base & cut by a plane inclined to HP and perpendicular to VP is also included.*	10	15	CO1, CO3
5. Isometric Views 5.1Difference between Isometric projection & Isometric view. 5.2Isometric view of geometrical planes and solids. 5.3Conversion of orthographic views into isometric views. 5.4Construction of Isometric view for any real object.	12	15	CO3, CO4
Total	50	80	

6. Course Delivery:
The course will be delivered through Practicals, class room interaction and exercises.

7. Specification table for Practical/Macro Lesson Plan

Unit No.	Unit	No. Of Practical Hrs.	Marks
1	Introduction	05	05
2	Geometrical construction & Engineering Curves	15	05
3	Orthographic projection	30	18
4	Section of solids Development of lateral surfaces	15	10
5	Isometric Views	15	12
	Total	**80**	**50**

8. Specification table for Practical/ Termwork:

No.	Practical
1	TYPES OF LINES, LETTERING, DIMENSIONING.
2	GEOMETRICAL CONSTRUCTIONS
3	ENGINEERING CURVES
4	PROJECTION OF POINTS & LINES
5	PROJECTION OF PLANES
6	PROJECTIONS OF SOLIDS
7	ORTHOGRAPHIC PROJECTIONS (First angle)
8	ORTHOGRAPHIC PROJECTIONS(Third angle)
9	SECTIONS AND DEVELOPMENT OF SOLIDS
10	ISOMETRIC VIEWS

9. Learning Resources:

Text Books

S.No.	Author	Title	Publisher
1	N.D. Bhatt	Engineering Drawing	Charoter Publisher,Anand
2.	R. K. Dhawan	Engineering Drawing	S. Chand Publishing
3.	K.R. Gopalakrishna	Engineering Drawing	Subhas Publications.

Reference Books only for further study

S.No.	Author	Title	Publisher
1	P.S. Gill	Geometrical Drawing	Kataria & Sons
2	P.S. Gill	Machine Drawing	Kataria & Sons
3	N.D. Bhatt	Machine Drawing	Charoter Publisher,Anand

Indian and International codes needed

S.No.	Author	Title	Publisher
1.	BIS, India	SP 46. (Latest revision).	BIS, India

(GC205) ENGINEERING MATERIALS

1. COURSE OBJECTIVE:

This course is introduced with an objective of providing knowledge to students regarding properties and composition of materials for engineering applications and enabling them to make comparative study of materials while selecting the appropriate material for various engineering applications.

2. TEACHING AND EXAMINATION SCHEME

Semester	II									
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	
(GC205) ENGINEERING MATERIALS		3	--	--	48	75	25	--	--	100

3.COURSE OUTCOMES:

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

GC205.CO1: List out the properties of materials used in engineering applications.

GC205.CO2: Explain the composition and properties of various engineering materials.

GC205.CO3: Classify materials based on composition and properties.

GC205.CO4: Select the appropriate material/s for the given engineering application/s.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentatn & Testing	Engg. Practices for Society,Sustain ability & Environment	Project Management	Life -long Learning
CO1	3	2	0	0	0	0	1
CO2	3	2	1	0	0	0	1
CO3	2	2	2	1	1	0	1
CO4	2	3	3	2	1	0	1

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 ENGINEERING MATERIALS			**08**	**04**	
1.1 Classification of Materials: Metal and Non-metal, Ferrous Metal & Non-ferrous Metals, Differences between Metals & Non-metals					**CO1, CO2, CO3, CO4**
1.2 Properties of Materials:(Note: Properties to be explained with relevant examples.) 1.2.1 Physical properties – Melting point, Freezing point, Boiling point, Density, Linear co-efficient of expansion, Thermal conductivity, Electrical resistivity					
1.2.2 Mechanical properties – Strength, Elasticity, Plasticity, Ductility, Malleability, Toughness, Brittleness, Hardness, Fatigue, Creep.					
1.2.3 Electrical properties – Resistivity, Conductivity, Temperature coefficient of resistance, Dielectric strength, Thermo-electricity, Super conductivity					
1.2.4 Magnetic properties – Permeability and Coercive force					
1.2.5 Chemical properties - Corrosion resistance and Chemical composition					
2 FERROUS & NON-FERROUS METALS & ITS ALLOYS			**18**	**12**	
2.1 FERROUS ALLOYS: 1.1.1 Low carbon steel, Medium carbon steel, High carbon steel, their carbon percentage, properties & uses. 1.1.2 Cast iron: grey cast iron, white cast iron, their properties & uses 1.1.3 Alloy steels: Constituents of alloy steels such as Phosphorous, Sulphur, Silicon, Manganese and their effect on properties of materials. 1.1.4 Stainless steel, Nickel-chromium-molybdenum steel, its properties & uses. 1.1.5 Tool steel – composition, HSS, properties & uses					**CO1, CO2, CO3, CO4**
2.2 NON-FERROUS METALS & ALLOYS: 2.2.1 Aluminium – Properties & uses 2.2.2 Aluminium alloys – constituents of alloy & their effect on properties of metal 2.2.3 Properties & uses of Duralumin, Y-alloy and Al-Si alloy 2.2.4 Copper – Properties & uses. 2.2.5 Copper alloys – Constituents of alloy & their effect on properties of metal 2.2.6 Properties & uses of Copper – Zinc alloys such as Muntz metal, manganese, bronze, Copper-Tin alloys such as Bronze, Copper-Aluminium alloys such as Aluminium bronzes. 2.2.7 Lead and its hazard to the environment					**CO1, CO2, CO3, CO4**
3 NON-METALLIC MATERIALS			**18**	**10**	
3.1 CONSTRUCTION MATERIALS 3.1.1 Classification of rocks, common building stones and their applications. 3.1.2 Cement: Types of cement, composition and applications 3.1.3 Bricks: Composition, properties, Classification, Special bricks- Refractory and fly-ash bricks and uses 3.1.4 Clay: Types, products of clay- tiles and pipes 3.1.5 Sand- sources – river, crushed aggregates, applications					**CO1, CO2, CO3, CO4**
3.2 ENGINEERING CERAMICS 3.2.1 Refractories: Desirable properties, Properties and Applications of Fire clay and Silica Refractory, Difference between acid, basic & neutral refractories					**CO1, CO2, CO3,**

3.2.2 Glass: Properties & uses of soda glass, borosilicate glass and fibre glass 3.2.3 Glass wool: Composition, properties & uses 3.2.4 Timber: Common varieties of timber, uses of wood products, veneer and plywood 3.2.5 Natural & Synthetic abrasive materials: Introduction, Properties & uses			**CO4**
4 CONDUCTOR, SEMI -CONDUCTOR, AND INSULATING MATERIALS	**16**	**12**	**CO1, CO2, CO3, CO4**
4.1 Classification of Materials as Conductor, Semiconductor and Insulating materials			
4.2 Conductor Material: 4.2.1 High conductivity materials: Copper, Aluminium, Carbon, Silver, Lead & Tungsten, their properties as conducting materials and applications. 4.2.2 High resistivity materials: nichrome, constantan, manganin and their applications			
4.3 Insulating Materials: Introduction and Characteristics of Good Insulating materials 4.3.1 Solid Insulating materials- wood, paper, rubber, mica, glass fibre, porcelain, PVC, resins, their characteristics as insulating materials and applications			
4.4 Semiconductor Materials: Silicon & Germanium, their specifications as semiconductor material and uses.			
Unit 5 MAGNETIC & COMPOSITE MATERIALS	**15**	**10**	
5.1 Magnetic Materials: Classification as Diamagnetic, Paramagnetic, Ferromagnetic, List of these materials and their applications			**CO1, CO2, CO3, CO4**
5.2 Composite Materials**:** metal matrix, ceramic matrix and polymer matrix composites, types of reinforcement materials and their applications			
5.3 Paints & Lubricants: 5.3.1 Classification: oil based and polymer based paints 5.3.2 Constituents of Paints – resin, binder, pigment, additives, solvents 5.3.3 Lubricants – Functions of lubricants, Types of Lubricants**,** Composition and Applications			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures and class room interactions

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit Name**	**Number of lectures (hrs)**	**Marks**
1	Introduction to Engineering Materials	04	08
2	Ferrous & Non-Ferrous Metals & its alloys	12	18
3	Non-Metallic Materials	10	18
4	Conductor, Semi-Conductor, & Insulating Materials	12	16
5	Magnetic & Composite Materials	10	15
		48	**75**

8. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.S. Khurmi	Material Science	S. Chand
2	R. Srinivasan	Engineering Materials & Metallurgy	Tata McGraw Hill
3	TTTI Madras	Electrical Engineering Materials	McGraw Hill Education, 2004
4	S. K. Hajra Choudhury	Material Science and Processes	Indian book distribution
5	P. C. Varghese	Building Materials	PHI
6	J. B. Gupta	Electrical and Electronic Engineering Materials	Katson

SEMSESTER III

(CC301) ENGINEERING MECHANICS

2. COURSE OBJECTIVES:

The students will be able to acquire knowledge of Engineering Mechanics is imperative in the analysis of static or dynamic force systems. The related concepts find extensive applications in the analysis of machine elements, fluids, structures, and every engineering problem that involves force or motion. The subject is a basis of myriads of higher-level subjects like Hydraulics, Strength of Materials, Theory of Machines and Machine Design, and practically there is no branch of engineering where the subject renders no scope.

2. TEACHING AND EXAMINATION SCHEME

Semester	III								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks		Total Marks
Engineering Mechanics		L	T	P	H	TH	TM	TW	PR/OR	
		3	1	1	5	75	25	25	-	125

3. COURSE OUTCOMES:

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

CC301CO1: Define various force systems, Equilibrium, centre of gravity, friction & dynamics.

CC301CO2: Explain methods to determine unknown reactions, forces, velocities and accelerations, Centroid, centre of gravity, friction machine efficiency, momentum & impulse.

CC301CO3: Solve problems on equilibrium of rigid bodies, centre of gravity, simple machines, friction, kinetics, momentum & impulse.

CC301CO4: Verify various laws & machine equations.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2
CO1	3	1	0	0	0	0	0	1	0
CO2	3	2	1	1	0	1	0	2	1
CO3	3	3	2	1	0	1	2	3	1
CO4	3	3	1	2	1	2	2	2	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 Forces and Moments.				
1.1 FUNDAMENTALS Definition and unit of force, types of force, characteristics of force, effects of force, principle of transmissibility of force, resultant, equilibrant.		3	1	
1.2 FORCE SYSTEM System of forces, resolution and composition of forces (Resolution along x and y axis), resolution of force along a plane and perpendicular to it (only introduction, no problems to be framed.)		3	2	**CO1 CO2 CO3 CO4**
1.3 RESULTANT Application of the principle of resolution to—1) find the resultant of a coplanar, concurrent force system, and 2) determine the missing force when the resultant is given.		6	3	
1.4 MOMENT Moment—Definition, unit, sign convention (clockwise moment +, anticlockwise -), couple and its characteristics. Avignon's theorem-- statement and application to compute the resultant in magnitude, direction and position in case of coplanar non-concurrent, and coplanar parallel force system.		6	4	
2 Equilibrium.				
2.1 FUNDAMENTALS Concept of equilibrium of forces, conditions of equilibrium of two forces, three forces, concurrent and non-concurrent force systems, concept and drawing of free body diagram for not more than three bodies.		3	2	
2.2 LAMI'S THEOREM Lami's theorem- statement and application to problems based on strings with suspended weights, and spheres.		6	3	**CO1 CO2 CO3 CO4**
2.3 BEAMS Types of beams, types of support, types of loadings. Application of equilibrium conditions to the beams (Beams with simple or roller support at the two ends) with concentrated loading, UDL, partially applied UDL only.		6	5	
3 Centroid and Centre of gravity.				
Definition of centroid, centroid of rectangle, triangle, circle, semicircle, trapezium. Centroid of simple composite figures (including cut out sections.) Definition of centre of gravity. Centre of gravity of solids-- cone, sphere, cylinder, hemisphere, rectangular solid. Centre of gravity of simple composite solids (including cut out solid portions)		9	7	**CO1 CO2 CO3**
4 Friction and Simple machines				
4.1Friction—FUNDAMENTALS Concept of friction, Coulomb's law of static friction, coefficient of friction, angle of friction, cone of friction, angle of repose.		3	1	

4.2 APPLICATIONS Application of concept of friction to a block resting on horizontal or inclined plane, ladder friction.	6	5	**CO1 CO2 CO3 CO4**
4.3 FUNDAMENTALS OF SIMPLE MACHINES Definition of simple machine, load, effort, mechanical advantage, velocity ratio, efficiency of machine, law of machine, reversibility of machine, self-locking machine. (Simple problems to be framed, no derivations.)	3	2	
4.4 STUDY OF SIMPLE MACHINES Simple axle and wheel, single purchase crab, double purchase crab, screw jack. (Simple problems to be framed, no derivation.)	6	4	
5 Dynamics			
5.1 KINETICS D' Alembert's principle and its applications to solve simple problems related to motion of lift, two bodies connected by a single string passing over a pulley, two string connected bodies of which one is lying on a horizontal plane (or on inclined plane) while the other suspended freely.	9	5	**CO1 CO2 CO3 CO4**
5.2 MOMENTUM, IMPULSE AND IMPULSIVE FORCE Momentum, impulse and impulsive force—definition and unit. Law of conservation of momentum, simple problems based on momentum, impulse, impulsive force, and law of conservation of momentum.	6	4	
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	Force and moment	10	18
2	Equilibrium	10	15
3	Centroid and centre of gravity	7	9
4	Friction and simple machines	12	18
5	Dynamics	9	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

Sr. No.	Practical (Minimum six to be conducted)	Marks
1.	Verification of Polygon law of forces.	
2.	Verification of Lami's theorem.	
3.	Determination of coefficient of friction (between any two different surfaces.)	
4.	Calculation of support reactions using Beam apparatus.	
5.	Determination of MA, VR, efficiency and law of machine for any three simple lifting machines.	
6.	Determination of angle of repose.	
7.	Determination of the resultant of coplanar and concurrent forces (Graphical analysis, one sheet.)	
8.	Determination of the resultant of coplanar, non-concurrent forces, and parallel forces. (Graphical analysis, one sheet.)	

No	**Class room Assignments**	
1	At least three assignments covering above units.	
No	**Tutorial Exercise**	
1	At least six problems on each of the units mentioned above.	
	Total	25

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	Dhade, Jamdar and Walawalkar.	Fundamentals of Applied Mechanics	Sarita Prakashan, Pune.
2	R.S.Khurmi	Applied Mechanics	S. Chand
3	A. R. Basu	Engineering Mechanics	Tata MacGraw Hill, Delhi.
4	Patel, Sanghavi and Thakur	Engineering Mechanics	Mahajan Publishing House, Ahmedabad.

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Beer-Johnson	Engineering Mechanics	Tata McGraw Hill, Delhi.
2	Joseph F. Shegley	Vector Mechanics for Engineers Vol-1 and 2	Tata McGraw Hill, Delhi.

9.3Internet and Web Resources

S. No.	Author	Title of Books	Publishers
1	WizIQ	https://www.wiziq.com/tutorials/applied-mechanics	-
2	NPTEL	https://nptel.ac.in/courses/122102004	-

9.4 Videos and Multimedia Tutorials

S. No.	Author	Title of Books	Publishers
1	NITTTR	CDs of experiments in Engineering Mechanics.	-
2	NPTEL	CDs of experiments in Engineering Mechanics.	-

(MC302) MANUFACTURING PROCESSES

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge of various manufacturing processes, tools, equipment's and Machines required for converting raw materials into finished product in the recommended manner. Knowledge about various Manufacturing processes and allied areas will be of great use to the personnel involved in production. This will provide the students an opportunity to skill themselves for the industrial scenario.

2. TEACHING AND EXAMINATION SCHEME

Semester	III								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
MC302 Manufacturing Processes		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:
MC302CO1: State basic manufacturing processes for manufacturing different components.
MC302CO2: Explain basic principles of various manufacturing processes and working of machine tools.
MC302CO3: Select the specific manufacturing process for getting the desired type of output.
MC302CO4: Compare various manufacturing processes in producing jobs.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2
CO1	2	1	1	1	1	1	1	2	1
CO2	2	2	1	1	1	1	1	2	2
CO3	3	3	2	3	3	3	2	3	3
CO4	3	3	2	3	3	2	2	3	3

Relationship: Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours			
Unit		**M**	**Thr**	**CO**
1. FOUNDRY		**15**	**10**	
1.1 PATTERN MAKING Introduction, Material used, types- Single piece, Multiple piece, Cope and drag pattern, gated pattern, Patterns allowances, introduction to Cores.				**CO1**
1.2 MOULDS Mould materials, Types of moulding sand, Moulding processes				**CO2**
1.3 MELTING PRACTICE Construction and working of Cupola furnace & electrical furnace				**CO3**
1.4 CASTING Casting principle and operation: Centrifugal, Pressure Die casting, Types of casting defects and remedies.				**CO4**
2. WELDING		**15**	**10**	
2.1 Classification				

2.2 MANUAL METAL ARC WELDING working Principle and procedure, polarity, Equipment & electrodes used,			**CO1**
2.3 GAS WELDING working Principle and procedure, Types of gas welding flames and their applications, Equipment's used			**CO2** **CO3** **CO4**
2.4 BRAZING AND SOLDERING Introduction, Principles & Applications			
2.5 WELDING DEFECTS Different types of welding defect and remedies			
3. METAL FORMING PROCESSES	**6**	**10**	
3.1 Basic working principle of mechanical and hydraulic press			**CO1**
3.2 SHEET METAL WORKING Trimming, Punching, notching, blanking, embossing, stamping and deep drawing.			**CO2** **CO3**
3.2 FORGING Open die & Close die forging			**CO4**
4. LATHE	**15**	**10**	
4.1 Introduction, Description and functions of various parts of Centre lathe			**CO1**
4.2 Specification of Centre Lathe, Parameters- Speed, feed, Depth of cut according to materials.			**CO2**
4.3 Operations and tools- Turning, parting off, Knurling, facing, boring, threading, taper turning.			
5. DRILLING AND MILLING PROCESSES	**20**	**12**	
5.1 DRILLING Introduction, Classification of drilling machines, Nomenclature of a drill, Basic parts and their function- Sensitive, Radial drilling machine			**CO1**
5.2 Types of drilling operations, Types of drill and reamers			**CO2** **CO3**
5.3 MILLING Introduction, Classification of Milling machines, Basic parts and their function- Column and knee type milling machine			**CO4**
5.4 Types of milling operations, Types of milling cutters			
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	Foundry	10	15
2	Welding	10	15
3	Metal forming Processes	6	10
4	Lathe	10	15
5	Drilling and Milling Processes	12	20
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
	Practical Title	
1	To prepare a single piece pattern: One Job	2.5
2	To Prepare a mould cavity using split pattern: One Job	2.5
3	To prepare a welding job in flat and horizontal position by arc welding process	05
4	One turning job on lathe containing the operations like plain turning, step turning, grooving, knurling	7.5
5	One job on milling and drilling operation	05
6	One job on sheet metal	2.5
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S.K Hajra Chaudhary & A. K. Hajra Chaudhary	Elements of workshop Technology – Volume I & II	Media Promoters and Publishers limited
2	P.N Rao	Manufacturing Technology (Foundry, Forming & Welding)	Tata McGraw Hill Publishers, New Delhi
3	O.P Khanna	A Textbook of Production Technology	Dhanpat Rai Publication, New Delhi
4	M. Adithan and A.B. Gupta	Manufacturing Technology	New Age International (P) Ltd, New Delhi

(MC301) MACHINE DRAWING

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge to develop proficiency in reading and interpreting a wide variety of production drawings. Also, to impart skills in visualizing component assemblies and freehand sketching. students will able to use IS conventions on drawings; they should also be able to draw free hand proportionate orthographic views of machine components & assembly and detailed drawings of machine components.

2. TEACHING AND EXAMINATION SCHEME

Semester	III								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
MC301		L	T	P	H	TH	TM	TW	PR/OR	
Machine Drawing		02	-	04	06	75	25	50	-	150

3. COURSE OUTCOMES:

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

MC301CO1: Define conventional representations, elements of production drawings, machine parts, pipe joints & weld joints.

MC301CO2: Demonstrate the skill of free hand sketching of machine components, assembly & detailed drawing of machine parts, piping & welding drawings.

MC301CO3: Interpret assembly and detailed drawings of machine components, piping & welding drawings.

MC301CO4: Develop the assembly and detailed drawings.

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

Relationship : Low-1 Medium-2 High-3

Marks	Thr = Teaching hours	CO = Course Objectives			
Unit			**M**	**Thr**	**CO**
1. Conventional Representations			**09**	**03**	
1.1 Conventional representation of different materials					**CO1**
1.2 Long and short break representation of pipes and shafts.					
1.3 Conventional representation for ball bearings, roller bearings, springs, screws, spoked wheels, studs, nuts and bolts.					
1.4 Representation of different types of sections.					
2. Free Hand Sketches			**09**	**04**	
2.1 Hexagonal headed bolt, washer and nut (Assembled & individual), Sunk key, Feather key, Woodruff key, Gib and cotter joint.					**CO1 CO2**
2.2 Muff Coupling, Flexible coupling, V-belt pulley and Flat belt pulley with arms.					
2.3 Pipe Joints Socket joint, socket and spigot joint, union joint and expansion joint					
3. Assembly and Detailed Drawings			**30**	**11**	
3.1 Assembly drawings Knuckle joint, Protected type flange coupling, Foot step bearing, non-return Valve.					**CO1 CO2 CO3 CO4**
3.2 Detailed Drawings Socket and spigot joint, Universal coupling, Plummer block, simple eccentric.					
4. Pipe Fittings, welds and Welded Joints			**18**	**08**	
4.1 Different types of pipe fittings Coupling, cap, Tee, elbows, cross, lateral, reducer, valves, union, plug. Single line and double line Representation of the pipe fittings.					**CO1 CO2 CO3**
4.2 Different types of welded Joints Lap joint, butt joint, Tee joint, corner joint, fillet weld.					
4.3 Representation of weld details on drawing Conventional/Sectional representation of fillet, butt, single and double U, V, J and Bevel weld, seam weld, spot weld. Chipping, grinding finish & machining finish & contour. Representation of weld on arrow side, site weld, weld all round, on other side, intermittent weld, weld length, weld size, concave & convex finish, flush finish.					
5. Elements of production Drawing			**09**	**06**	
5.1 Introduction to ISO system of tolerancing Elements of interchangeable system, hole and shaft-based system, limits, fits and allowances. Selection of Fit.					**CO1 CO3**
5.2 Geometrical Tolerances Types, terminology, representation of geometrical tolerances on drawings.					
5.3 Dimensional Tolerances Terminology, selection of dimensional tolerances, representation of dimensional tolerances on drawings.					
5.4 Surface Roughness Terminology, representation of surface roughness on drawings.					
Total			**75**	**32**	

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

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	Conventional Representations	03	09
2	Free Hand Sketches	04	09
3	Assembly and Detailed Drawings	11	30
4	Pipe Fittings, welds and Welded Joints	08	18
5	Elements of production Drawing	06	09
	Total	32	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
1.	Fair sheet on conventional representation & freehand sketches	08
2.	Fair sheet on assembly drawing of machine Component	12
3.	Fair sheet on detail drawings of machine Component	12
4.	Fair sheet on piping & welded joints.	08
5.	Fair sheet on production drawing.	10
	Total	50

9. LEARNING RESOURCES

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	N.D. Bhatt. &V.M.Panchal	Machine Drawing	Charotkar publishing house
2	R.V.Mali & B.S. Chaudhari	Mechanical Engineering Drawing	Vrinda Publication
3	P. S Gill	A Text book of Machine Drawing	S.K. Kataria & Sons
4	N.Sidheswar,P.Kannaiah, VVS Sastry	Machine Drawing	Tata McGraw Hill
5	R. K. Dhawan	Machine Drawing	S. Chand

(MC 303) THERMAL ENGINEERING

1. COURSE OBJECTIVES:

Mechanical engineering diploma holders have to work with various power producing, power absorbing and heat transfer devices. In order to understand the principles, construction & working of these devices, it is essential to understand the concept of energy, work, heat & conversion between them. Thermal engineering includes the study of various sources of energy, basic laws & concept of thermodynamics, gas laws, properties of steam & generation. Heat transfer forms the basis for different power engineering application. Boilers find application in different process industries. Steam turbines and Condensers are the major component of any steam power plant. Mechanical engineer will able to understand working and application of these devices.

2. TEACHING AND EXAMINATION SCHEME

Semester III									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
THERMAL ENGINEERING	L	T	P	H	TH	TM	TW	PR/OR	
	03	01	01	05	75	25	25	-	125

3. COURSE OUTCOMES:

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

MC303CO1: Define the various thermodynamic processes and gas laws.

MC303CO2: Explain the construction and working of various thermodynamic equipments.

MC303CO3: Solve various problems on laws of thermodynamics, gas laws, properties of steam and heat transfer.

MC303CO4: Compare the various types of thermodynamic equipments.

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

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**			
Unit		**M**	**Thr**	**CO**
1 BASICS OF THERMODYNAMICS (No Numericals)		**06**	**04**	
1.1 Types of systems, Properties of systems, Extensive and intensive properties and their units				**CO1**
1.2 Work and Energy—Thermodynamic definition of work, heat, difference between and work, definition of potential energy, kinetic energy and internal energy.				
1.3 Concept of enthalpy and entropy.				
2. LAWS OF THERMODYNAMICS		**12**	**07**	
2.1 Laws of Thermodynamics—Zeroth's law, First law of Thermodynamics, Principle of conservation of energy, irreversibility.				**CO1**
2.2 Second Law of Thermodynamics, Kelvin Plank and Clausius statements, Applications to heat engines, refrigerator and heat pumps (simple numericals).				**CO3**
3 IDEAL GAS		**15**	**10**	
3.1 Concept of ideal gas, Charles Law, Boyle's Law, Gay-Lussac's Law, Avogadro's Law, Equation of state for a perfect gas				**CO1**
3.2 Characteristic gas equation (no derivation), Universal Gas constant (Simple Numericals).				**CO3**
3.3 Ideal Gas Processes- Isobaric, Isochoric, Isothermal, Adiabatic and Polytropic processes with representation on P-V AND T-S diagram (simple numericals).				
4. STEAM AND STEAM BOILERS		**24**	**15**	
4.1 Enthalpy and Entropy of water and steam, Generation of steam at constant pressure with representation on various charts such as T-H, T-S and H-S.				**CO1** **CO2** **CO3** **CO4**
4.2 Properties of steam, quality of steam and use of steam tables. (Simple Numericals)				
4.3 Types of steam calorimeter – Barrel, Separating and Throttling (No Numericals).				
4.4 Steam Boilers- Classification of Boilers				
4.5 Principle and Working of Packaged Type Fire Tube Boiler				
4.6 Principle and working of Babcock and Wilcox, Lamont and Benson Boiler				
4.7 Boiler mountings- construction and working of Water level indicator, Pressure gauge, Feed check valve, Spring loaded safety valve (Ramsbottom valve), blow-off cock and fusible plug.				
4.8. Boiler accessories- construction and working of Economiser, Air preheater and Superheater.				
5. HEAT TRANSFER		**18**	**12**	
5.1 Modes- Conduction, Convection and Radiation				**CO1** **CO2** **CO3** **CO4**
5.2 Fourier's law of heat conduction-Equation and terminologies.				
5.3 Heat transfer by conduction through a single slab (Simple Numericals)				
5.4 Heat Exchangers- Construction and working of Direct contact type, Indirect contact type, Parallel flow, Counter flow and Cross flow.				
5.5 Condensers: Classification of condenser				
5.6 Surface Condenser-Construction and working of 1.) Shell and tube type - Down flow 2) Evaporative condenser				
5.7 Cooling Towers: Types, Construction and working of Natural draught, and Forced draught				
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 Thermodynamics	04	06
2	Laws of Thermodynamics	07	12
3	Ideal Gas	10	15
4	Steam and Steam Boilers	15	24
5	Heat Transfer	12	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
1.	Demonstration of Babcock and Wilcox boiler model	5
2.	Study of Package boiler (Field visit/Video presentation)	5
3.	Study of Shell & Tube Heat Exchanger	5
4.	Demonstration of a cooling tower (Field visit/Video presentation)	5
5.	Study of surface condensers (Field visit/Video presentation)	5
	Total	25

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	Patel & Karamchandani	Elements of Heat Engines- VOL 1 &2	Acharya Publications
2	R S. khurmi	A text book of Thermal Engg	S. chand
3	Pandya & Shah	Heat Engines Vol 1	Charotar publishing house Pvt Ltd
4	R K Rajput	Thermal Engg	Laxmi publications (pvt) ltd
5	P L Ballaney	Thermal Engg	Khanna Publishers.

9.2Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	P K Nag	A text book of Engg Thermodynamics	McGraw Hill
2	R K Rajput	A text book of Engg Thermodynamics	Laxmi Publications(pvt.) Ltd

(CC302) ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge about electrical and electronics engineering relevant to his job requirement of operation and maintenance in industry. The students will able to acquire basic knowledge of distribution of electrical energy including wiring & Earthing, use of various protective devices, construction & working of Transformer, Motors etc.

2. TEACHING AND EXAMINATION SCHEME

Semester	III								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING		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:

CC302CO1: Describe concepts in distribution of electrical power.

CC302CO2: Illustrate the construction and working of different types of electrical machines, electrical & electronic devices.

CC302CO3: Sketch simple electrical & electronic circuits.

CC302CO4: Compare different types of electrical machines and simple electronic circuits.

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

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	Thr = Teaching hours			
Unit		**M**	**Thr**	**CO**
1 Distribution of Electrical Energy		**15**	**11**	
1.1 Voltage levels in the various stages in the flow of electrical power from 110KV substation to 11KV/440V distribution transformer (using single line diagram only). Voltage levels for commercial and domestic use.				**CO1 CO3**
1.2 Features of Overhead and underground distribution systems and their comparison				
1.3 Features of Conduit wiring system- surface and concealed, its advantages and disadvantages.				
1.4Definition of Earthing, its necessity. Types of Earth electrodes—Pipe and Plate electrode. Methods of reducing earth resistance.				
2 Cables, Switching and Protective Devices		18	10	
2.1 Construction of three phase PVC insulated power cables. Specifications of PVC cables. Colour codes of single phase and three phase PVC cables. Method of laying underground cables.				**CO1 CO2 CO3**
2.2 Fuses- Construction and Applications of Rewirable fuses and HRC fuses. Functions and symbols of Switch-Fuse Unit, Fuse-switch Unit, Contactors, MCB, MCCB and ELCB.				

2.3 Construction and operation of a simple electromagnetic relay and limit switches.			
3 Transformers	6	04	
3.1 Principle of operation and basic construction of a single-phase transformer (core and winding only). Comparison between core type & shell type arrangement .EMF equation (no derivation and no numerical).			**CO1 CO2 CO3**
3.2 Losses in a transformer, efficiency and concept & significance of voltage regulation (no derivation and no numerical). Significance of KVA Rating of transformer.			
4 DC and AC Motors	18	12	
4.1 Working principle of DC motors, main parts of DC motor and their functions, Classification of DC motors (shunt, series and compound and their applications). Necessity of a starter for DC motors (No study of starters). Methods of reversal of direction of rotation of DC shunt and series motor. Methods of Speed control for DC shunt motors			**CO1 CO2 CO4**
4.2 Principle of operation of three phase induction motor. Main parts of three phase squirrel cage & Slip Ring Induction motors. Applications of induction motors. Necessity of starter, Names of starters used, reversal of direction of rotation.			
4.3 Working principle of an alternator.			
5 Basic Electronic Devices & Logic Gates	15	11	
5.1Semiconductor theory-Construction of Intrinsic and extrinsic semiconductor, P and N type semiconductors, working principle of Diode, diode V-I characteristics,			**CO2 CO3 CO4**
5.2 Full wave centre-tap and bridge rectifiers- circuit diagram, operation and waveforms, capacitor filter to reduce ripple voltage.			
5.3 Transistor -NPN and PNP, construction, symbol and operation. Transistor CE Amplifier-circuit diagram and operation using waveforms only. Applications of transistors (naming only)			
5.4 Binary number system, Symbols and Truth Tables of AND, OR, NOT, NAND, NOR, X-OR, X-NOR Gates			
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	**Distribution of Electrical Energy**	11	15
2	**Cables, Switching and Protective Devices**	10	18
3	**Transformers**	04	09
4	**DC and AC Motors**	12	18
5	**Basic Electronic Devices & Logic Gates**	11	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical(Any eight to be conducted)	Marks
1.	Identification of various components of a Diesel-Engine Generator set and study its operation.	
2.	Connection of a single-phase Transformer and Calculation of its efficiency & Voltage Regulation for different loads.	
3.	Simulation of fuse failure on any one primary phase of a 3-phase transformer and study its effect on the secondary voltages.	
4.	Connection and Starting of three phase induction motor using manual and automatic star delta starter	
5.	Connection, starting, running and speed control of Slip Ring induction motor	
6.	Calculations for selection of PVC cables for different currents.	
7.	Identification of Fuses, MCBs and ELCBs and study of operation of MCB and ELCB for different simulated faults.	
8.	Circuit assembly, measurement of input and output voltages and fault simulation and troubleshooting of Bridge and Centre-tap Rectifiers	
9.	Circuit assembly for ON/OFF control of single-phase loads such as lamps, home appliances, etc. using transistorized circuit and a Relay.	
10.	Verification of truth tables of Logic Gates	
11.	Mini Electronic project	
	Total	25

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	B.L. Thereja.	Text book of Electrical Technology Vol I & Vol II	S Chand & Comp. Ltd
2	V.K. Mehta	Principles of Electronics Engineering (Revised Addition)	S Chand & Comp. Ltd

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	J B Gupta	Course in Electrical Power (Latest Adddition)	S K Kataria & Sons.
2	B.L. Thereja.	Text book of Electrical Technology Vol IV	S Chand & Comp. Ltd

(MC 304) COMPUTER AIDED DRAFTING

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge of CAD software for preparing 2D and 3D drawings. The market driven economy demands frequent changes in product design to suit the customer needs and the introduction of drafting and designing softwares in manufacturing has made the task of incorporating frequent changes as per requirement easier. This course will make the student capable of creating, editing and plotting quality CAD drawings using CAD software.

2. TEACHING AND EXAMINATION SCHEME

Semester	III								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
COMPUTER AIDED DRAFTING		L	T	P	H	TH	TM	TW	PR/OR	
		-	-	4	4	-	-	50	50	100

3.COURSE OUTCOMES:

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

MC304CO1: Identify the various Toolbars and commands required for making 2D & 3D drawing.

MC304CO2: Interpret the use of Toolbars & commands in making 2D & 3D drawing.

MC304CO3: Select the correct toolbars & commands in making 2D & 3D Drawings.

MC304CO4: Develop 2D & 3D drawing in CAD environment.

4. Mapping Course Outcomes with Program Outcomes

Relationship : Low-1 Medium-2 High-3

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

5. DETAILED COURSE CONTENTS FOR TERM WORK & PRACTICALS

Marks	Phr = Practical hours			
Unit		**M**	**Phr**	**CO**
1 **Introduction and CAD Preliminaries.**		**-**	**2**	
1.1 Computer aided drafting concept.				**CO1 CO2**
1.2 Hardware and various CAD software available				
1.3 Components of a CAD software such as various toolbars in respective software's				
1.4 File features Management: (like New file, Saving the file, Opening, Import and Export of file)				
1.5 Setting up the CAD environment				
2 Drawing, Editing, Modifying and organizing 2D drawing:		-	**28**	
2.1 Drawing basic geometric elements				**CO1 CO2 CO3 CO4**
2.2 All View Commands: (like Zoom all, Zoom Previous, Zoom Extents, zoom window, zoom real time, Zoom Dynamic, Zoom Pan)				
2.3 All Modify commands / Transformation commands: such as Mirror, Array, Move, Scale, Trim, chamfer, fillet.				
2.4 Concepts of layers and blocks.				
3 Dimensioning and Tolerancing		-	**12**	
3.1 Dimensioning: Types of dimensioning, Linear, Horizontal, Vertical, Aligned, rotated, Baseline, continuous, diameter, radius, angular dimension, Leader.				**CO1 CO2 CO3 CO4**
3.2 Dimension scale variable, adding geometric tolerances				
3.3 Editing dimensions				
3.4 Text styles: selecting font, size, arrows, alignment, line text, Multiline text.				
4 Solid Modelling		-	**16**	
4.1 3D features such as understanding co-ordinate system, Viewing in 3D				**CO1 CO2 CO3 CO4**
4.2 Concept of solid modelling				
4.3 Creating predefined solid primitives such as box, cone, cylinder, sphere, torus, wedge.				
4.4 Creating an extruded solid, creating a revolved solid.				
4.5 Creating composite solids				
4.6 Rendering				
5 Model space, Paper space, viewports, layouts & Printing/Plotting		-	**6**	
5.1 Concept of model space and paper space				**CO1 CO2**
5.2 Creating viewports in model space and creating floating viewport in paper space.				
5.3 Shifting from model space to paper space and vice versa.				
5.4 Selecting various plotting parameters such as paper size, paper units,				

drawing orientation, plot scale, plot offset, plot area, print preview.			
Total	**50**	**64**	

6. COURSE DELIVERY:

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

07. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
1.	Drafting of common template for all the following assignments with Institute logo and standard title block.	03
2.	At least Five problems on different geometrical shapes using basic commands.	05
3.	At least Three problems with transformation features.	07
4.	Two problems on orthographic views for various Engineering drawing objects covering dimensioning, text.	10
5.	Create at least two solid models, which cover all the features available in solid modelling.	15
6.	Drafting project: a) Civil Engg. & Architectural Engineering: Plan, elevation and section of a single-story residential building. b) Electrical & Electronics and Allied Engg. Branches: Electrical layout of components like bulbs, fan, A.C., T.V. point, telephone point, etc. for a single-story house. c) Mechanical and Allied Engg. Branches: Industrial components such as machines, automobiles, jigs and fixtures with dimensioning, tolerancing, text, title block, Assembly etc. d) Shipbuilding Engg. Body plan of a ship. e) F.T.E.E.: Front View and Bottom View of a Simple truss like Saw Tooth truss, King-Post truss, Snow Tooth truss. (Any one of the three)	10
	Total	50

8. LEARNING RESOURCES

8.1Text Books

S. No.	Author	Title of Books	Publishers
1	P. Nageshwar Rao	AutoCAD for Engineering drawing made easy – P. Nageshwar Rao- Tata McGraw Hill.	Tata McGraw Hill.
2	Sagar Linkan	AutoCAD 2018 training Guide	BPB Publications
3			
4	Sham Tickoo	PRO/ Engineer PTC creo parametric 3.0	Dreamtech Press (2015)
5	Sham Tickoo	Solid Works 2018	BPB Publication
6	Nader G. Zamani.	CATIA V5 Tutorials	SDC Publications

8.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Sham Tickoo	Pro/ENGINEER Wildfire 5.0 for Designers	CADCIM Technologies
2	Sham Tickoo	AutoCAD 2019: A problem Solving Approach	BPB Publication
3	George Omura	Mastering AutoCAD	BPB Publication
4	Sham Tickoo	CATIA V5-6R2017 for Designers 15th Revised Edition	BPB Publication

SEMESTER IV

(MC 401) STRENGTH OF MATERIALS

1. COURSE OBJECTIVES:

Through this course the students will able to understand the fundamentals of solid mechanics, acquire the elementary knowledge of stresses, strains and their effects. They will also analyze the behavior of machine parts under various loads. It is important to understand and analyze various types of loads, stresses and strains, which are the main causes of failure of machine parts. The subject also deals with understanding the properties of engineering materials and applying the same in solving engineering problems.

2. TEACHING AND EXAMINATION SCHEME

Semester IV									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(MC 401) Strength of Materials	L	T	P	H	TH	TM	TW	PR/OR	
	3	1	1	5	75	25	25	-	125

3. COURSE OUTCOMES:

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

MC401CO1: Describe behaviour of engineering materials under the action of external loads.

MC401CO2: Represent simple stress & strain, SF & BM, Moment of inertia, bending stresses & torsion.

MC401CO3: Solve various problems on simple stresses & strains, SF & BM diagrams, bending stresses, moment of inertia & torsion.

MC401CO4: Analyse the behaviour of materials under various loads.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimenting & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning		
CO1	3	1	0	0	2	0	2	2	1
CO2	3	3	1	1	0	1	1	2	0
CO3	3	2	2	1	0	0	2	3	0
CO4	3	3	2	1	1	1	2	3	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**			
Units:		**M**	**Thr**	**CO**
1. SIMPLE STRESS AND STRAIN		15	10	
1.1 Definition of stress and strain (Numericals on stress and strain)				
1.2 Stress – strain Curve for Ductile Material labeling the significant points on the curve.				
1.3 Concept of elastic limit, Hooks law &Young's Modulus of Elasticity				
1.4 Deformation expression of a body subjected to single force [δl = PL/AE]				
1.5 Numericals based on concept of principle of Superposition [Bars of uniform cross section & Bars of different cross sections only]				**CO1 CO2 CO3 CO4**
1.6Concept of lateral strain and Poisson's Ratio. [Numericals on lateral strain & Poisson's Ratio to be covered]				
1.7 Concept of shear stress, shear strain and Modulus of Rigidity.				
1.8 Definition of term- volumetric strain and bulk Modulus [No Numericals] Note: - [Numericals on stresses in composite sections are to be excluded.]				
2. SHEAR FORCE & BENDING MOMENT		15	10	
2.1 Types of beams and Supports.				
2.2 Concepts of shear force & Bending Moment.				**CO1 CO2 CO3 CO4**
2.3 Sign Conventions for shear force & Bending Moment.				
2.4 Shear force and bending moment diagram for simple cantilever and simply supported beams subjected to point and uniformly distributed load only.				
3. MOMENT OF INERTIA		15	10	
3.1 Definition of Moment of Inertia				
3.2 Perpendicular & Parallel Axis Theorem.				**CO1 CO2 CO3**
3.3 Expression of M.I of Rectangular, circular, Triangular & hollow Rectangular sections (No derivations, simple numericals).				
3.5 Numericals on sections like L section, T section and I section				
4. THEORY OF SIMPLE BENDING		15	09	
4.1 Concept of pure Bending.				**CO1 CO2 CO3 CO4**
4.2 Theory of simple Bending, Neutral Axis and Bending equation.				
4.3 Bending stress distribution diagram				
4.4 Application of bending equation for solid rectangular, solid circular section, hollow rectangular and hollow circular section. (simple numericals)				
5. TORSION		15	09	
5.1 Concept of pure Torsion				
5.2 Torsion equation assumptions in Theory of pure torsion.				**CO1 CO2 CO3 CO4**
5.3 Strength of circular solid &hollow shaft in pure torsion.				
5.4 Shear stress distribution diagram.				
5.5 Polar Modulus, power transmitted by shaft.				
Total		**75**	**48**	

N.B: - Question paper will not carry questions on derivations

6. COURSE DELIVERY:

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

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	SIMPLE STRESS AND STRAIN	10	18
2	SHEAR FORCE & BENDING MOMENT	10	18
3	MOMENT OF INERTIA	10	15
4	THEORY OF SIMPLE BENDING	09	12
5	TORSION	09	12
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical (no 1 and 2 are compulsory and any 03 from 3 to 8)	Marks
1.	Tensile Test on M.S or Al using UTM	4
2.	Compression Test on wood/Resin sample using UTM	3
3.	Shear Test on M.S using UTM	3
4.	Brinell Hardness Test on Hardness Testing Machine	3
5.	Rockwell Hardness Test on Hardness Testing Machine	3
6.	Izod Impact Test on M.S or Al.	3
7.	Charpy Impact Test on M.S. or Al.	3
8.	Torsion Test on M.S Specimen.	3
	Total	25
No	**Tutorial Exercise**	
1	Solve atleast 5 problems on unit 1	
2	Solve atleast 5 problems on unit 2	
3	Solve atleast 5 problems on unit 3	
4	Solve atleast 5 problems on unit 4	
5.	Solve atleast 5 problems on unit 5	

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	R.S Khurmi	Strength of Materials	S.Chand Publisher
2	S.S. Bhavikatti	Strength of Materials	Vikas Publishing
3	S. Ramamurtham	Strength of Materials	DhanpatRai&Sons
4	R. K. Rajput	Strength of Materials	S.Chand Publisher

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	F.L. Singer	Strength of Materials	London Harper & row
2	Timoshenko & Gere	Mechanics of Materials	CBS Publisher & Distributors, New Delhi

(MC402) MECHANICAL WORKSHOP PRACTICE

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge to Plan methodology and prepare the job as per given specification by selecting and applying appropriate manufacturing process and Understand the concepts, procedures, types of cutting tools, work holding devices, various operations performed on these machines, their working principles and practices related to various manufacturing processes.

2. TEACHING AND EXAMINATION SCHEME

Semester IV									
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	
(MC402) MECHANICAL WORKSHOP PRACTICE	-	-	04	-	-	-	50	50	100

3. COURSE OUTCOMES:

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

MC402CO1: Identify different types of machine tools and machining processes to produce a component.

MC402CO2: Outline a manufacturing sequence to produce a given part.

MC402CO3: Apply basic skills in the use of various machine tools (milling m/c, grinding machine, shaper and lathe) to perform job following safety guidelines.

MC402CO4: Plan a maintenance schedule for effective functioning of machine tools.

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
CO 1	3	1	1	2	2	1	1	1	2
CO 2	3	2	2	1	0	0	0	0	2
CO 3	3	2	2	3	1	1	1	2	3
CO 4	2	1	2	3	1	1	1	1	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Phr = Practical hours**	

Unit	**M**	**Phr**	**CO**
1. LATHE.			
1.1 Introduction to types of Lathe.			
1.2 Centre Lathe: Tool nomenclature, thread cutting operation. Preventive maintenance, maintenance schedule and lubrication chart. Types of Coolants.			
1.3 Introduction to Capstan and turret lathe, Principal parts of capstan and turret lathe.			**CO1**
1.4 Introduction to CNC lathe, main elements of CNC lathe, Hand operation, operating element. CNC operation- operating and control elements, co-ordinate system. CNC programming- methods of programming-absolute system and Incremental system, Preparatory functions (G-functions), CNC program input format.			**CO2** **CO3**
2. Milling machine			
2.1 Introduction, column and knee type milling machine (horizontal and vertical), milling cutters, milling operations.			**CO1**
2.2 Universal dividing head-construction and working, Indexing-direct and simple indexing only.			**CO2** **CO3**
2.3 Preventive maintenance, maintenance schedule and lubrication charts. Coolants.			**CO4**
3 Grinding.			
3.1 Introduction, grinding machine types. Work holding devices.			**CO1**
3.2 Types of abrasive and bond. Grite, Grade and structure of wheel, dressing and truing of wheel, marking system, mounting of wheel, balancing of wheel.			**CO2** **CO3**
3.2 Use of Coolant			
4 Shaper.			
4.1 Introduction to Shaper.			**CO1**
4.2 Main parts of standard shaper, work holding devices shaper operations.			**CO2**
4.3 Preventive maintenance schedule and lubrication chart.			**CO3** **CO4**
Total		**64**	

6. COURSE DELIVERY:

The Course will be delivered through shop talk, shop floor interactions, demonstrations, assignments, video clips and Practicals.

7. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

Sr. No	Unit No	Practicals/Assignment	Phrs
1	1	Job on external threading	04
2	1	Prepare simple job on CNC machine	04
3	2	Produce a hexagonal head/spur gear by indexing device	08
4	2	Machine sides of a rectangular block (centre lathe/milling machine) and mill two slot or opposite sides and a V-groove on one side (V-block)	08
5	3	Prepare job on the following grinding machine 1) Surface grinder-flat surface-01 2) Cylindrical grinder-cylindrical surface-01	04
6	3	Grind lathe tool	04
7	4	Machine two flat horizontal opposite sides of the rectangular block on a shaper (to complete V-block. at Sr. No 4)	08
8	1,2,4	Prepare a preventive maintenance schedule(daily/monthly) and a lubrication chart for any one of the following machine tools (1) Centre lathe (2) Milling machine (3) Shaper	06
09	1,2,4	Identify different types of machine tools in your workshop and write down its specifications and uses	04

Note: A field visit to modern workshop to be arranged during the semester

8. LEARNING RESOURCES

8.1 Text Books

S. No.	Author	Title of Books	Publishers
1	S.K Hajara Chaudhary	Elements of W/s Technology Vol I & II	Media Promoter & Publisher Pvt. Ltd
2	Raghuwanshi	Workshop Technology Vol II	Dhanpat Rai & Co
3	P.C Sharma	Production Technology	S. Chand & Co
4	Kaushik and Gupta	Workshop Technology	

8.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	R.K Jain	Production Technology	Khanna Publishers
2	W.A.J Chapman	Workshop Technology Vol I & II	CBS

(MC 403) MECHATRONICS

1. COURSE OBJECTIVES:

Modern industry demands lot of flexibility in product design and manufacturing processes. While satisfying this need industries cannot afford to compromise with quality, cost and delivery schedule. The area of Mechatronics has a tremendous potential to address such challenges by integrating Mechanical engineering with electrical, Electronics and software components. We can hardly find any field where mechatronics is not applicable. Basic knowledge of this course will definitely enhance the employability of pass-out students in various engineering areas.

2. TEACHING AND EXAMINATION SCHEME

Semester	IV								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
(MC 403) Mechatronics		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:

MC403CO1: Define mechatronics, its basic elements & related terms.

MC403CO2: Explain basic types of mechatronics system and constructional features of different sensors, actuators and controllers.

MC403CO3: Select appropriate sensing and actuating elements having proper compatibility with the controller.

MC403CO4: Analyse the functioning of various mechatronic systems along with relevant control programs.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2
CO 1	3	2	1	0	0	0	0	1	0
CO 2	3	2	1	1	0	0	0	2	0
CO 3	3	3	3	3	1	1	2	3	2
CO 4	3	3	3	3	2	1	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 to Mechatronics			**9**	**4**	**CO1 CO2 CO4**
1.1 Introduction to Mechatronics and its scope.					
1.2 advantages and disadvantages of mechatronics.					
1.3 Comparison between Traditional and Mechatronics system					
1.4 Two types of Mechatronic systems – (i)Measurement type and (ii) Control type; Elements of Measurement system (Block diagram) and examples, Elements of Open loop & Closed loop Control systems (Block diagrams) and examples; Applications of Mechatronics.					
1.5 Case studies of Mechatronics systems: - (i) Measurement type - Digital thermometer (ii) Control type- Engine Management system, Automatic Washing Machine,					
2. Sensors and Transducers			**18**	**12**	
2.1 Introduction of sensors and Transducers, Difference between sensor and transducer.					**CO1 CO2 CO3**
2.2 Performance Terminology related with sensor, 2.2.1 Static characteristics - range and span, error, accuracy, sensitivity, repeatability, stability, resolution. 2.2.2 Dynamic characteristics - response time, settling time.					
2.3 Classification of sensors- A) Based on type of Output- (i) Analog (ii) Digital B) Based on need of external power: – (i) Active (ii) Passive C) Based on sensed parameter: – (i) Pressure, Force (ii) Temperature (iii) Motion (displacement, Velocity, Acceleration) (iv) Flow and level (v) light (vi) smoke (vii) Colour (viii) touch (ix) Humidity (x) Proximity (xi) Infrared (IR)					
2.4 Working principle and application of following sensors / Transducers: - **(i)** Potentiometer (ii) Strain gauge (iii) Linear Variable Differential Transformer (LVDT) (iv) Optical Encoder (v) Photoelectric Proximity sensor (vi) Tach generator (vii) Thermocouple (viii) RTD sensor.					
2.5 Selection criteria for sensors.					
2.6 Signal Conditioning – need, process, functions, ADC and DAC. Block diagram of DAQ.					

3. Actuations Systems	15	10	
3.1 Introduction and Classification of Actuators.			
3.2 Pneumatic Actuation System: Basic Elements of Pneumatic System. Hydraulic Actuation Systems: Basic Elements of hydraulic system.			**CO1 CO2 CO3 CO4**
3.3 Working principle, schematic diagram and symbols of following: - Valves: - Direction control valves (Spool type) - 3/2 DC Valve and 5/2 DC Valve; actuation methods of DC Valves; Check valve, Pressure relief valve, Flow control Valves.			
3.4 Cylinders: - Single Acting and Double acting cylinder. Rotary Actuators: - Gear motors and Vane Motors.			
3.5 Electrical Actuation systems: - Switching devices: Relays, Solenoid type devices: Solenoid valves, Drive systems: Stepper Motor and servo motor (Brief Working with neat sketches).			
4. Microcontroller	15	12	
4.1 Microcontroller: - Introduction, characteristics, classification and applications, Basic Block diagram. Introduction to Arduino platform.			
4.2 Atmel ATmega328 microcontroller: - Pin layout and other features. Arduino UNO R3 Board: - Hardware, main features, input output pins, powering, IDE and its installation, connecting to computer, program (sketch) compilation and uploading,			**CO1 CO2 CO3 CO4**
4.3 Introduction to basic Arduino circuit components: – LED, Resistor, Diode, Bread Board, Jumper, Button, Servo, LCD, LDR, IR LED, Relay.			
4.4 Writing, compiling, uploading and running following programs: –Digital output (LED blinking), Analog output (LED fading).			
4.5 Arduino applications- Home and Industry automation, Robotics and control systems.			
5. Programmable Logic Controller (PLC)	18	10	**CO1 CO2 CO3 CO4**
5.1 Introduction to PLC: Need for PLC, Definition, Advantages and disadvantages of PLC, PLC sizes.			
5.2 Criteria for selection of PLC.			
5.3 PLC system layout (Basic block diagram). Input/output processing. PLC function and operation.			
5.4 ladder programming: Concept of Ladder Diagram, sequence of ladder programming, logic functions, use of latching, internal relays, timers, counters in elementary level Ladder diagrams like motor start and stop, water level control, Output interlock, logic functions.			

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 hrs**	**Marks**
1	Introduction of Mechatronics	04	09
2	Sensors and Transducers	12	18
3	Actuations Systems	10	15
4	Microcontroller	12	15
5	Programmable Logic Controller (PLC)	10	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	**Practical**	**Marks**
1.	**Experiment on sensors from any three of the following:** Temperature sensor, Pressure sensor, Flow sensor, level sensor, proximity sensor & force sensor.	3
2.	**Identification, working of different actuating elements:** Relay, solenoid valve, stepper motor, Servo motors, valves, cylinders etc	3
3 & 4	**Experiment to build any two simple Pneumatic circuits.**	3
5,6,7	**Any three experiments on Arduino Board from the following.** i) Blinking and fading effects on LED ii) Turn on LED with button iii) Move the Servo to commanded angle iv) Print “Hallo world” in LCD v) Using a sensor	5
8 & 9	**Any two experiments on PLC trainer by developing ladder diagram from the following.** i) Output interlock	5

	ii) Logic Functions iii) Timers and Counters iv) Water Level control v) Conveyor Belt control vi) Traffic Light control	
10	**Mini project on developing simple Mechatronic system.(Group activity)**	6
	Total	**25**

8. LEARNING RESOURCES

8.1Text Books

S. No.	Author	Title of Books	Publishers
1	W. Bolton	Mechatronics	Pearson Education Ltd
2	John W. Webb	Programmable Logic Controller	PHI
3	Andrew Parr	Hydraulics and Pneumatics	JAICO
4	Massimo Benzi	Make: Getting Started with Arduino	Maker Media

8.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	R. K. Rajput	Mechatronics	S. Chand Publications
2	K.Shanmugasundaram	Hydraulic and Pneumatic Controls	S. Chand
3	K.P. Ramachandran	Mechatronics	Wiley

(MC405) ENERGY CONVERSION

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge about the processes and machines which convert energy from naturally available forms to useful forms viz mechanical power and electrical power. This knowledge is important in design, operation and maintenance of various kinds of mechanical engineering and technological products and processes.

2. TEACHING AND EXAMINATION SCHEME

Semester	IV								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	TotalMarks
(MC405) ENERGY CONVERSION		L	T	P	H	TH	TM	TW	PR/OR	
		3	1	1	5	75	25	25	-	125

3. COURSE OUTCOMES:

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

MC405CO1: Define various terms related to air compressors, IC engines, turbines and power plants.

MC405CO2: Explain the construction and working of air compressors, IC engines, turbines and power plants.

MC405CO3: Calculate the various performance parameters of an IC engine

MC405CO4: Distinguish between various prime movers and power plants.

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	0	0	1	1	1	3	0
CO2	3	1	0	0	0	2	2	3	1
CO3	3	2	2	2	1	1	0	3	0
CO4	3	2	0	0	1	1	1	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 Air Compressors		12	07	
1.1 Introduction and uses of compressed air				
1.2 Classification of air compressors				
1.3 Construction and working of reciprocating, centrifugal, axial flow and screw compressors				**CO1 CO2 CO4**
1.4 Definitions of Free Air Delivered, capacity of the compressor, piston displacement, Volumetric Efficiency				
1.5 Advantages of multistage compression				
1.6 Reciprocating compressed air motor				
2 Internal Combustion (IC) Engines		24	16	
2.1 Introduction and classification				
2.2 Engine terminology, Functions of engine parts viz Cylinder, Cylinder head, Piston, Piston rings, Valves, Crank shaft and Connecting rod.				
2.3 Cycle of operations – Otto and Diesel cycles, their P-V diagrams and thermal efficiencies				
2.4 Two-stroke and four-stroke engines, construction and working				**CO1 CO2 CO3 CO4**
2.5 Valve timing diagrams				
2.6 Differences between two-stroke and four-stroke, and between petrol and diesel engines.				
2.7 Schematic flow diagrams of cooling, lubrication and fuel systems; Introduction to MPFI, Turbocharging.				
2.8 Calculation of Brake Power, Indicated Power, various efficiencies and specific fuel consumption. Preparation of heat balance sheet of an IC engine.				
3 Steam Turbines (No Numerical)		12	07	
3.1 Steam nozzle – Function & types of nozzles				**CO1 CO2 CO4**
3.2 Steam Turbine - Classification of turbines, construction and working principle of impulse and reaction turbines.				

3.2 Compounding of steam turbines - Velocity compounding, Pressure compounding and Pressure-Velocity compounding.			
4 Energy Generation Through Power Plants Layouts, functions of different components and basic principle of operations of following power plants:	15	10	**CO1 CO2 CO4**
4.1 Thermal Power plant			
4.2 Hydro-electric Power Plant			
4.3 Nuclear Power Plant			
4.4 Gas Turbine Power Plant			
5 Introduction to Non-Conventional Energy Sources	12	08	
5.1 Solar Energy 5.1.1 Applications of Solar energy 5.1.2 Working of Solar energy-based equipment viz water heater, cooker, solar lighting and solar still.			**CO1 CO2 CO4**
5.2 Wind Energy 5.2.1 Basic principles of wind energy conversion. 5.2.2 Main considerations in selecting a site for wind mills. 5.2.3 Basic components of a Wind Energy Conversion system 5.2.4 Advantages and limitations of wind energy conversion.			
5.3 Energy from Biomass 5.3.1 Introduction 5.3.2 Biomass conversion technologies 5.3.3 Wet processes & Dry processes			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, classroom interactions, exercises and industrial visits.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks

1	Air Compressors	07	12
2	Internal Combustion (IC) Engines	16	24
3	Steam Turbines (No Numerical)	07	12
4	Energy Generation Through Power Plants	10	15
5	Non-Conventional Energy Sources	08	12
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	**Practical (anyone from sr. no 4 to 6)**	**Marks**
1.	To demonstrate the construction and working of reciprocating, centrifugal and screw compressor.	05
2.	To dismantle and assemble a petrol engine or diesel engine	05
3.	To conduct a test on a petrol/diesel engine and determine its brake power,brake thermal efficiency and brake specific fuel consumption. Also, to prepare a heat balance sheet for any load.	05
4.	To demonstrate the construction and working of **any one** conventional power plant. (by making a visit to the plant)/video	05
5.	To demonstrate the construction and working of **any one** solar thermal equipment and **any one** solar photovoltaic equipment. (by making a visit to solar energy park)/video	05
6.	To demonstrate the construction and working of wind power plant or solar-wind hybrid power plant. (by making a visit to the plant)/video	05
7.	To demonstrate the construction and working of **any one** type of biogas plant. (video presentation)	05
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Late R. C. Patel & C. J. Karamchandani	Elements of Heat Engines – Vol I and Vol II	Acharya Publications
2	M. L. Mathur & R. P. Sharma	Internal Combustion Engines	Dhanpat Rai & Co.
3	N. K. Mangal	Diesel Engine Mechanics	Tata McGraw Hill
4	Arora & Domkundwar	Power Plant Engineering	Dhanpat Rai & Co.
5	G. D. Rai	Non-conventional Energy Sources	Khanna publication
6	Dr. B. H. Khan	Non-conventional Energy Sources	Tata McGraw Hill
7	K. M. Mittal	Non-conventional Energy System Principles, Progress and Prospects	Wheeler Publishing

(MC 404) Fluid Machinery

1. COURSE OBJECTIVES:

The students will be able to acquire knowledge to apply the concept introduced in Fluid Machinery to engineering applications such as turbo machinery and flow measurement. Fluid machinery plays an important role in the conversion of hydraulic energy to mechanical energy and vice-versa. Hydraulic turbines are used for meeting our day-to-day power demands. Also, different types of pumps are essential equipment in all the industries. Hydraulic systems have a wide range of applications in machine tools, material handling, marine, mining, metal processing, equipment and other fields.

2. TEACHING AND EXAMINATION SCHEME

Semester	IV								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks	Total Marks
(MC 404) Fluid Machinery		L	T	P	H	TH	TM	TW	PR/OR
		03	-	02	05	75	25	25	-

3.COURSE OUTCOMES:

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

MC404CO1: Define various terms related to fluid mechanics & fluid machineries.

MC404CO2: Explain fluid properties, fluid pressure, fluid flow, water turbine, pumps, accumulator & intensifier.

MC404CO3: Apply laws and theorems on statics and dynamics to calculate various parameters of fluids, flowing through pipes and various devices.

MC404CO4: Classify fluids, fluid flow, water turbines & pumps.

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

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 to fluid mechanics and Pressure Measurement			**12**	**10**	
1.1 Definition and classification of fluids, Branches of hydraulic -Hydrostatics & Hydrodynamics					
1.2 Fluid properties Density, Specific gravity, specific weight - (Simple Numerical) Viscosity, surface tension, capillarity, compressibility (No Numerical)					
1.3 SI Units of Pressure, Pressure head, Atmospheric pressure, Positive and Negative Gauge pressure, Absolute pressure (Simple Numerical on pressure, pressure head and conversion to equivalent heads of other liquids)					**CO1 CO2 CO3 CO4**
1.4 Pascal's Law and its applications.					
1.5 Pressure measuring devices Manometers-principle & working of piezometer tube, simple 'U' tube, differential 'U' tube and inverted 'U' tube manometers (Simple Numerical)					
1.6 Bourdon pressure gauge-its working principle & constructions, Calibration of pressure gauges					
2 Hydrostatics			**12**	**06**	
2.1 Total pressure, Centre of Pressure					
2.2 Pressure on plane surfaces immersed in liquid – horizontally, vertically & inclined to free surface, calculation of total pressure and determination of position of centre of pressure for circular, triangular & rectangular surfaces immersed vertically and inclined in one type liquid. (Simple Numerical)					**CO1 CO2 CO3**
3 Hydrodynamics			**21**	**14**	
3.1 Types of flow - steady; unsteady, - uniform, non-uniform, laminar and turbulent flow, compressible, incompressible flow.					
3.2 Continuity equation, Energies of liquid - pressure head, Datum head, velocity head, Total energy of liquid, Bernoulli's theorem (Simple Numerical)					**CO1 CO2 CO3 CO4**
3.3 Application of Bernoulli's theorem: Pitot tube, Venturi-meter (Simple Numerical on Discharge through Horizontal Venturi-meter)					
3.4 Definition of orifice, types, Vena contracta, Hydraulic coefficients Cc, Cv and Cd, Discharge through a circular orifice. (Simple Numerical)					
3.5 Laws of fluid friction, Reynold's number and it significance, Various losses in pipe flow-major and minor losses- loss of head due to entrance, sudden enlargement, sudden contraction. (Simple numerical on loss of head due to friction, sudden expansion and contraction)					

3.6 Hydraulic gradient line, Total energy line (No numerical)			
3.7 Water hammer in pipes - causes, effect and remedial measures			
4 Water Turbines (No numerical in this unit)	**12**	**08**	
4.4 Water Turbines: Classification of water-turbines			**CO1 CO2 CO4**
4.5 Impulse turbines: Pelton Turbine-Construction and working			
4.6 Reaction Turbines: Francis Turbine- construction and working, Kaplan turbine – Construction and working			
4.7 Difference between Impulse turbine and Reaction Turbine			
4.8 Advantages and Disadvantages of Francis Turbine over a Pelton wheel			
5 Pumps, Accumulator and Intensifier (No numerical in this Unit)	**18**	**10**	
5.1 Centrifugal Pumps: Classification, construction & working, Types of casings, Types of impellers, Multistage centrifugal pumps, pumps in series, pumps in parallel, Priming, Cavitation, faults & remedies of centrifugal pumps. Definition of Static head, delivery head, manometric head, NPSH			**CO1 CO2 CO4**
5.2 Reciprocating pumps: Classification of reciprocating pumps, Construction and working of single acting reciprocating pump, Slip and negative slip, Air vessels, functions of air vessels.			
5.3 Difference between centrifugal pump and reciprocating pump.			
5.4 Construction, working and application of rotary vane pump, External Gear pumps			
5.5 Construction, working and application of Accumulator and Intensifier			
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 fluid mechanics and Pressure Measurement	10	12
2	Hydrostatics	06	12
3	Hydrodynamics	14	21
4	Water Turbines	08	12

5	Pumps, Accumulator and Intensifier	10	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
1.	Measurement of pressure of water in a pipe by manometer	03
2.	Verification of Bernoulli's theorem	03
3.	Determination of coefficient of Discharge of Venturi meter	03
4.	To determine the relationship between loss of head and velocity for pipe flow	03
5.	Demonstrate the construction and operation of a Pelton Turbine	04
6.	Demonstrate the construction and operation of a Francis Turbine	03
7.	Demonstrate the construction and operation of a Centrifugal Pump	03
8.	Demonstrate the construction and operation of a Reciprocating Pump	03
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.K. Rajput	Fluid Mechanics and Hydraulic Machines	S. Chand Ltd
2	R.K. Bansal	Fluid Mechanics and Hydraulic Machines	Laximi Pvt. Ltd
3	R.S. Khurmi	A Text book of Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand Ltd
4	P.N. Modi/S.M. Seth	Hydraulics and Fluid Mechanics including Hydraulic Machines	Rajsons Pvt. Ltd

(MC 406) Metrology and Quality Control

1. COURSE OBJECTIVES:

Metrology and Quality Control is concerned with application of measurements to manufacturing and other processes so that they can be suitably applied in industry to ensure quality product. As this subject form the basis for design of mechanical measurement systems, students will be acquire necessary knowledge and develop required abilities for performing the job effectively and efficiently.

2. TEACHING AND EXAMINATION SCHEME

Semester IV									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(MC 406) Metrology and Quality Control	L	T	P	H	TH	TM	TW	PR/OR	
	02	-	02	04	75	25	25	-	125

3. COURSE OUTCOMES:

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

MC406CO1: Define various terms of measurement in metrology & quality control.

MC406CO2: Explain the instruments of linear, angular measurement & quality control charts.

MC406CO3: Select appropriate instruments used for appraisal of product quality.

MC406CO4: Apply the concept of Metrology & Quality control for real time measurement.

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	0	1	2	1	2
CO2	2	2	2	2	1	2	3	1	2
CO3	3	3	3	3	1	2	3	2	3
CO4	3	3	3	3	1	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			
Unit			**M**	**Thr**	**CO**
1 Introduction to metrology			**06**	**03**	
1.1 Definition of metrology, precision and accuracy.					**CO1**
1.2 Concept of Sensitivity, Readability, magnification, Repeatability, Reproducibility.					
1.3 Sources of errors.					
1.4 Calibration-Definition and need.					
2 (Standards & Measuring Instruments)			**12**	**06**	
2.1 Standards in measurement: Line standard and end standard List of Linear and angular measuring instruments. (No description)					**CO1** **CO2**
2.2 Slip gauges, angle gauges, Sine bar. (numerical on angle gauges and slip gauges)					**CO3**
2.3 Autocollimator, Spirit Level, Clinometer.					**CO4**
3 Limits, Fits & Tolerances			**12**	**06**	
3.1 Types of Fits, Shaft & Hole basis system, Tolerances.					**CO1** **CO2**
3.2Limit gauges. Taylor's principle.					**CO4**
3.3Types of GO and NO-GO gauges. Gauge tolerances					
3.4 Simple numerical on tolerances.					
4 Comparators and Testing			**15**	**07**	

4.1 Working Principle & comparison of Mechanical, pneumatic & Electrical-Electronic Comparators. Construction of Dial indicator, pneumatic & Electrical-Electronic comparator.			
4.2 Testing of straightness, flatness, parallelism, roundness & Surface finish.			**CO1 CO2 CO3 CO4**
4.3 Gear Terminology and errors in gears, screw thread terminology and errors in threads. List of instruments used to measure gear & screw threads parameters. (No description)			
5 Quality Control	**30**	**10**	
5.1 Concept of quality, Characteristics of Quality, Quality Assurance. Total Quality Management: Principles of T.Q.M: a) Customer focus b) Commitment by top management c) Continuous improvement-PDCA d) Quality circles.			
5.2 Statistical Quality Control: Control charts in S.Q.C, X-R chart, P-chart, (Steps in preparation and numerical example). Acceptance sampling: Single and Double sampling curve. Introduction to Six sigma.			**CO1 CO2 CO3 CO4**
5.3 Introduction to ISO 9000, Necessity and importance of I.S.O.			
Total	**75**	**32**	

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 metrology	3	6
2	Linear and Angular Measurements	6	15
3	Limits, Fits & Tolerances	6	15
4	Comparators and Testing	7	15
5	Quality Control	10	24
	Total	32	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS.

No	Practical	Marks
	Practical Title	
1	Use of basic measuring instruments. Surface plate, v-block, sprit level, angle gauges, filler gauge, screw pitch gauge, radius gauge, Vernier calliper, micrometre, Universal bevel protractor and slip gauges to measure dimension of given jobs.	
2	Use of Dial indicator to measure as a comparator to compare the given work piece with a standard specimen.	
3	Use of Sine-Bars to measure angle.	
4	Study on Calibration of Vernier caliper	
5	Measurement of different Parameters of Gear.	
6	Measurement of different Parameters of screw thread	
7	Demonstration of optical flats using monochromatic light source.	
8	Demonstration of Tool Maker's microscope/Profile projector.	
9	To draw and interpret the control limit for variable measurement (X, R and P Chart).	
	Total	25

9. LEARNING RESOURCES

9.1Text Books

S. No.	Author	Title of Books	Publishers
1	R. K. Jain	Engineering metrology	Khanna Publisher, Delhi.
2	J.F.W. Galyer and C. R. Shotbolt	Metrology for Engineers	ELBS
3	K. J. Hume	Engineering Metrology	Kalyani publishers
4	I.C. Gupta	A text book of Engineering metrology	DhanpatRai and Sons,
5	M. Adithan and R. Bahn	Metrology Lab. Manual	T.T.T.I. Chandigarh.

9.2 Reference Books for further study

S. No.	Author	Title of Books	Publishers
6	M. Mahajan	Statistical Quality Control	DhanpatRai and Sons ,
7	T.T.T.I. Chennai	Quality control	Tata McGraw Hill,
8	Juran U.M. and Gryna	Quality planning and analysis	Tata McGraw Hill,
9	National productivity council	Inspection and quality control	N.P.C., New Delhi.
10	Metrology and Precision Engineering	A.J.T.Scarr	Tata McGraw Hill

9.3 Indian and International codes needed

S. No.	Author	Title of Books	Publishers
1	IS919-1993	Recommendation for limits. Fits and tolerances.	B.I.S
2	IS2029-1962	Dial Gauges	B.I.S
3	IS2984-1966	Slip Gauges	B.I.S
4	IS4218	Isometric Screw Threads	B.I.S
5	IS5359-1969	Sine Bars	B.I.S

9.4 Internet and Web Resources

S. No.	Author	Title of Books	Publishers
1	AmmarGrouss	Applied Metrology for Manufacturing Engineering	Wiley
2	G.M.S de Silva	Basic Metrology for ISO9000 Certification	Butterworth-Heinemann

9.5 Videos and Multimedia Tutorials

S. No.	Author	Title of Books	Publishers
1	www.nptel.iitm.ac.in	Lectures in Metrology	
2			

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**	
Attendance Marks*	Industrial Mentor's assessment Marks	Institute Mentor's assessment Marks	Training Report	Report Assessment & Seminar/Viva	TOTAL Marks
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
CC601 INDUSTRIAL ORGANISATION AND MANAGEMENT	L	T	P	H	TH	TM	TW	PR/OR	100
	3	-	-	3	75	25	-	-	

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) उनवेद (आयुवेद, धनुवेद, गन्धवेद, स्थानत्य आदद) (iii) वेदांग (शिक्षा, कल्त, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उनाइग (धर्म सि, ीशांसा, नुराण, 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

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
(CC 602) BUSINESS COMMUNICATION		L	T	P	H	TH	TM	TW	PR/OR	
		-	-	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		06	CO1 CO2 CO4
4**.1 Job application and resume** draft job application and resume, draft letter of acceptance and cold contact letter			
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 MECHANICAL ENGINEERING PROJECT		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**
		-	**-**	**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
MC 601 MACHINE DESIGN		L	T	P	H	TH	TM	TW	PR/OR	
		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					
1.1 Machine Design philosophy and procedures			10	8	CO1 CO2
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					
2.1knuckle joint			12	10	CO1 CO2 CO4
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					
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			42	36	CO1 CO2 CO3 CO4
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-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 CO2 CO3
2.2 Types of geometric models.					
2.3 Solid modelling- Primitives & Boolean operations, Types of Solid modelling Techniques: Constructive solid geometry (CSG) method, sweep methods.					
2.4 Transformations: Types of transformation, Numericals of 2^{nd} and 3^{rd} order only.					
2.5 Classification of surface, free form surfaces, (No numerical treatment)					
3 INTRODUCTION TO COMPUTER NUMERICAL CONTROL			15	10	CO1 CO2
3.1 Introduction - NC, CNC, DNC,					
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 CO2 CO3 CO4
4.2 Programming format, part programming					
4.3 Use of subroutines and do loops,					
4.4 Simple programs on Turning and Milling operations.					
5 ROBOTICS &AUTOMATION					
5.1 Introduction, physical configuration, basic robot motions,			20	12	CO1 CO2
5.2 Technical features such as - work volume, precision and speed of movement, Load carrying capacity, range, repeatability & accuracy					
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**
(MC621) REFRIGERATION & AIR CONDITIONING		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		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

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
(MC 622) AUTOMOBILE 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 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 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	CO2 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
MC629 JIG & FIXTURES DESIGN	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:

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.

.

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	15	08	CO1 CO2
3.1 Principles of clamping: position, strength, productivity, operator fatigue, and work piece variation			
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	18	10	CO1 CO2
4.1 Linear indexing; Rotary Indexing			
4.2 Indexing plate; Rotary Indexing Tables			
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	24	18	CO1 CO2 CO3 CO4
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			
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	
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. LEARNING RESOURCES

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
(MC631) LEAN MANUFACTURING	L	T	P	H	TH	TM	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:

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	22	13	CO1
1.1 History of lean manufacturing.			

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
		L	T	P	H	TH	TM	TW	PR/OR	
(MC 623) POWER PLANT ENGINEERING		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, 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.			20	10	**CO1 CO2 CO3**

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
MC630	L	T	P	H	TH	TM	TW	PR/OR	
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			15	08	CO1
1.1 Introduction to concept of maintenance: Need for maintenance, Types of maintenance practices: Breakdown, preventive, predictive. Their comparison and areas of application.					
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			9	7	CO2
2.1 Maintenance stores control, Maintenance store rooms Inventory & classification of inventory related to maintenance Standardisation of maintenance parts.					
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			12	7	CO3
4.1 Types of lubricants: Liquid, semi fluid and solid, Requirementsof lubricants, Selection of lubricants for various applications using some, available commercial grades,					
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/