MONAD UNIVERSITY

School of Engineering and Technology

Department of Mechanical Engineering

SCHEME, CURRICULUM AND SYLLABUS

DIPLOMA - Three – Years

Effective from 2019-20

Diploma Mechanical Engineering: Structure at a Glance

Year	Semester	Course Code	Subject	L	T	P	C
1	1	DIP-111	Professional Communication	3	1	2	5
		DIP-112	Applied Physics-I	2	1	2	4
		DIP-113	Applied Chemistry-I	2	1	2	4
		DIP-114	Applied Mathematics-I	2	1	0	3
		DIP-115	Computer Fundamentals and Applications	3	1	2	5
		EY-111	Conventional Energy Resources	2	1	0	3
		DIP-116	Workshop Practice-I	0	0	4	2
			Total	**14**	**6**	**12**	**26**
	2	DIP-121	Applied Physics-II	2	1	2	4
		DIP-122	Applied Chemistry-II	2	1	2	4
		DIP-123	Applied Mathematics-II	2	1	0	3
		DIP-124	Applied Mechanics	2	1	2	4
		DIP-125	Engineering Drawing	0	0	4	2
		EY-121	Basics of Renewable Energy	2	1	0	3
		DIP-126	Environmental Science	2	1	0	3
		DIP-127	Workshop Practice-II	0	0	4	2
			Total	**12**	**6**	**14**	**25**
2	1	DIPME-211	Strength of Materials	2	1	2	4
		DIPME-212	Materials and Processes	2	1	2	4
		DIPME-213	Machine Drawing	0	0	4	2
		DIPEE-211	Electrical & Electronics Engineering	3	0	2	4
		DIPME-214	Theory of Machines	2	1	0	3
		DIPME-215	Measurement and Metrology	2	1	2	4
			Total	**11**	**4**	**12**	**21**
	2	DIPME-221	Hydraulics & Hydraulics Machines	2	1	2	4
		DIPMEA-222	Basic Automobile Engineering (**Elective for Automobile**)	2	1	2	4
		DIPMEP-222	Production Technology-I (**Elective for Production**)	As above			
		DIPME-223	Mechanical Estimating and Costing	2	1	0	3
		DIPMGM-221	Basics of Entrepreneurship Development	2	1	0	3
			Total	**08**	**4**	**4**	**14**
3	1	DIPMEA-311	Automobile Maintenance Servicing and Repair (Elective for Automobile)	3	1	0	4
		DIPMEP-311	Production Technology-II (Elective for Production)	As above			
		DIPME-312	Manufacturing Processes & Machine Design	2	1	2	4
		DIPME-313	Thermal Engineering and IC Engine	2	1	2	4
		DIPME-314	Machine Tool Technology & Maintenance	2	1	0	3
			Total	**09**	**4**	**4**	**15**
	2	DIPMEA-321	Automobile Engine (Elective for Automobile)	3	1	0	4
		DIPMEP-321	Production Automation (Elective for Production)	As above			
		DIPME-322	Industrial Engineering safety	3	1	0	4
		DIPME-323	Basics of Destructive and Non Destructive Testing	3	1	0	4
		DIPME-324	Industrial Training /Project	0	0	12	6
		DIPME-325	Comprehensive Viva-Voce	0	0	0	2
			Total	**9**	**3**	**12**	**20**

DIP- 111 Professional Communication

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE

Professional Communication aims to develop the basic knowledge and skills of spoken English so that the students attain the requisite confidence to express themselves effectively in English language. The designed course curriculum covers basic grammar and vocabulary at the outset to build up the initial knowledge base for developing communication skills. Besides, the course addresses verbal communication along with communicative practice, listening skills, special communication with emphasis on extempore speaking, presentation/ group discussion/ interview skills. It also includes business communication to impart training on proper use of internet, intranet, e-mail, and video-conferencing. The programme curriculum concludes with non-verbal communication techniques wherein aspects related to positive body language and etiquettes are adequately covered. The course has been structured in a manner that the students are exposed to relevant guidelines pertaining to the spoken English as well as its communicative practices to build up the desired confidence in a short span of time

The course is divided into six units. The objectives of each unit are given below:

Unit No	Contents	Contact Hrs
Unit -I	**Grammar and Vocabulary:** After going through this unit, you will be able to understand: The Sentence, Pronoun, Verb, Subject Verb Agreement, Adjective, Article, Prepositions, Vocabulary Common Mistakes in Understanding Words	**6**
Unit -II	**Verbal Communication :** After going through this unit, you will be able to understand: Importance of Verbal Communication, Communication Practice, Important Expressions and Etiquette, Etiquette, Better Verbal Communication, Interpersonal Communication Skills, Hierarchical Communication, Public Speaking	**6**
Unit -III	**Listening Skills :** After studying this unit, you should be able to understand: Difference between Listening and Hearing, Listening Process, Types of Listening, Listening Comprehension and Note-taking, One-way Communication, Two-way communication	**6**
Unit -IV	**Special Communication:** After going through this unit, you will be able to understand: One-to-One Conversation, Extempore, Presentation Skills, Group Discussion, Interview Techniques	**6**
Unit -V	**Business Communication:** After going through this unit, you will be able to understand: Telecommunications, Voice Mail, Conference Calls, Video Conferencing, Internet, Intranet, E-mail, Chat Rooms**.**	**8**
Unit -VI	**Non-Verbal Communication:** After going through this unit, you will be able to understand: Eye Contact, Body Language and Lying, The Eyebrows, The Mouth, The Head, The Smile, Dressing, Dos and Don'ts, Artifacts, Time, Touch, Nonverbal Communication in India, Business Etiquette in India	**8**

PARACTICAL

We envisage two successive stages for attaining skill in communication ability;

1. Listening   2. Speaking

We can club them together as shown above.

1.	**Listening:** For improving listening skills the following steps are recommended, Listen to Prerecorded Tapes, Reproduce vocally what has been heard, Reproduce in Written form, Summaries the text heard, Suggest Substitution of Words and Sentences, Answer Questions related to the taped text, Summaries in Writing.
2.	**Speaking:** Introducing English consonant-sounds and vowel-sounds. Remedial exercises where necessary, Knowing Word stress Shifting word stress in poly-syllabic words [For pronunciation practice read aloud a Para or page regularly while others Monitor]
3.	**Vocabulary:** Synonyms. Homonyms. Antonyms and Homophones, Words often confused, as for example, [I-me; your-yours; its-it's; comprehensible-comprehensive; complement-compliment] Context-based meanings of the words, for example, an[N] man[vibe]; step[|N| ,step[vibe],conflict _____Israel Palestinian conflict Emotional conflict, Ideas conflict, Learn ——— 1 learns at this school I learnt from the morning news.
4.	**Delivering Short Discourses:** About oneself, Describing a Place, Person, Object, Describing a Picture, Photo.
5.	**Group Discussion: Developing** skill to initiate a discussion [How to open], Snatching initiative from others [Watch for weak points, etc.]
6.	**Expand a topic-sentence into 4-5 sentence narrative.**

REFERENCE BOOKS:		
1.	Intermediate English Grammar	Raymond Murphy, Pub: Foundation Books, New Delhi
2.	Eng. Grammar, usage & Composition	Ticked & Subramanian Pub: S.Chand and Co.
3.	Living Eng. Structure	Standard Alien. Pub: Longman
4.	A Practical Eng. Grammar (and its Exercise Books)	Thomson and Martinet. Pub : ELBS
5.	High School English Grammar and Composition	Wren & Martin.

DIP- 112 APPLIED PHYSICS-1

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

Physics is an applied science from which all engineering technologies have evolved, therefore, a thorough knowledge of the basic principles & applied aspects will help students understand, apply & evolve technologies more effectively and there-by improve the life of the society.

UNIT	CONTENTS	Hrs
Unit -I	**Units and Dimensions** : Idea of various systems of units SI units - Basic, Supplementary and Derived Units, Prefixes &Symbols, Dimensions and Dimensional Formulae, Principle of Homogeneity of Dimensions, Dimensional Analysis, Applications and Limitations **Elasticity** : Elasticity ,Stress and Strain ,Elastic Limit & Hooke's law ,Young's Modulus, Bulk Modules & Modulus of Rigidity, Poisson's Ratio	6
Unit- II	**Properties of Liquids**: Surface Tension & Surface Energy, Cohesive & Adhesive Force ,Angle of Contact ,Capillarity & Expression for Surface Tension ,Streamline & Turbulent Flow, Reynolds Number. Viscosity & Coefficient of Viscosity Stake's law & Terminal Velocity	6
Unit-III	**Gravitation & Satellites**: Newton's law of Gravitation, Acceleration due to Gravity, Kepler's laws of Planetary Motion (statement only),Artificial Satellite (simple idea), Geo-Stationary Satellites, Escape Velocity ,Velocity & Time Period of an Artificial Satellite. **Sound Waves:** Velocity of Sound Waves, Newton's Formula, Laplace Correction, Factors affecting Velocity of Sound Waves, Propagation of Progressive Wave, Displacement, Velocity and Acceleration of a particle during propagation of wave, Superposition of Waves, Stationary Waves (without mathematical analysis), Resonance tube	10
Unit-IV	Transfer of Heat: Modes of Transmission of Heat - Idea of Conduction, Convection & Radiation ,Thermal Conductivity & Coefficient of Thermal Conductivity, Black Body ,Kirchhoff's Laws & Stefan Boltzmann Law (statement only),Newton's Law of Cooling & its Derivation from Stefan's Law **Electrostatics:** Coulomb's Law ,Intensity of Electric Field, Intensity due to a Point Charge, Electric Lines of Forces & Electric Flux, Electric Potential, Electric Potential due to a Point Charge	8

PRACTICALS

1.	To Measure Internal Die, External Die and Depth of a Calorimeter using Vernier Calipers.
2.	To Measure Density of a Wire using Screw gauge .
3.	To Measure Radius of Curvature of a Lens, Mirror using Spherometer.
4.	To Determine Refractive Index of Glass using Prism.
5.	To Determine the Refractive Index of Glass using Travelling Microscope.
6.	To Determine Focal Length of a Convex Lens by Displacement Method.
7.	To Determine the Velocity of Sound at O c using Resonance Tube.
8.	To Determine Young's Modulus of Elasticity using Searle's Apparatus.
9.	To Determine Acceleration due to Gravity using Simple Pendulum
10.	To Verify Newton's Law of Cooling.

REFERENCE BOOKS:		
1.	Engineering Physics	Gaur & Gupta
2.	Applied Physics Vol.-I	Hari Harlal, NITTTR
3.	Applied Physics Vol.-II	Hari Harlal, NITTTR
4.	A Text Book of Applied Physics	N.S. Kumar
5.	Principles of Physics	Brijlal, Subhramanyam

DIP-113 APPLIED CHEMISTRY-1

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE
It is essential that one has to understand the fundamentals of basic sciences before trying to learn their application in various branches. In framing the curriculum of chemistry, emphasis has been laid on the teaching of such topics, which have a bearing on the topics of various branches of engineering. With this object in view, some important fundamental topics of chemistry have been Included in this syllabus.

UNIT	CONTENTS	Contact Hrs
Unit-I	**Atomic Structure**: Constituents of the Atom, Bohr's Model of the Atom, Quantum Number and Electronic Energy Levels, Aufbau's Principle, Pauli's Exclusion Principle, Hund's Rule, $n + l$ Rule Electronic Configuration of Elements (s, p, d Block Elements), **Development of Periodic Table:** Modern Periodic Law, Long form of Periodic Table. Study of Periodicity in Physical and Chemical Properties with special, reference to, Atomic and Ionic Radii, Ionization Potential. Electron Affinity Electro negativity, Variation of Effective Nuclear Charge in a Period. Metallic Character.	10
Unit-II	**Electro Chemistry:** Ionization, Degree of Ionization, Factors which Influence Degree of Ionization. Hydrolysis – Degree of Hydrolysis, Hydrolysis Constant. pH Value, Buffer Solution . Electrolysis, Faraday's Laws of Electrolysis. **Kinetic Theory of Gases:** Postulates of kinetic Theory, Ideal Gas Equation, Pressure and Volume Corrections, Vender Walls, Equations, Liquefaction of Gases, Critical Pressure and Critical Temperature for, Liquefaction. Liquefaction of Gases by Joule – Thomson Effect, Claude's Method and Linde's Method	8
Unit-III	**Carbon Chemistry:** Definition of Organic Chemistry. Difference between Organic and Inorganic Compounds. Classification and Nomenclature - Open Chain and Closed Chain Compounds, IUPAC System of Nomenclature. (Up to C5). **Metals and Alloys:** General Principles and Terms listed in Metallurgy, Metallurgy of Iron and Steel, Different forms of Iron, Effect of Impurities on Iron and Steel, Effect of Alloying Elements in Steel.	6
Unit-IV	**Pollution:** Water Pollution, Causes and Effects, Treatment of Industrial Water Discharges Screening, Skimming and Sedimentation Tanks, Coagulation, Reductions, Chlorination, Biological, Methods. Air Pollution, Causes and Effects, Control Methods – Electrostatic, Precipitator, Scrubbers, Gravitational, Setting Methods, by Plants. Awareness on Green House Effect, Depletion of Ozone Layer and Acid rain.	6

PRACTICALS

1.	Identification of Acid and Basic Radicals in a Salt (Total Numbers = 5)
2.	Analysis of a Mixture Containing Two Salts (Not Containing Interfacing Radicals). (Total Numbers = 5)
3.	Determination of Percentage Purity of an Acid by Titration With Standard Acid.
4.	Determination of Percentage Purity of a Base by Titration With Standard Alkali Solution.
5.	Determination of the Strength of Ferrous Sulphate using Standard Ferrous Ammonium Sulphate and Potassium Dichromate as Intermediate Solution
6.	Determination of the Strength of Ferrous Sulfate Solution using Standard Solution of Thio sulphate.
7.	Determination of the Strength of Copper Sulphate Solution using a Standard Solution of thio Sulphate.

REFERENCE BOOKS:		
1.	Engineering Chemistry II (Hindi)	Mathur and Agarwal
2.	Chemistry of Engineering Materials	C.V. Agarwal
3.	Engineering Chemistry	P.C. Jain and Monika
4.	Engineering Chemistry	M.M. Uppal
5.	Engineering Chemistry	V.P.Mehta Jain Bros. Jodhpur
6.	Practical Chemistry for Engineers	Virendra Singh
7.	Hand book of Technical Analysis	Bannerji Jain Bros.Jodhpur

DIP-114 APPLIED MATHEMATICS -1

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
Mathematics is the root of engineering. To understand the engineering subjects the knowledge of mathematics is required. This proposed syllabus of mathematics is essential for diploma students of every engineering branch. The maximum number of problems related to engineering should be given to the students in their home assignment. More and more practice of numerical problems is needed for the better understanding of the subject.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Introduction to Different Types of Expansion:** Factorial Notation, Meaning of C(n, r), P(n, r) Binomial Theorem for Positive Index, any Index, Exponential Theorem, Logarithm Theorem **Complex umber:** Definition of Complex Number, Operations on Complex Number (Add., Sub., Multiplication, Division),Conjugate Complex Number, Modulus and Amplitude of a Complex Number, Polar form of a Complex Number.	8
Unit-II	**Matrices and Determinants:** Definition and Properties of Determinants, Definition and Types of Matrix, Transpose of a Matrix, Symmetric, Skew Symmetric Matrices, Orthogonal, matrices, Hermitical and Skew Hermitian, Minors and Cofactors, Adjoint and Inverse of a Matrix, Cramer's Rule, Solution of Simultaneous Linear Equations by Inverse Matrix Method. Characteristic Matrix, Characteristic Equation, Eigen Values & Vectors, Cayley Hamilton Theorem (verification only)	8
Unit-III	**Numerical Integration :**Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Newton - Rap son Rule, **Two Dimensional Coordinate Geometry:** General Introduction, Distance Formula and Ratio Formula, Co-ordinate of Centroid, In-Centre, Ortho-Centre and Ex-Centre of a Triangle Area of Triangle, Straight Line, Slope form, Intercept form, Perpendicular form, One Point Slope form, Two Point form & General form, Angle between Two Lines, Perpendicular Distance of a Line from a Point.	8
Unit-IV	**Conic: Circle :**Definition and Standard Equations, Equations of Tangent and Normal at a Point (simple problems),**Parabola :**Definition and Standard Equations, Equations of Tangent and Normal at a Point (Simple problems),**Ellipse and Hyperbola :**Definition and Standard Equations, Equations of Tangent and Normal at a Point (simple problems)	6

REFERENCE BOOKS:		
1.	Mathematics XI & XII	NCERT, New Delhi
2.	Mathematics XI & XII	Rajasthan Board, Ajmer
3.	Polytechnic Mathematics	H. K. Dass
4.	Text Book on Differential Calculus	Chandrika Prasad
5.	Text Book on Integral Calculus	Chandrika Prasad
6.	Differential Calculus	M. Ray, S. S. Seth, & G. C. Sharma
7.	Integral Calculus	M. Ray, S. S. Seth, & G. C. Sharma

DIP-115 COMPUTER FUNDAMETALS AND APPLICATIONS

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE
Day by day use of computer is increasing for correct, speedy and concise work So it is very essential to educate every technocrat in computer education so that it can be used in regular work. The contents of this course have been developed with a view to give the students a computer fundamental such as components and operating system. After getting the fundamental knowledge students may go through the advanced field very smoothly. Information processing and transferring with concise and consistent was is the major goal behind Information Technology. In the present Information Technology scenario a technician should be familiar with basics of Information Computer Communication and Internet.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Introduction:** Computer: An Introduction, Generation of Computers & Types : PC, PC/XT, PC/AT, Main Frame, Super, Lap Top, Pam Top, Data Representation, Bit, Nibble, Byte, Word Number System : Decimal, Binary, Hexadecimal & their Conversions, Arithmetic Operations (Addition, Subtraction using Binary Number System,1s , 2s Compliment, Coding Technique : BCD, EBCDIC, ASCII, Idea of: Hardware, Software, Firmware, Free ware, Human ware, Computer Languages and Translators: Machine, Assembly, High Level Language, Scripting Language, Object Oriented Language, Platform Independent Language, Translators: Assembler, Interpreter, Compiler. **Introduction to Computer:** Central Processing Unit (CPU),Memory Unit, Input/ Out Devices : Keyboard, Mouse (Optical), Digitizer, Scanner, Web, Camera, Monitor (CRT, TFT) ,Printers, Plotters, Bar Code Reader. **Secondary Storage Devices:** Floppy, Hard Disk, CD, DVD, Flash Drive, Block Diagram Showing Interconnection of Computer Parts.	10
Unit-II	**Operating System: Definition** of Operating System (OS),Types of OS, Single user, Multi user, Multi Programming, Time Sharing, Multi Processing. **Introduction to Windows XP:** Introduction to Windows Environment, Parts of Windows Screen, Icon, Menu, Start Menu,.4 Minimizing, Maximizing, Closing Windows, Windows Explorer, Recycle Bin, Clipboard, My Computer, My Network Places, Control Panel : Adding New Hardware and Software, Display, Font, Multimedia, Mouse, international System, Accessories: Paint, Media Player, Scan disk, System Information. **Information Concepts and Processing:** Definition of Data, Information Need of Information, Quality of Information, Concepts of Data Security, Privacy, Protection Computer Virus and their types, Scanning & Removing Virus	10
Unit-III	**Computer and Communication:** Need of Data Transmission, Data Transmission Media, Baud rate and Bandwidth, Digital and Analog Transmission Serial and Parallel, Data Transfer, Protocols, MODEM. **Networking of Computers:** LAN, WAN, MAN, Blue tooth, LAN Topologies: Bus, Star, Ring, Hybrid, Introduction to Ports: RS232, IEEE 488, PS2, USB, UTP. **Internet:** Introduction to Internet, Bridges, Routers, Switch, Gate way, www, Web Site, URL, e-mail, e-Commerce, Web browsing, Web page, Introduction to Hyper text & HTML, Introduction to http & ftp Protocol	10

| Unit-IV | **Information Processing:** Word processor, Introduction to MS-Word, Starting MS-Word, Special Features of MS-Word, Using Help, Opening Document, Typing and Editing, Copying, Inserting, Moving, Deleting, Copying from One Document to Others. Undo, Redo, Spell Check, Find and Replace, Formatting, Characters and Fonts, Spacing, Removing Characters Formatting, Inserting Symbols, Paragraphs, Page Setting, Header and Footer, Page Breaks, Borders and Shading, Print Preview and Printing, Tables and Columns, Mail Merge, Auto Text and Auto correct, Introduction to Macro, Electronic Spread Sheet, Introduction to MS-Excel, Working with Spread Sheet, Editing the Worksheet, Worksheet Formatting, Formula Entering, Function Wizard, Saving and Printing Work Book, Analysis Tools, Data Tools, Charts, Linking Work Sheets, Report Wizard, Data Base Application, Data Base Components, Working with Database, Creating Excel Database, Adding Records using Data Form, Deleting Records using Menu Command, Deleting Records using Data Form, Editing Records, Finding Records based on Criteria.

 Power Point: Introduction to Power Point, Creating a Presentation/Slide, Adding Animation in Slide, Running a Slide Show. | 10 |

PRACTICALS

1.	Study of Computer Components
2.	Practice of Computer Booting Process in XP
3.	Demonstration of Windows Environment
4.	Practice of using My Computer, Windows Explorer
5.	Practice of using Control Panel
6.	Practice of My Network Places
7.	Practice of CD and DVD Writing
8.	Practice of Paint
9.	Installation of Windows XP by using NTFS File System.
10.	Demonstration of Network
11.	Visit to Internet Site
12.	Creating e-mail Account, Sending and Receiving e-mails.
13.	Sending e-mail with Attachment & Signature
14.	Searching Web Page/ Site using Search Engine: (eg. google.com, yahoo.com, altavista.com etc.)
15.	Exercise Based on MS-Word: 15.1 Document Preparation 15.2 Printing Document 15.3 Mail Merge usage 15.4 Draw Table

16.	Exercise Based on Ms-Excel : 16.1 Work Book Preparation 16.2 Printing Workbook 16.3 Data-base usage 16.4 Draw Charts
17.	Exercise Based on Power Point : 17.1 Creating Slide 17.2 Adding, Animations in Slide 17.3 Running Slide
18.	Creating Simple Web Page using HTML.

REFERENCE BOOKS:	
1.	Computer Fundamental	V.K. Jain, Standard Pub. & Distributors
2.	PC Software for Windows made simple	R.K. Taxali, TMH
3.	Mastering Windows XP	TMH
4.	BPB Computer Course	BPB Editorial Board, BPB in Hindi
5.	Introduction to Networking	NANCE, PHI
6.	First Course in Computer Science	Sanjeev Saxena, Vikas Publishing House
7.	First Look Microsoft Office 2003	Murray, PHI
8.	Web Based Application Development using HTML, DHTML, JavaScript Pearl/ CGI	Ivan Beyross, TMH

EY-111 CONVENTIONAL ENERGY RESOURCES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
This course on conventional energy resources aims at making the students familiar with various forms of energy. The students will also learn about various conventional energy resources.

Unit	Contents	Contact Hrs
Unit-I	Introduction to Energy and Its Various Forms Energy, Grades of Energy, Basics of Electrical Energy, Basics of Thermal Energy, Energy and Thermodynamics, Various Forms of Energy, Units of Energy	8
Unit-II	Conventional Energy Sources Earth's Energy Resource Base, Primary and Secondary Resources, Renewable and Non-renewable Resources, Commercial and Non-commercial Resources, Conventional Energy, Coal, Oil, Natural Gas, Oil Shale and Tar Sands, Nuclear Power.	8
Unit-III	World Scenario of Conventional Energy Resources Fossil Fuel, Coal, Oil, Natural Gas, Nuclear power.	7
Unit-IV	Calorific Values of Fuels: Calorific Value Defined, Units of Calorific Values, Higher Calorific Values, Lower Calorific Values, Calorific Values of Coal, Calorific Values of Petroleum Products, Calorific Values of Gaseous Fuels	7

REFERENCE BOOKS:		
1.	Solar energy utilization, Ed, V.1995	G.D.Rai
2.	Solar energy, Tata McGraw Hill Publishing Company, Ed., II 1997	S.P.Sukhatme
3.	Energy Technology, Ed. II, 1997	S.Rao and Dr.B.B. Parulekar
4.	Power Plant Technology, 1993	A.K.Wahil

DIP-116 WORKSHOP PRACTICE -1

L	T	P	Cr
0	0	4	2

COURSE OBJECTIVE
Every student of diploma course is expected to have the knowledge in basic shops like fitting, plumbing, carpentry, welding, sheet metal. It is expected that students should be able to carry out minor installation work / repair work of domestic appliances independently. The theoretical / practical knowledge thus gained will be helpful in achieving that end. With this view this subject is to be taught in all the branches of diploma.

UNIT	CONTENTS		Contact Hrs
Unit-I	**Fitting shop: Theory:** Introduction to different materials used in Fitting Shop. Description of Work Bench, Names, Functions and Specification of Holding Devices. Specification of Files, Precautions While Filing. Marking of Jobs, use of Marking and Measuring Tools. What is Chipping, Where Chipping is one. Names Functions and Specifications of Chisels, Hammers etc. Simple Operation of Hacks awing, different types of Blades, and their uses, Fitting of Blade in Hacksaw Frame. Name, Functions and Specifications of Drills, Selection of Drills for Tapping, Types of Tapes, Tapping and Dyeing Operations. Precaution While Drilling Soft Metals, Specially Lead. **Plumbing shop: Theory: Classification** of Pipes According to Materials and use I.S.I. Specification for Pipes. Introductions to Cement and PVC Pipes and their uses. Names Functions and Specifications of Plumbing Tools and Accessories- such as Pipe Dies, Wrenches, and Pipe Vices. Different Pipe Fittings.	**Exercises :** 1. Cutting and Threading on G.I. Pipe 2. Exercise on PVC Pipe Fitting. 3. Repair of Taps and Cocks.	10
Unit-II	**Welding Shop: Theory :** Introduction to Welding and its Importance in Engineering Practices, Common Materials that can be Welded.. Gas Welding Theory: Gas Welding Equipment, Adjustment of different types of Flames, Practice in Handling Gas Welding Equipment. Electric arc Welding	**Exercises :** 1. Preparation of a Butt Joint by Gas Welding. 2. Preparation of Lap Joint by Electric arc Welding. Preparation of T-Joint by Electric arc Welding. 3. Demonstration on Brazing by the Instructor	10

REFERENCE BOOKS:		
1.	Workshop Technology	Gupta & Malan
2.	Workshop Technology	Kumar & Mittal
3.	Workshop Technology	Hajra, Chaudhary
4.	Workshop Technology	B.S. Raghhuwanshi
5.	Workshop Technology (Hindi)	Tahil Maghnani
6.	Workshop Technology (Hindi)	Vinay Kumar

DIP- 121 APPLIED PHYSICS-II

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

Physics is an applied science from which all engineering technologies have evolved, therefore, a thorough knowledge of the basic principles & applied aspects will help students understand, apply & evolve technologies more effectively and there-by improve the life of the society.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**D.C. Circuits :** Resistivity, Effect of Temperature on Resistance, Ohm's Law, Resistance in Series and Parallel and their Combination, Kirchhoff's Law, Wheatstone Bridge, Meter Bridge, Principle of Potentiometer, **A.C. Circuits:** Faraday's Laws of Electro Magnetic Induction, Lenz's Law, Self and Mutual Inductance ,Alternating Current, Phase & Phase Difference, Instantaneous, Average and, rms value of AC, Behavior of Resistance, Capacitance and Inductance in an AC Circuit, AC Circuits Containing, R-L, R-C and LCR in Series, Power in AC Circuit and Power Factor, Choke Coil	8
Unit-II	**Semi Conductor Physics:** Energy Bands in Conductor, Semi Conductor & Insulator, Chemical Bonds in Semiconductor, Intrinsic and Extrinsic Semiconductors, PN-Junction Diode, Working, Biasing and Characteristics Curves, Zener Diode and Voltage Regulation using it, Half Wave & Full Wave Rectifiers (only working, no derivations),Junction Transistors, Working, Biasing and Characteristic Curves, Brief Idea of Using Transistors as an Amplifier (without mathematical analysis)	8
Unit-III	**Modern Physics:** Photo Electric Effect, Einstein's Equation, Photo Cells, Lasers, Stimulated, Emission and Population Inversion, Types of Laser - Helium Neon and Ruby Laser, Application of Lasers (brief idea only),Material Processing, Lasers in Communication, Medical Applications **Nuclear Physics:** Idea of Nuclear Force, Mass - Defect and Binding Energy, Nuclear Reactions, Natural and Artificial Radioactivity, Law of Radioactive Disintegration, Half Life & Mean Life, Idea of Nuclear Fission and Fusion, Chain Reaction, Nuclear Reactor	8
Unit-IV	**Pollution and its control:** Introduction to Pollution – Water, Air, Soil , Noise, Nuclear and mental pollution, Types of Pollution, Brief idea about Noise Pollution and its Control, Nuclear Hazards Nuclear Waste Management	6

PRACTICALS

1.	To Verify Law of Resistances.
2.	To Determine Specific Resistance of Material using Meter Bridge.
3.	To Determine Internal Resistance of a Primary Cell using Potentiometer.
4.	To Compare emf of two Primary Cells using a Potentiometer.
5.	To Draw Characteristic Curves of PN Diode and Determine it's Static and Dynamic Resistance.
6.	To Draw Characteristic Curves of a PNP/NPN Transistor in CB/CE Configuration.
7.	To Measure Resistance of a Galvanometer by Half-Deflection Method.

REFERENCE BOOKS:		
1.	Engineering Physics	Gaur & Gupta
2.	Applied Physics Vol.-I	Hari Harlal, NITTTR
3.	Applied Physics Vol.-II	Hari Harlal, NITTTR
4.	A Text Book of Applied Physics	N.S. Kumar
5.	Principles of Physics	Brijlal, Subhramanyam

DIP-122 APPLIED CHEMISTRY -II

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE
It is essential that one has to understand the fundamentals of basic sciences before trying to learn their application in various branches. In framing the curriculum of chemistry, emphasis has been laid on the teaching of such topics, which have a bearing on the topics of various branches of engineering. With this object in view, some important fundamental topics of chemistry have been Included in this syllabus.

UNIT	CONTENTS	Contact Hrs
Unit-I	**Water:** Sources of Water, Hardness of Water. Degree of Hardness, Estimation of Hardness by EDTA method, Problems on, Calculation of Hardness, Disadvantages of Hardness, Softening Methods, Lime-Soda Method, Permutite Method, on -Exchange Method, Problems on Softening of Water, Drinking Water, its Requisites, Purification and Sterilization of Water., **Fuels:** Definition, Classification, Calorific Value (HCV and LCV) and Numerical Problems on Calorific Value Combustion of Fuels, Numerical Problems on Combustion, Solid Fuels, Coal and Coke, Liquid Fuels, Petroleum and its Distillation, Cracking, Octane and Catani Values of Liquid Fuels, Synthetic Petrol, Power Alcohol	10
Unit-II	**Corrosion:** Definition, Theories ff Corrosion, Acid Theory (Rusting), Direct Chemical Corrosion or Dry Corrosion, Wet Corrosion or Electro-Chemical Corrosion (Galvanic and Concentration Cell Corrosion),Various Methods for Protection from Corrosion, **Polymers:** Definition, Plastics, Classification, Constituents, Preparation, Properties and Uses of Polythene, Bakelite Ethylene and Nylon. Rubber, Natural Rubber, Vulcanization, Synthetic Rubbers - Buna - N, Buna-S, Butyl and Neoprene	8
Unit-III	**Cement and Glass:** Manufacturing of Portland Cement, Chemistry of Setting and Hardening of Cement, Glass: Preparation, Varieties and Uses. **Lubricants:** Definition, Classification Properties of Lubricants: Viscosity, Oiliness, Flash Point, Fire Point, Acid, Value, Saponification, Emulsification, Cloud and Pour Point. Artificial Lubricants	6
Unit-IV	**Miscellaneous Materials:** Refractoriness' : Definition, Classification and Properties, Abrasives : Natural and Synthetic Abrasives, Paint and Varnish : Definition and Function of Constituents Soap and Detergents : Definition, Properties and Uses, **New Engineering Materials: (Brief Idea of Following),** Superconductors, Organic Electronic Materials, Fullerenes, Optical Fibers.	6

PRACTICALS

1.	Determination of pH Values of Given Samples.
2.	Determination of Hardness of Water by EDTA Method.
3.	Estimation of Free Chlorine in Water.
4.	Determination of Acid Value of Oil.
5.	Preparation of Soap.

REFERENCE BOOKS:

1.	Engineering Chemistry-I(Hindi)	Mathur & Agrawal.
2.	Inorganic Chemistry	Shivhare & Lavania.
3.	Organic Chemistry	Kumar & Mehnot
4.	Practical Engineering Chemistry	Dr Renu Gupta & Dr Sapana Dubey
5.	Practical Engineering Chemistry in Hindi	Dr R. S. Sindhu & Dr. Roshan lal pitalia
6.	A Text book of Engineering Chemistry	S. K. Jain & K. D. Gupta
7.	Engineering Chemistry	Dr. K.L. Menaria & Dr Praveen Goyal

DIP-123 APPLIED MATHEMATICS -II

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
Mathematics is the root of engineering. To understand the engineering subjects the knowledge of mathematics is required. This proposed syllabus of mathematics is essential for diploma students of every engineering branch. The maximum number of problems related to engineering should be given to the students in their home assignment. More and more practice of numerical problems is needed for the better understanding of the subject.

UNIT	CONTENTS	Contact Hrs.
Unit-I	Function: Definition of Function, Range and Domain of Function, Types of Function, Absolute Value Function, Exponential value Function, Identity Function, Reciprocal Function, Rational and Irrational Function, Increasing and decreasing Function, Limits, Concept of Limit, L.H.L., R.H.L. Limit of Standard Functions, Concept of Continuity and Differentiability at a Point (simple Problems)	5
Unit-II	**Differential Calculus :**Standard Formulae (Except Hyperbolic Function),Derivative of Sum, difference, Multiplication and Division of two Functions, Differentiation of Function of a Function, Logarithmic Differentiation, Differentiation of Implicit Functions, Differentiation of Parametric Functions, Differentiation by Trigonometric Transformations, Differentiation of a Function wart. Another Function, Second Order Derivative, **Applications of Differential Calculus:** Geometrical meaning of die / do. Tangents and Normals, Angle of Intersection between two Curves ,Derivative as a Rate Measurer, Errors and Approximations, Maxima and Minima of Function with one Variable	10
Unit-III	**Integral Calculus,** General Introduction of Integral Calculus, Integration of Sum and difference of Functions. Integration by Simplification, Integration by Substitution, Integration by Parts, Integration of Rational and Irrational Functions, Definite Integral and its Properties, **Differential Equations:** Definition of differential Equation. Order, Degree and Solution of a differential, Equation. Solution of a differential Equation of First Order and First Degree using: Variable Separable Method ,Homogenous Form, Reducible to Homogenous Form, Linear differential Equation, Bernoulli's Equation, Exact differential Equation, Substitution Method, Solution of Linear Differential Equation of Higher order with Constant Coefficients, Applications of Differential Equations to L-R, L-C, L-C-R Circuits of Standard, Forms	10
Unit-IV	**Vector Algebra:** Definition, Addition and Subtraction of Vectors, Scalar and Vector Product of two Vectors, Scalar Triple Product and Vector Triple Product, Applications of Vectors in Engineering Problems,	5

	REFERENCE BOOKS:	
1.	Mathematics XI & XII	NCERT, New Delhi
2.	Mathematics XI & XII	Rajasthan Board, Ajmer
3.	Polytechnic Mathematics	H. K. Dass
4.	Text Book on Differential Calculus	Chandrika Prasad
5.	Text Book on Integral Calculus	Chandrika Prasad
6.	Differential Calculus	M. Ray, S. S. Seth, & G. C. Sharma
7.	Integral Calculus	M. Ray, S. S. Seth, & G. C. Sharma
8	Engineering Chemistry	Dr. K.L. Menaria & Dr Praveen Goyal

DIP-124 APPLIED MECHANICS

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

The Subject deals with the understanding of basic concepts of statics and dynamics and its application to various disciplines of engineering. Knowledge of this subject is essential for all the disciplines of engineering for better understanding of their respective subjects

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Force:** Definition, Units, Different Types of Forces. **Coplanar Forces:** Resolution of Forces, Law of Parallelogram of Forces, Resultant of two or more Forces, Basic Conditions of Equilibrium, Lami's Theorem (No Proof),Jib Crane, Law of Polygon of Forces (Only Statement) **Moment:** Definition, Units & Sign Convention, Principle of Moments, Application of Equilibrium Conditions for non-concurrent Forces, **Application of Principles of Forces & Moments:** Levers & their Types. Reactions of Simply Supported Beams (Graphical & Analytical Method), Steel Yard. Lever Safety Valve, Foundry Crane	10
Unit-II	**Centre of Gravity:** Concept, Centroid, And Calculation of C.G. of Regular Bodies, Calculation of C.G. of Plain Geometrical Figures, Friction: Types of Friction, Laws of Friction, Angle of Friction, Angle of Repose, Friction on Horizontal and Inclined Plains, and Application of Laws of Friction Related to Wedge, Ladder and Screw Jack. **Simple Machines:** Basic Concepts, Loss in Friction, Inclined Plane Simple & Differential Wheel and Axle (Neglecting Rope thickness),Screw Jack, Lifting Crabs Systems of Pulleys, Worm and Worm Wheel.	8
Unit-III	**Projectiles:** Concept, Range, Maximum Height and Time of Flight, Equation of Trajectory, Calculation of Velocity of Projectile at Certain Height And at Certain instant. **Newton's Laws of Motion:** Definitions, Momentum and its Unit, Application of Second Law of Motion	5
Unit-IV	**Impact and Collision:** Concept, Impulse and Impulsive Force, Law of Conservation of Momentum Collision Between Two Rigid Bodies, Newton's Experimental Law of Collision, Coefficient of Restitution, **Circular Motion:** Concept, Motion under Constant Velocity, Motion under Constant Acceleration, Relationship between Linear Velocity and Angular Velocity, Centrifugal and Centripetal Forces, their Applications, **Work, Power and Energy:** Work Done by a Constant Force Work Done by Uniform Variable Force, Power, Indicated Power, Brake Power. Efficiency Power required for an Engine on Horizontal and Inclined,(smooth and rough) Planes. Energy, Potential Energy, Kinetic Energy of Rectilinear Motion, Kinetic Energy of Circular Motion	7

PRACTICALS

1.	Use of Engineering Calculator.
2.	Verification of the Law of Parallelogram and Polygon of Forces, By using Force Board ,By using Force Table
3.	Verification of the Principle of Moments in case of, Compound Lever, Bell crank Lever
4.	Determination of Reactions in Case of Simply Supported Beams.
5.	To Determine Coefficient of Friction between two Surfaces on, Horizontal Plane, Inclined Plane.
6.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Simple Wheel and axle
7.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of differential Wheel and Axle
8.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Single Purchase Crab
9.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Double Purchase Crab
10.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Worm and Worm Wheel
11.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Screw Jack
12.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of First System of Pulleys
13.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Second System of Pulleys
14.	Determination of Mechanical Advantage, Velocity Ratio and Efficiency of Third System of Pulleys.
15.	Determination of Value of "g" by Simple Pendulum.

REFERENCE BOOKS:		
1.	Engineering Statics (in Hindi)	Ochre & Sony
2.	Applied Mechanics (in Hindi)	A. R. Paage
3.	Applied Mechanics	I. B. Prasad
4.	Engineering Mechanics	R.S. Khurmi
5.	Engineering Mechanics	A. R. Basu
6.	Applied Mechanics Practical	Soni & Chandel

DIP-125 ENGINEERING DRAWING

L	T	P	Cr
-	-	4	2

COURSE OBJECTIVE
Drawing is the language of engineers. It is the only media of expressing thoughts and imaginations for giving them the practical shape. For developing universal understanding, it is necessary to follow certain universal conventions. This subject is essential for all the discipline of Engineering.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Sections and Conventions:** Conventional Method of Representing Full, Half, Removed, Revolved, Partial And Offset Section. Section Lines for Different Material as per ISI recommendations. **Rivets and Riveted Joints:** Different Types of Rivets -Snap Head, Pan Head with Tapered Neck, Rounded Counter Sunk Head, Flat Counter Sunk Head. Lap Joint - Single Riveted, Double Riveted (Chain Riveting and Zigzag Riveting),Butt Joint - Single Riveted, Double Riveted Chain Riveting and Zigzag Riveting, (using Single and Double Cover Plates)	5
Unit-II	**Screw Threads and Fasteners:** Classification of Threads, Profiles and uses of - Metric, BSW, Square, ACME, Knuckle, Sellers Threads, Machine Screw – Fillister, Flat Counter Sunk, Rounded Counter Sunk, Cup and Socket. Set Screws – Oval, Conical, Flat and Cup Pointed, Hexagonal Bolt and Nut, Stud and Collar Stud. **Foundation Bolt and Locking Devices:** Drawing and uses of Rag, Lewis and Eye Bolt, Locking by Simple Lock Nut, Split Pin and Spring Washer, Castle Nut, Locking by Plate.	5
Unit-III	**Keys and Pulleys:** Drawing and uses of Various Types of Keys - Saddle Key - Hollow and Flat, Sunk, Rectangular, Square, Key with Gibb Head, Woodruff Key, Pulley - Straight Arms flat Belt Pulley, V-Belt Pulley, **Shaft Couplings:** Muff Coupling, Protected Type Flange Coupling. **Bearings:** Simple Bush Bearing.	5
Unit-IV	**Building Drawing:** Introduction of Orientation and Sun Chart Diagram of Residential Building. Section of a Wall Including Foundation, Sectional Plan of One Room and Toilet from Given Sketch	5

PRACTICALS

1.	Riveted Joints.
2.	Screw Threads and Fasteners
3.	Pulleys
4.	Couplings
5.	Bearing
6.	Building Drawing

Preparation of following Drawings in Sketch Book (Home Assignment) :

1.	Various Types of Rivet Heads
2.	Section and Conventions
3.	Set Screws
4.	Machine Screws
5.	Foundation Bolts, Keys

REFERENCE BOOKS:		
1.	Machine Drawing	N D Bhatt
2.	Machine Drawing	V. Laxmi Narayan
3.	Machine Drawing	P S Gill
4.	Machine Drawing	M L Mathur
5.	Engineering Drawing (Hindi)	B K Goyal
6.	Mechanical Engineering Drawing (Hindi)	Gupta & Kumar
7.	Engineering Drawing	A C Parkinson

ENY 121 BASICS OF RENEWABLE ENERGY

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
This course on conventional energy resources aims at making the students familiar with various forms of energy. The students will also learn about various non-conventional energy resources.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**RENEWABLE ENERGY SCENARIO:SOLAR ENERGY:** Introduction, Expectations from the Renewable Energy during 11th Plan, Estimated Potential and Installed Capacity of Major Renewable, Energy Technologies in India, Advantages and Disadvantages of Renewable Energy, Solar Energy Potential, Solar Energy Uses, Direct use of Solar Energy, Solar Collectors, Low Temperature Solar Collectors, Medium Temperature Solar Collectors, High Temperature Solar Collectors, Model Solar Cities, Advantages and Disadvantages of Solar Energy.	5
Unit-II	**BIOMASS ENERGY:** Introduction, Resources of Biomass, Classification of Biomass Resources, Availability of Biomass, Composition of Biomass, Energy Content of Biomass, Characterization of Biomass, Effect of Calorific Value, Effect of Moisture Content, Effect of Ash Content, Effect of Volatile Matter, Effect of Fixed Carbon Effect of Ash Melting Point, Effect of Bulk Density, Environment Effects of Biomass.	5
Unit-III	**BIOGAS ENERGY:** Introduction, Energy, Environment and Health, Main Sources for Biomass for Biogas Production, Biogas, Plant Size and Requirement of Number of Cattles, Characteristics of Feed Materials, Process, Stoichiometric Calculations of the Biogas Yield and Composition, Process Parameters Affecting the Biogas Production, Organic Loading Rate (OLR), pH-Value, Alkalinity, Temperature, Carbon to Nitrogen Ration, Nutrients and Trace Elements, Hydraulic Retention Time (HRT), Toxicity, Degree of Mixing, Efficiency of Gas Production and Uses, Major Benefits	7
Unit-IV	**Wind Energy Introduction:** The History of Wind, How Wind Machines Work Types of Wind Machines, **Horizontal-axis, Vertical-axis,** Wind Power Plants, Wind Production, Wind and the Environment, Wind Energy for Water Pumping and Off-grid Power, Generation, Water-pumping, Windmill, Aero generator, Wind–solar Hybrid Systems, System Availability and Repair/Servicing Facility, Potential and Achievement, Success Stories.	6

Unit- V	OTHER FORMS OF RENEWABLE ENERGY: Introduction Geothermal Power, Use of Geothermal Energy, Geothermal Power Plants and Environment, Ocean and Tidal Energy, Ocean Thermal Energy, Tidal Energy, Advantages and Disadvantages of Tidal Energy, Hydrogen and Fuel Cells, Hydrogen as Fuel, Hydrogen as Energy Carrier, Hydrogen Fuel Cells Produce Electricity, Hydrogen Use in Vehicles, Fuel Cells, Fuel Cell Components, Advantages of Fuel Cells, Bio fuels, 1st-Generation Biofuels, 2nd-Generation Bio fuels, Hydropower, Hydropower and Environmental Impacts	7

	REFERENCE BOOKS:	
1	Renewable energy resources	Tiwari and Ghosal/ Narosa
2.	Non-Conventional Energy	Ashok V Desai /Wiley Eastern
3.	Non-Conventional Energy Systems	K Mittal /Wheeler
4.	Solar Energy	Sukhame
5.	Non-Conventional Energy Sources	G.D. Rai
6.	Renewable Energy Technologies	Ramesh & Kumar /Narosa

DIP-126 ENIVRONMENTAL SCIENCE

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
This course will help students to develop an understanding of various environmental issues, Need for sustainable development, Solid waste disposal, Degradation of environment, Global warming, The depletion of ozone layer, Loss of biodiversity and various environmental laws.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Environment:** Definition, scope and importance of Environmental Science; Interaction between man and environment; Components of environment (atmosphere, hydrosphere, lithosphere and biosphere). **Ecosystem:** Structure and components; Aquatic Ecosystems (Freshwater, Marine, Wetlands), Terrestrial ecosystem (Forest, Grassland, Agro & Desert); Energy flow in ecosystem; Biogeo- chemical cycles (Nitrogen, Carbon, Phosphorus, Water); Food Chain, Food Web and Ecological Pyramids.	10
Unit-II	**Population and Biotic Community:** Characteristics of population; Population growth (vis-a-vis the concept of Carrying capacity); Concept and characteristics of Biotic-communities (concept of habitat, niche, keystone species, dominant species, flagship species, ecotones, edge effect). **Self Sustenance of Ecosystem: Homeostasis in natural ecosystems**; Ecosystem stability and resilience; Biodiversity and ecosystem stability; Ecological succession (primary and secondary); Climax communities and trends in succession.	10
Unit-III	**Biodiversity and Conservation:** Concept and value of biodiversity; Biodiversity at different levels (genetic, species and ecosystem); Threats to biodiversity; Hotspots of biodiversity; Biodiversity protection (a sustainable approach), Biodiversity Act. 2002.	10

REFERENCE BOOKS :		
1.	Ecology from Individuals to Ecosystems. Wiley-Blackwell, USA.	Begon, M., Townsend, C. R., and Harper, J. L. (2005). Edwards, Andres R. (2005)
2.	Ecology: Theories and Applications, 4th edition. Prentice Hall.	Stiling, Peter, (2001).
3.	A Primer of Ecology, 4th edition. Sinauer.	Gotelli, Nicholas J. (2008).
4.	Fundamentals of Ecosystem Science. Academic Press	Kathleen C. Weathers (2012).

DIP-127 WORKSHOP PRACTICE-II

L	T	P	Cr
-	-	4	2

COURSE OBJECTIVE
Every student of diploma course is expected to have the knowledge in basic shops like fitting, plumbing, carpentry, welding, sheet metal. It is expected that students should be able to carry out minor installation work / repair work of domestic appliances independently. The theoretical / practical knowledge thus gained will be helpful in achieving that end. With this view this subject is to be taught in all the branches of diploma.

UNIT	CONTENTS		Contact Hrs.
Unit-I	**Carpentry Shop: Theory:** Knowledge of Common Indian Timbers. Name, Functions, Material and Specifications of Common Hand Tools, Holding Tools, Cutting Tools, Measuring and Marking Tools used in Carpentry, Safety Measures. Introduction of Carpentry Joints and their relative Advantages and uses. Elementary Idea about the Wooden Polishing Work. Introduction to Various Carpentry Machine (Band Saw, Circular Saw, Wood Turning Lathe, Wood Planner)	**Exercises :** 1. Preparation of Cross-Half Lap Joint. 2. Preparation of Dovetail Joint. 3. Preparation of Bridle Joint. 4. Preparation of Mortise and Tenon Joint. 5. Preparation of Mitre Joint. 6. Demonstration of Job on Wooden Polishing Work	**10**
Unit-II	**Sheet Metal Shop:** **Theory :** Name, Functions and Specification of Common Sheet Metal Tools Like Slakes, Hammers, Hand Snips, Hand Punches, Groovers, Rivet Sets, Chisels Name and Function of Marking and Measuring Tools-Scale, Circumference Rule, Straight Edge, Scriber, Semi Circular Protector, Trammel. Preliminary Idea of Simple Sheet Metal Operations, Different Types of Sheet Metal Edges and Joints, Riveting Methods. Development of Surface in Sheet Metal Work.	**Exercises :** Preparation of following utility Jobs Involving Various Sheet Metal Joints (Single and Double Hem Joints, Wired Edge, Lap Joint, Grooved Seam Joint, Single and Double Seam Joint) and Exercises (Soldering and Riveting Joints) 1. Preparation of a Soap Tray & Mug 2. Preparation of Funnel.	**10**

REFERENCE BOOKS:		
1.	Workshop Technology	Gupta & Malan
2.	Workshop Technology	Kumar & Mittal
3.	Workshop Technology	Hajra, Chaudhary
4.	Workshop Technology	B.S. Raghhuwanshi
5.	Workshop Technology (Hindi)	Tahil Maghnani
6.	Workshop Technology (Hindi)	Vinay Kumar
7.	Domestic Devices and Appliances	K.B. Bhatia

DIPME-211 STRENGTH OF MATERIALS

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

In Engineering every structure or machine element is designed for a particular application. Then it is tested. A Diploma holder should be capable of designing the various elements for particular requirements. For this he must be able to calculate the stresses in an elements and their nature.

UNITS	CONTENTS	Contact Hrs.
Unit-I	**Simple Stress and Strain :** Various mechanical properties, Elasticity, Plasticity, Ductility, Brittleness, Toughness, Hardness, Concept of stress and strain, Type of force - Direct, shear, Stress - Tensile, compressive, shear, Hook's law, Statement of Hook's law, Young's modulus of elasticity, Tensile test diagram, Gauge length, Limit of proportionality, Elastic limit, Yield point, Yield strength, Ultimate stress, Rupture strength, Nominal stress, Proof stress, Working stress and factor of safety, Stress and strain calculations, Principle of superposition, Bar of homogeneous section, Bar of uniform cross-section, Bar of steeped cross-section, Bar of composite section, Temperature stresses, Homogeneous section, Composite section, Shear stresses, Modulus of rigidity, Complementary shear stress, Concept of single shear and double shear, Shear strain, Poisson's ratio and volumetric strain, Lateral strain, Longitudinal strain, Volumetric strain, Bulk modulus, Relationship between elastic constants (Derivation),$E=3K(1-2/m)$,$E=2N(1+1/m)$, $E=9KN/(3K+N)$,**Compound Stress:** Introduction, Stress components on an inclined plane, Induced by direct stresses, Induced by simple shear, Induced by direct and simple shear stresses, Mohr's circle: For like direct stresses, For unlike direct stresses, For two perpendiculars direct stresses with state of simple shear, Principal stresses and planes, Major principal stress, Minor principal stress, Mohr's circle method for principal stresses, **Strain Energy:** Introduction, Strain energy from stress - strain diagram, Proof resilience, Types of loading - gradual, sudden, impact, Stress in gradual loading, Stress in sudden loading, Stress in impact loading	8
Unit-II	**Bending Moments and Shear Force:** Basic concept, Types of support, Movable hinge support, (roller), Immovable hinge support, Fixed support, Types of beam, Cantilever beam, Simply supported beam, Fixed beam, Continuous beam, Overhanging beam, Types of load, Point load, Distributed load - uniformly and non-uniformly, Shear force and bending moment, Concept and calculation of shear force and bending moment, Sign convention for shear force and bending, moment, Bending moment and shear force diagrams (for point loads, U.D.L. and their combinations), Cantilever beam, Simply supported beam, Simply supported beam with overhang **Moment of Inertia:** Concept of moment of Inertia, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of various section, Rectangle, Triangle, Circle, Moment of inertia of unsymmetrical section like: T-section, channel section, L-section etc. **Bending Stresses in Beams:** Concept of bending stress, Theory of simple bending, Assumptions in theory of simple bending, $\underline{M} = f = \underline{E,}$ use of equation I y R (with proof),Design criterion and section modulus, Section modulus, Calculation of max bending stress in beams of, rectangular, circular, I and T section	7
Unit-III	**Shear Stress in Beams:** Concept, Use of equation $q = F/Ib *(A^-y)$, Shear stress distribution, diagram of various sections, Rectangle, I section, Channel section, H section,+ section, Circular section, **Deflection:** Concept of deflection of a beam, Use of standard formula for, calculating deflection (for point loads, U.D.L. and their combination),Cantilever beam, Simply supported beam, **Columns and Struts:** Concept of column and struts, Modes of failure, Types of column; long and short,	7

	Buckling loads, Slenderness ratio, Euler's formula (without proof),Both ends hinged, One end fixed and other end free, Both ends fixed, One end fixed and other end, hinged, Limitations of Euler's Formula, Equivalent length, Rankine's formula	
Unit-IV	**Torsion of Shaft:** Concept of torsion, Angle of twist, Polar moment of Inertia, Assumptions in the theory of pure torsion, Derivation and use of, $\underline{Q}=\underline{T}=\underline{N}$ R J I ,Relation between power and torque, Combined stress due to bending and torsion in solid and hollow shaft, **Springs:** Introduction and classification of springs, Flat carriage springs, Application of flat carriage springs, Determination of number of leaves and their sections, deflection and radius of curvature, Quarter elliptical spring, Closely coiled helical springs: Application of closely coiled helical springs, Determination of deflection, angle of twist, number of coils and stiffness, under axial loading in closely coiled helical springs. **Thin Cylindrical Shells:** Use of cylinders, Stresses due to internal pressure, Circumferential stress or hoop stress, Longitudinal stress, Design of thin cylinders - calculation of the various dimensions of a thin cylinder, **Combined Direct and Bending Stress:** Effect of eccentricity, Stress due to eccentric load, Middle third rule, Quarter rule,	**8**

PRACTICALS	
1	Study of extensometers
2.	Study and operation of UTM
3.	Tensile test on mild steel specimen and plotting stress strain curve.
4.	Bending test on timber beams.
5.	Compression test on common structural materials viz. timber, cast iron etc.
6.	Determination of toughness of cast iron and mild steel specimen by Charpy and Izod test.
7.	Hardness test by Brinell and Rockwell test.
8.	Determination of deflection for various types of loading
9.	Torsion test on brass and mild steel
10.	Determination of stiffness of close coiled spring

REFERENCE BOOKS :		
1.	Strength of Materials & Theory of Structures (vol. I)	B.C.Punmia
2.	Strength of Materials	Ramamurtham
3.	Strength of Materials	Junarkar
4.	Strength of Materials	R.S. Khurmi
5.	Strength of Materials (Hindi)	Gurcharan singh

DIPME-212 MATERIALS AND PROCESSES

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

Diploma holders in mechanical & automobile engineering are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and nonferrous materials and various heat treatment processes. This subject aims at developing knowledge about characteristics, testing and usage of various types of materials used in mechanical automobile engineering industry. Manufacturing processes are also important for an Engineer and this subject provides an opportunity to the student to learn about various welding processes and foundry work.

UNIT	CONTENT	Contact Hrs.
(A) Engineering Materials:		
Unit-I	**Classification and Properties of Materials :**Introduction to engineering materials, Classification of materials, Thermal, chemical, electrical, mechanical properties of various, materials, Selection criteria for use in industry, **Structure of Metals and Their Deformation :**.1 Metal structure, Arrangement of atoms in metals, Crystalline structure of metals, Crystal imperfections, Deformation of metal, **Ferrous Metals :**Classification of iron and steel, Sources of Iron ore and its availability, Manufacture of pig iron, wrought iron, cast iron and steel, Effect of various alloying elements on steel, **Non Ferrous Metals:** Important ores and properties of aluminum, copper, zinc, tin, lead, Properties and uses of nonferrous alloys	8
Unit-II	**Engineering Plastics and Fibers :**Introduction and use of plastics and fibers, Classification of plastic (Thermoplastic and thermosetting),Classification of fibers (Inorganic and organic fibers **Insulating Materials: Various** heat insulating material like asbestos, glass, wool thermocole, cork, puf, china clay and their use. **Testing of Metals and Alloys :**Identification tests : appearance, sound, spark, weight, magnetic, microstructure, filing, **Fundamentals of Heat Treatment :**Principles of heat treatment, Iron-carbon diagram, TTT curve in steels and its importance, Introduction of various heat treatment processes	6
(B)Manufacturing Processes :		
Unit-III	**Welding Process: Principle** of welding, Classification of welding process, Advantage and limitation of welding, industrial applications of welding. **Gas Welding :**Principle of operation of oxy-acetylene gas welding, Gas welding equipment's : gas welding torch, blow pipe, pressure regulators, Oxy- acetylene gas cutting, construction of gas cutting torch, **Electric Arc Welding :** Principle of operation, A.C and D.C arc welding, Arc welding machine and equipment, Effect of polarity, Electrodes (Metal and Carbon), Flux and their functions, **Other Welding Processes :** Resistance welding : Spot, butt, flash, Seam, percussion and projection welding, Submerged arc welding, Welding distortion, welding defects, method of controlling welding defects and, inspection of welded joints, **Modern Welding Methods :**Principle of operation, advantage, disadvantages, application, Tungsten inert gas welding (TIG),Metal inert gas welding (MIG), Brief concept of following, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding	8

Unit-IV	**Foundry: Pattern** – Types, materials and allowances. Molding sends : Types and Properties (permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility), Molds :Types of molds, Steps involved in making a molds, Elementary idea of gating & risering, Core :Function of core, Type of core according to shape & position of core. Molding Furnaces, Construction & Cupola, Introduction of tilting type Crucible Furness, Elementary Idea, Advantages, Disadvantages and Application of following special, Casting Techniques :Die casting - Hot chamber, cold chamber process, Investment or lost wax process, Centrifugal casting - True, Semi centrifugal, centrifugal, Shell molding, Types of Casting defects	**8**	

PRACTICALS	
1.	Identification of different metals (ferrous & Non Ferrous) by various methods. (e.g. appearance, sound, spark,
2.	weight, magnetic, microstructure, filing
3.	Study of heat treatment furnace.
4.	Study of metallurgical microscope
5.	Exercise of TIG welding
6.	Exercise of MIG welding
7.	Exercise on spot welding
8.	Study of pattern making procedure
9.	Study of mold making procedure
10.	Study of Cupola furnace
11.	Study of thermocouple and pyrometer. Study casting procedure and inspection of casting defects (visual inspection)

Note: Industrial visit may be arranged for study experiments.

REFERENCE BOOKS :		
1.	Engineering Material	B.K. Agarwal
2.	Elements of Metallurgy	H.S. Bawa
3.	Materials and Metallurgy Lab Manual	Adithan & Bahl
4.	Engineering Materials	O.P. Khanna
5.	Material Science	R.K. Rajput
6.	A Text Book of Welding Technology	O.P. Khanna
7.	Welding Technology	Tahil Maghnani
8.	A Text Book on Foundry Technology	M.Lal & O.P.Khanna
9.	Foundry Engineering	Tahil Meghnani
10.	Foundry Technology	O.P. Khanna & M. Lal
11.	Manufacturing Process – I	R.K. Yadav

DIPME-213 MACHINE DRAWING

L	T	P	Cr
0	0	6	3

COURSE OBJECTIVE

For better communication and effective working in Mechanical and automobile industries, motor garages, service stations, and other fields, the knowledge of MACHINE drawing is very essential. In the present time, computer is becoming more and more importance in every field, so the engineering drawing is also not untouched with it. Computer aided drawing makes the work of drawing, easier, faster, accurate and clear.

UNIT	CONTENT	Contact Hrs.
Unit-I	**Machining Symbols and Tolerances:** Introduction of limits, fits, tolerances. Machining symbol, Application of machining symbol, Indication of machining allowance, Indication of surface roughness, Tolerancing, Unilateral and Bilateral tolerance, Standard tolerance, Symbols for tolerance, deviation and fits, **Gear tooth profile,** Gear types and gear nomenclature (spur, helical and bevel gears),Drawing involutes tooth profile (spur gear only) by-Approximate method, Prof. Unwin's method, **Cam profile,** Types of cams and followers, Types of follower motions, Construction of disc cam profile with knife edge follower	6
Unit-II	**Working Drawing :**Piston and Connecting rod, Crankshaft, Bush bearing, ball bearing and roller bearing, Lathe spindle, **Assembly Drawing:** Drilling jigs, milling jigs, Stepped pulley, fast and, loose pulley, V – belt pulley, Footstep bearing, Plummer block and Universal coupling, Lathe tail stock and Shaper tool head, Fuel injector and Fuel injection pump (jerk type)Machine vice and screw jack	6
Unit-III	**Computer Graphics :**Application software :- Introduction of CAD and similar software, application like, CATIA , Pro / Engineer and other, Getting Started – I, Starting AutoCAD –AutoCAD screen components – Starting a drawing: Open drawings, Create drawings,(Start from scratch, Use a template & Use a wizard) – Invoking commands in AutoCAD – Drawing lines in AutoCAD – Co-ordinate systems: Absolute co-ordinate system, Relative co-ordinate system – Direct, distance method – Saving a drawing: Save & Save As – Closing a drawing – Quitting AutoCAD, Getting Started – II, Opening an existing file – Concept of Object – Object selection methods: Pick by box, Window selection, Crossing Selection, All, Fence, Last, Previous , Add, Remove – Erasing objects: OOPS command, UNDO, REDO commands – ZOOM command – PAN command, Panning in real, time – Setting units – Object snap, running object snap mode – Drawing circles, Draw Commands, ARC command – RECTANG command – ELLIPSE command, elliptical arc – POLYGON command (regular polygon) – PLINE command – DONUT, command – POINT command – Construction Line: XLINE command, RAY command – MULTILINE command	6
Unit-IV	Editing Commands MOVE command – COPY command – OFFSET command – ROTATE command – SCALE command – STRETCH command – LENGTHEN command –TRIM command –EXTEND command – **B**REAK command – CHAMFER command – FILLET command –ARRAY command – MIRROR command –MEASURE command – DIVIDE command – EXPLODE command – MATCHPROP command –Editing with grips: PEDIT Drawing Aids Layers – Layer Properties Manager dialog box – Object Properties: Object property toolbar, Properties Window – LTSCALE Factor – Auto Tracking – REDRAW command, REGEN command Creating Text Creating single line text – Drawing special characters – Creating multiline text –Editing text -	12

Text style Basic Dimensioning Fundamental dimensioning terms: Dimension lines, dimension text, arrowheads, extension lines, leaders, centre marks and centerlines, alternate units – Associative dimensions –Dimensioning methods –Drawing leader Inquiry Commands AREA – DIST – ID – LIST – DBLIST – STATUS – DWGPROPS, Editing Dimensions diting dimensions by stretching – Editing dimensions by trimming & extending – Editing dimensions: DIMEDIT command – Editing dimension text: DIMTEDIT command – Updating dimensions – Editing dimensions using the properties window – Creating and restoring Dimension, styles: DIMSTYLE, Hatching BHATCH, HATCH commands – Boundary Hatch Options: Quick, tab, Advance tab – Hatching around Text, Traces, Attributes, Shapes and Solids– Editing Hatch Boundary – BOUNDARY command, Blocks   The concept of Blocks – Converting objects into a Block: BLOCK, _BLOCK commands – Nesting of Blocks – Inserting Blocks: INSERT, MINSERT commands – Creating drawing files: WBLOCK command – Defining Block Attributes – Inserting Blocks with Attributes – Editing Attributes, Plotting Drawings in AutoCAD PLOT command – Plot Configuration – Pen Assignments – Paper Size &Orientation Area – Plot Rotation & Origin – Plotting, Area – Scale, Draw isometric views of simple objects. Introduction of 3D modeling, Wire frame and surface modeling

REFERENCE BOOKS :

1.	AutoCAD for Windows	Bible (with Applications) / Sham Ticked / Golgotha Publications Pvt. Ltd.
2.	Advanced AutoCAD	Robert M. Thomas / Sybex BPD
3.	AutoCAD Part – 1 & 2	Banglay Prokashito Tutorial / CD Media / Sonolite, 55, Elliot Road, Kolkata
4.	Auto CAD	George omura
5.	Machine drawing	P. S. Gill
6.	Machine drawing	Laxmi narayan
7.	Machine drawing	R. B. Gupta
8.	Machine Drawing	N.D. Bhatt

DIPEE-211 ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	Cr
3	0	2	4

COURSE OBJECTIVE

This subject is designed to give basic knowledge of electrical m/c such as transformer, A.C. /D.C. machine. Diode, transistor, digital and power electronics, relays, timers and photo electric devises.

Unit	Content	Contact Hrs
Unit-I	**D.C. Machines:** Construction, Operation of D.C. generator, Operation of D.C. motor, Types of D.C. generator and motor, I Starters, Speed control methods, Characteristics of D.C. motors **Transformer:** Construction of single phase transformer, Types of transformer, Principle of operation, E.M.F equation, Testing of T/F, Polarity test, Open circuit test, Short circuit test, Efficiency and losses, Voltage regulation, Single phase auto transformer, Types of 3 phase transformers, Cooling methods, **Induction Motor:** Construction and working principle of single-phase induction motor, Types of single phase induction motors (description only),Production of rotating magnetic field by three phase currents. Construction and working principle of three-phase induction motor, Torque equation, Torque slip characteristics, Starting and speed control of 3-phase induction motor, Various types of starters, Methods of increasing starting torque, Application. **Industrial Drives:** Elementary idea for industrial drives, Application of industrial drives in following fields Rolling mill, Textile mills, Paper mill, Crane, Mines, Lathe machine, Pumps, Food processor, refrigerators punches	8
Unit-II	**Electric Heating:** Advantages of electric heating over other types of heating, Principle of operation, construction and uses of electrical heating in -Resistance heating, Induction heating, Arc heating, Brief idea of high frequency heating, dielectric heating and its application, **Illumination:** Nature of light, Standard terms and definitions, Laws of illumination, Types of lamps, Tungsten, Halogen, Sodium, Neon, Mercury vapor lamp, Fluorescent tubes. **Instrumentation and Measurement:** Principle, construction and working of the following measuring instruments -Ammeter and voltmeter (moving coil and moving iron type), Dynamometer types wattmeter, Single phase AC energy meter, Multimeter and megger, Transducers, Measurements of mechanical quantities like pressure, strain, temperature	7
Unit-III	**Semiconductor and P-N Junction Diode:** Intrinsic and extrinsic semiconductor, Description of conductor, insulator and semiconductor-N junction diode, Space charge and barrier potential, Volt-ampere characteristics (forward and reverse bias), Zener and avalanche breakdown, LED and LCD, **Bipolar Junction Transistor:** Fundamentals of BJT operation, Amplification phenomenon, CE, CB and CC configuration and DC current relationship, Input and output, characteristic of CE, CC and CB. **Digital Electronics:** Binary, Decimal, Octal and Hexadecimal number system, Logic gates - OR, AND, NOT, NAND, NOR, Ex-OR, Ex-NOR	8
Unit-IV	Unit- **Power Electronics:** Introduction of SCR's, Diac, Triac, UJT, Series and parallel connection of SCR's Half wave and full wave rectifiers using SCR's with resistive and inductive load, Snubber circuit, Application of SCR's in speed control of AC and DC motors. **Relays Contactors and Timers:** Type of relays, Relay	7

parts, Construction and working of relays, contactors and timers. DC operated time delay relay, AC operated time delay relay. **Photo Electric Devices:** Photo cells Photo transistors, LDR's ,Solar cells – working principle and applications

PRACTICALS

	Preparation of following on Imperial Size Drawing Sheet :4
1	Study of D.C. machines.
2.	Study of D.C. starter
3.	Connecting starting and reversing the direction of D.C. motor
4.	Determination of turn ratio of transformer
5.	Open circuit and short circuit test on a single phase transformer
6.	Connecting, starting and reversing the direction of 1-phase induction motor
7.	Starting of 3 phase Induction motor by D.O.L. starter / star- delta starter motor.
8.	Study of various types of transducers.
9.	Use of megger and multimeter.
10.	To plot V-I characteristics of P-N diode.
11.	To plot V-I characteristics of Zener diode.
12.	To plot V-I characteristics of NPN transistor in CE, CB, CC configuration.
13.	To plot V-I characteristics of PNP transistor as above
14.	Study of logic gates of- AND, OR, NOT , NAND, NOR, Ex-OR, Ex-NOR
15	Study and testing of solar cell and photo cells

	REFERENCE BOOKS :	
1.	Power Electronics	P.S. Bhimbara
2.	Electronics	K. Mehta
3.	Integrated Electronics	Millman Halkias
4.	Industrial Electronics	Bhattacharya
5.	Basic Electronics	B.L. Theraja
6.	Electronics Principles (For Mechanical)	L.M. Shaikh
7.	Industrial Electronics & control (Hindi)	Kumar & Tyagi (Nav Bharat)
8.	Electrical Engineering (Hindi & English)	K.D. Sharma
9.	Electrical Technology	B.L.Theraja
10.	Utilization of Electrical Power	H.Pratap
11.	Electrical and Electronic Instrumentation& Measurement	H.Cotton

DIPME-215 THEORY OF MACHINES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE

An engineer should be well acquainted with the motion of mechanism of different machine element. With this view the study of Theory of machine is very much important. The contents of this subject include simple mechanism, kinematics of machine, dynamics of reciprocating parts, friction involved in the machine elements, power transmission, governors, balancing and vibrations in machine.

UNIT	CONTENT	Contact Hrs.
Unit-I	**Simple Mechanism:** Introduction to link, kinematic pair, kinematic chain, structure, mechanism, machine, Slider crank mechanism and its inversion, Double slider crank chain, Example of mechanism with higher pairs, **Velocity and Acceleration in Mechanism:** Velocity diagrams of four bar and single slider crank mechanisms by relative, velocity method and instantaneous centre method, Acceleration diagram of four bar chain and reciprocating engine mechanism, carioles components, **Dynamics of Reciprocating Parts:** Analytical method for velocity and acceleration of piston, Piston effort, crank pin effort, turning moment diagrams, Fluctuation of energy and speed, Energy of a flywheel, Calculating the weight of flywheel.	8
Unit-II	**Friction:** Friction of collars and pivots, Friction clutches-plate clutch and centrifugal clutch, Friction in journal bearings, Rolling friction, **Transmission of Power:** Flat and V-belt drives, Velocity ratio of belt drives, slips in belt, and creep in belt. Length of open and cross belt drives, Power transmitted by a belt, Ratio of driving tension, centrifugal tension, Condition for the maximum, power transmission, initial tension in the belt. Chain drives - types of chain drives, roller chain and inverted tooth chain. Gear drives - Types of gear wheels, proportions of gear tooth, Gear trains - Simple gear train, compound gear train, reverted gear train and simple, epicyclical gear train.	7
Unit-III	**Balancing:** Static and dynamic balancing, need of balancing, Balancing of single rotating mass by a single mass in the same plane, by two masses, rotating in different planes. Partial primary balancing of a single cylinder reciprocating engine, **Vibration:** Causes of vibrations in machine, their effects and method of reducing them, Free or natural vibration, Forced vibration, Damped vibration.	7
Unit-IV	**Governors (No derivation & numerical): Introduction** and classification, Methods of governing (Quality, Quantity and hit and miss governing), Dead wt governors (watt, porter and proell), Spring control governors (hartnell and Wilson hartnell),Concept of sensitivity, stability, isochronisms, hunting, effort and power. **Brakes and Dynamometer:** Introduction, function, capacity of brakes :Block and shoe brake, Band brake, Internal expanding brake, Functions of dynamometer, Pony brake, Rope brake and Froude's hydraulic, dynamometer, **Gyroscope –** Introduction and principle, Gyroscopic couple	8

REFERENCE BOOKS :

1.	Theory of Machines	Jagdishlal
2.	Theory of Machines	R.S.Khurmi
3.	Theory of Machines	Abdullah Sharif
4.	Theory of Machines	Malhotra, Gupta
5.	Theory of Machines	S.S. Ratan

L	T	P	Cr
2	0	4	4

COURSE OBJECTIVE:-

Subject covers the study of various components used in various machines. This also deals with various types of cutting fluids and their property. Technicians have to carry out the job of measurement and inspection in the factories for controlling the quality of products. Therefore they must have the knowledge of science of measurements or metrology. They must be familiar with the concept and technique of inspection and quality control methods. The subject has been designed to impart all the related and concerned knowledge to the student to fulfill the need.

UNIT	CONTENT	Contact Hrs.
(A) Measurement :		
Unit-I	**Cutting Tools and Materials:** Cutting tools, Standard shape of single point tool, Cutting angles, effect of rake angle, importance of clearance angle, Heat produced by cutting and its effect, Cutting speed, feed and depth of cut, Materials, Materials of cutting tools and their properties, High-speed steel, cobalt steel, tungsten carbide, cemented carbide, satellite, diamond, ceramics. **Lathe Machine:** Specifications and Classification of lathe machines, Constructional features of a centre lathe and its function, Functions of various parts of lathe, Different operations, which can be performed on the centre, lathe with and without, attachments. Calculation of gear trains for thread cuttings ,Lathe attachments and lathe accessories, **Drilling Machines :**Description, working and uses of different drilling machines, Multi spindle drill, gang drill, deep whole drill and small diameter hole drill machines. Specifications and constructional features of radial arm and upright drilling machines, Work holding devices, tool holding devices, Various operations of drilling machines e.g. drilling, reaming, boring, counter-boring, counter sinking, spot facing, tapping. Selection of drill	5
Unit-II	**Shaping, Planning and Slotting Machines:** Specification, constructional features working and uses of various types of shapers, planers and slotters Mechanism used in shaper - crank and slotted link, whit worth quick return and hydraulic mechanism, Feed mechanism of planner Various works holding devices and clamping devices used on shaper and planner Various shaper and planner operations, Shaper and planner tools, Cutting speed, feed and depth of cut on shaper, Difference between shaper, planner and slotter, **Cutting Fluids and Cooling Process:** Types of cutting fluids and coolants, Functions of cutting fluid and its action, Difference between cutting fluid and coolant, Selection of cutting fluids for different material .	5
(B) Metrology		
Unit- III	**Introduction to Metrology:** Units and standards of measurement, International, National and company standards, Line and end standards, Errors in measurement, Precision and accuracy, **Linear and Angular Measurement:** Vernier caliper, micrometers, height and depth gauges, Bevel protractor, sine bar, slip gauges, angle gauges and clinometers, Auto collimator, angle dekkar, Taper measurements, Cylinder bore gauge, Telescopic gauge, feeler and wire gauge **Measurement of Surface Finish:** Meaning of surface texture, primary and secondary texture Terminology of surface roughness, Factors affecting surface finish, Representation of surface roughness parameters CLA and RMS values, Comparison and direct instrument methods of surface finish measurements. **Comparators:** Classification, advantages and working mechanism of dial	5

	indicators, pass meters Mechanical, Electrical, Electronic and pneumatic comparators	
Unit- IV	**Light Wave Interference:** Principle of interference, Interferometer applied to flatness testing, N.P.L. flatness interferometer, **Gear and Screw Measurement:** Screw thread terminology, errors in threads, Effective diameter measurement by two wire and three wire methods, Major and minor diameter measurement, Thread micrometers, Gear tooth terminology, Gear tooth Vernier caliper and its application, Measurement of gear pitch. **Limits, Fits and Tolerance:** Interchangeability - control and need, Definitions and Terminology of limits, fits and tolerances, Basis of limit system Type of fits, Limit gauges, **Machine Tool Metrology:** Alignment tests, Performance tests, Alignment test on lathe and drilling machine	**5**

	PRACTICAL
(A) Measurement	
1.	Grinding of various types of single point cutting tool
2.	Simple exercise on Lathe Machine involving following operation 2.1 Simple turning, facing, step turning, Grooving and knurling and taper turning by compound rest 2.2 Facing, drilling, boring and step turning, parting off. 2.3 Taper turning by tails tock off set method 2.4 V threading, square threading and taper threading by attachment 2.5 A utility job on lathe machine with an accuracy of 0.2 mm ☐
3	Preparing a M.S. block with all faces finished and V grooved on shaper machine
4	Planning practice on a planner on a rectangular C.I plate.
5.	Internal slot cutting on the slotter machine
PRACTICAL	
(B) Metrology	
6.	Internal and External measurement with the Vernier caliper
7.	Internal and External measurement with micrometer
8.	Measurement with height and depth gauges.
9.	Measurement with dial indicator using surface plate and accessories for 9.1 Flatness 9.2 Concentricity
10.	Measurement with combination set and bevels protractor
11.	Measurement of thread characteristics
12.	Study and use of slip gauges and limit gauges.
13.	Internal and external taper measurement.
14.	Measurement of gear characteristics
15.	Measurement of angle with sine bar and slip gauges
16.	Study and use of comparators and tool room microscopes.
17.	Measurement of bore with cylinder dial gauge for ovality and taper.
18.	Measurement of worn out I.C. Engine piston, clearance between cylinder and piston and between bearing and journal

Note: Industrial visit can be arranged to show these practical to the students.

	REFERENCE BOOKS :	
1.	Workshop Technology (Hindi) – II	Tahil Manghnani
2.	Workshop Technology (Hindi) – II	B.S.Raghuvanshi
3.	Workshop Technology – II	Hazra & Chaudhary
4.	Workshop Technology (Hindi)	S.K.Bhatnagar
5.	Production Technology	R.K. Jain
6.	All About M/C Tools	Gerling
7.	Engineering Metrology	R.K.Jain
8.	Engineering Precision Metrology	R.C.Gupta
9.	Engineering Metrology (Hindi)	Mittal
10.	Engineering Metrology (Hindi)	Bhatnagar
11.	Engineering Metrology	R.K.Rajput
12.	Metrology Lab Manual	Adithen, Bahl
13.	Metrology	M. Mahajan

DIPME-221 HYDRAULICS AND HYDRAULIC MACHINES

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

Technicians have to deal with pressure measurement, transportation of fluids and the machines converting hydraulic power into mechanical power and vice versa, in the field/industries for that one has to have a basic knowledge of fluid mechanics and machines. Topics such as pressure measurement, laws governing the flow of liquids, measurement of discharge, production of power are included in this subject. Although the major emphasis in this subject is on the study of liquids like water an incompressible fluid yet all the principles are applicable to all the fluids such as air, gas, steam etc. It includes the knowledge of various machines working on the principles of hydraulics.

UNIT	CONTENT	Contact Hrs.
Unit-I	**Introduction:** Introduction concepts, Fluids and solids, Liquid, gas and vapor, Fluid mechanics, Kinematics, Dynamics, Fluid properties, Density, Specific volume, Specific gravity, Viscosity, Newton's law of Viscosity, Dynamic and Kinematic Viscosity, Compressibility, Surface tension - soap bubble, drop, Capillarity, Vapour pressure and its importance. **Fluid Pressure and its Measurement:** Definition and its units, Pascal's law, Intensity of pressure at a point in fluid at rest Pressure head, Pressure, Atmospheric pressure, Gauge pressure, Vacuum pressure, Absolute pressure, Differentials pressure, Law of hydrostatic pressure, Brahma's press, Pressure, measurement, Manometers, Piezometer - its limitation, U-tube - simple, differential, inverted, Micro-manometers, Inclined tube micro-manometers, Mechanical gauge, Bourdon gauge, Bellow gauge, Diaphragm gauge, Dead weight gauge. **Hydrostatics :** Total pressure, Centre of pressure, Total pressure and center of pressure in following cases, Plane surface immersed horizontally, Plane surface immersed vertically, Plane surface immersed at an angle, Curved surface (no proof), Working of lock gates, sluice gate, Pressure on masonry dams of rectangular and, trapezoidal sections and their condition of stability.	8
Unit-II	**Hydro kinematics :** Description of fluid flow, Eular approach, Lagrangian approach, Definition of path line, stream line, Types of flow, Steady - Non steady, Uniform - Non uniform, Laminar – Turbulent, One, Two, Three dimensional flow, Continuity equation (no proof) :Assumption, Rate of discharge, For one dimensional flow. **Hydrodynamics and Measurement of Flow:** Energy of fluid - pressure, kinetic and potential. Bernoulli's theorem (no proof).Assumptions and its. Limitation. Conversion of pressure into pressure head, velocity into kinetic head. Applications of Bernoulli's theorem. Pitot tube, Venturimeter, Orifice meter. **Orifices:** Definition and classification Discharge through small orifices, Coefficient of contraction, Coefficient of velocity, Coefficient of discharge, Coefficient of resistance, Time of emptying a vessel of uniform cross section through an orifice at bottom. (Simple Numerical Problem). **Flow Through Pipes:** Types of flow in pipes (Reynolds's experiment), Laminar flow, Turbulent flow, Transient flow, Law of fluid friction, Laminar flow, Turbulent flow, Loss of head due to friction (No. proof),Darcy's Weisbach equations, Chezy's formula, Manning formula, Other energy losses in pipe (only expressions), Total energy line and hydraulic gradient line, Pipe arrangement, Pipes in series, Pipes in parallel, Transmission of power through pipes, Siphon, Water hammer.	7

Unit-III	**Impact of Free Jet:** Impulse momentum equation (no proof), Force exerted by a fluid jet on stationery flat plate, Plate normal to the jet, Plate inclined to the jet, Force exerted by fluid jet on moving flat plate, Plate normal to the jet, Plate inclined to the jet, Force exerted by fluid jet on stationary curved vane, Jet strikes at the centre of symmetrical cured vane, Jet strikes tangentially at one, Force exerted by a fluid jet on moving curved vane. **Hydraulic Turbines:** Classification of water turbines, Pelton turbine, Working principle, Constructional features, Francis turbine and Kaplan turbine, Working principle, Constructional features, Draft tube, Cavitations, Governing of Turbines, Need for governing, Simple governing mechanism, Surge tank, Turbine performance, Heads - gross, net, Efficiency - Hydraulic, Mechanical, Volumetric, Overall, Unit quantities, Specific speed, Introduction to characteristics curve (no numerical problems),Numerical problems on turbines**.**	8
Unit-IV	**Centrifugal Pump:** Introduction and working principles, Advantages over reciprocating pump, Classification, Constructional features, Mechanical manometric and overall efficiency, Head of a pump - static, manometric, Power required to drive the pump, Losses in pump and efficiency, Minimum stating speed, Pumps in series and parallel, Priming, Description and working of, multistage centrifugal pump, submersible, deep well pump and gear pump, Numerical problems. **Reciprocating Pump :**Types of pump, Main components and working, Slip, Percentage slip, Negative slip, Work down by a reciprocating pump, Acceleration of piston, Its effect on velocity and pressure, Air vessel, Troubles in Reciprocating pump and their remedies, Numerical problems. **Miscellaneous Hydraulic Machines:** Description, working principle of following machines, Hydraulic accumulator, Hydraulic intensifier, Hydraulic press, Hydraulic coupling and torque converter	7

PRACTICALS	
1	Study of different types of manometers and pressure gauges
2.	Verification of Bernoulli's theorem
3.	Determination of C_d for Venturimeter
4.	Determination of C_d for Orifice meter
5.	Determination of C_c, C_v and C_d of small orifice
6.	Determination of coefficient of friction for pipes
7.	Determination of slip, coefficient of Discharge for a reciprocating pump
8.	Study of construction and working of following : 8.1 Centrifugal pump 8.2 Pelton wheel turbine 8.3 Francis turbine
9.	Study of model of Kaplan turbine
10.	Study of submersible pump, jet pump, deep well pump.

REFERENCE BOOKS :		
1.	Fluid Mechanics & Machines	Dr. Jagdish Lal
2.	Fluid Mechanics & Machines	Dr. R.K.Bansal
3.	Fluid Mechanics & Machines	R.S.Khurmi
4.	Hydraulics & Pneumatics	H.L. Stewart
5.	Fluid Machines	S.S. Ratan

DIPMEA- 222 BASIC AUTOMOBILE ENGINEERING

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE

Knowledge of chassis layout, suspension system, braking system, wheel and tyres, frame and body, transmission and steering is imparted in this subject.

UNIT	CONTENT	Contact Hrs
Unit-I	**Introduction:** Classification of Automobiles, Chassis and body, Components of vehicle – basic structure, power unit, transmission system, accessories, superstructure. (Basic functions and arrangements),Layout of conventional type vehicle (front engine rear wheel drive),Vehicle dimensions – wheel base, wheel track, front & rear overhang, overall dimensions, minimum ground clearance, minimum turning radius. **Suspension System:** Basic functions of suspension system, Types - Independent and rigid, coil, leaf, torsion bar, air, rubber suspension, (Elementary idea), Conventional leaf spring rigid beam suspension for light vehicle and with helper spring for heavy vehicles. Function, construction and working of Telescopic type shock absorber. Sprung and unsprung weight.	**8**
Unit-II	**Braking Systems: Purpose**, principle, classification of brakes. Layout and description of mechanical brakes. Hydraulic brakes, Principle, layout, Construction & working of single and tandem master cylinder, wheel cylinder, Bleeding of hydraulic brakes, Brake fluids and characteristics, Maintenance of brakes, brake troubles and remedies. Hand brakes, **Wheels and Tyres :**Wheels, Requirements of wheel, Types- pressed steel disc, wire, light alloy cast wheels,2 Tyres, Types (Tube, Tubeless, Cross ply, Radial ply, Cross section of a pneumatic tyre, Specification of tyres, Tyre maintenances, tyre trouble and repair	**7**
Unit-III	**Front axle and Steering System:** Front axle - types and construction, front wheel stub axle assembly, Purpose and requirements of steering system, General arrangement of steering systems steering gear ratio, Steering system components – steering wheel, steering column, conventional steering linkage, steering and ignition lock, Construction and working details of different types of steering gear boxes, **Power Transmission System :**Clutch :Purpose and requirements of clutch Construction of working detail of single plate, coil spring, clutch, multi, plate clutch, Dry and wet clutch, Construction of clutch plate, Gear Box, Functions and types of gear boxes, Constructional and working of sliding mesh, constant mesh and, synchronous mesh gear boxes, Construction and working of selector and inter locking mechanism, Final Drive: Function and constructional details of - Propeller shafts, Universal joints, Sliding joint, Differential - Principles, function, construction and working of conventional differential, Different types of rear axles according to methods of supporting.	**8**

Unit-IV	**Frame and Body :**Frame, Function of frame, loads or frame, Frame construction, sub-frame, Defects in frame chassis repair and alignment, Frame less construction ,Body, Types and construction (parts of body),Main features – strength, stiffness, space air drag, stream lining weight, vibration, protection against weather, corrosion, safety and economy considerations. Body alignment, Bumpers – types and functions.	7

PRACTICALS

1	Study of various tools used in Auto workshop.
2.	Study of conventional layout of vehicle.
3.	Study and inspection of suspension system of light and heavy vehicles.
4.	Study of mechanical and hydraulic braking system and bleeding of hydraulic braking system.
5.	Study of Steering system of four wheeler.
6.	Study of clutch (single plate & multi plate).
7.	Study of sliding mesh, constant mesh and synchronous mesh gear boxes.
8.	Study of Propeller shafts, Universal joints, Sliding joint, differential and rear axle.
9.	Study of frame & body of vehicle.
10.	Visit to nearby auto workshop and service station.

REFERENCE BOOKS :		
1.	Automotive Chassis & Body.	P.L.Kohli.
2.	Vehicle & Engine Technology (Vol. I & II)	Heinz Heisler.
3.	Basic Automobile Engineering	C.P.Nakra
4.	Automobile Engineering.	T.R.Banga & Nathu Singh.
5.	Automobile Engineering	H.S. Reyat
6.	Automobile Engineering (Hindi & English)	Kirpal Singh

DIPMEB- 222   PRODUCTION TECHNOLOGY-I

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE
This course focuses on the production technology.

UNITS	CONTENT	Contact Hrs.
Unit-I	**Introduction:** Concept of manufacturing processes, classification and application. **METAL FORMING PROCESSES:** **(a) FORGING:** Hammer forging, drop-forging, dies for drop-forging, drop hammers, press forging, forging machines or up setters, forging tools, forging defects and remedies. Concept of losses in forging operation, estimation of stock required for hand forging considering scale and shear losses	**6**
Unit-II	**(b) ROLLING:** Elementary theory of rolling, hot and cold rolling, types of rolling mills, rolling defects and remedies. **(c) PRESS FORMING:** Types of presses, working, and selection of press die, die-material. Press operation-Shearing, piercing trimming, shaving, notching gearing or rubber forming, embossing, stamping, punching. **(d)** Drawing, extrusion, pipe and tube drawing. **(e)** Energy forming technique - Explosive forming, electromagnetic forming	**6**
Unit-III	**CONVENTIONAL METAL CUTTING PROCESSES:** (a) Gear manufacturing process- Gear hobbling, gear shaping gear shaving, gear generating, gear burnishing, farming's' generator, straight bevel gear manufacturing, spiral bevel gear manufacturing. (b) External threading process-Roll threads, thread milling, thread grinding, thread rolling, and thread chasing, Die heads. (c) Machining of cylindrical holes - Multiple spindle drill press, gang drill press, drilling deep holes and small diameter holes, boring, coordinate method of locating holes, Jig boring machine.	**6**
Unit-IV	**METAL FINISHING PROCESS:** Grinding Process, Diamond machining, Honing, Lapping, Super finishing, Polishing and buffing. **SURFACE TREATMENT & FINISHING:** Meaning of the terms surface treatment and its purpose. Elements of surface treatment cleaning protecting, Coloring, Altering surface properties. Surface Treatment Processes- Wire brushing. Belt sanding. Alkaline cleaning, Vapor degreasing. Pickling. Ultrasonic cleaning. Solvent cleaning. Painting application by dipping. Hand spraying. Automatic spraying. Electrostatic spray finishing. Electro coating. Hot dip coating. Phosphate coating- Packetizing and Bonder sing. Buffing. Blackening, Anodizing. Electro Nickel Plating. Nickel carbide plating. Sputtering.	**6**

Unit-V	**Plant Maintenance** (A) Maintenance: maintenance definition, scope of maintenance, maintenance strategies, economics and performance measures, objective of maintenance, concepts of general approach to eliminate Losses, classification of maintenance-corrective, scheduled, preventive, predictive and productive maintenance. Common techniques to monitor the conditions of systems-vibration based, radiographic, thermos graphic, Ferro graphic, computer based diagnosis etc., forms of wear, weapon guide surfaces, breakdown and remedies of machine tools, repair cycle, installation and maintenance of machine tools, PERT in maintenance. (B) Organization- Objective of maintenance organization, function and duties of maintenance department, inspections and scheduling, routine-servicing and scheduled repair, maintenance planning, concepts of maintenance management.	6

PRACTICALS

1	Centre lathe.
2.	Allgerared head Lathe
3.	C.N.C. Trainer Lathe Center height 100 mm, swing over carriage 60mm, and distance between centers 200 mm, Max. Machining diameter-50 mm, Max. Longitudinal travem-300 mm, Spindle speed 40-2000 RPM, Automatic lubrication paints provided
4.	Planning Machine
5.	Shaping Machine
6.	Slotting Machine
7.	Universal Milling Machine 3 Axis, Travel X-300mm, Y-250 mm, Z-125 capable of milling acrylic, Al., Wood, etc. Compatible with FM5/DNC
8.	Universal Tool Cutter and Grinder
9.	Two Wheel bench Grinder (Wheel size 150x16x12 mm), Wheel standard Accessories Single phase motor .25 HP high speed
10.	Bench Drilling Machine 13 mm capacity, 5 HP, AC 230 Volt Single Phase, 1400 rpm motor with starter switch 30 mm capacity drill chuck V belt 100 mm machine vice.
11.	Power Hacksaw motorized with coolant pump, vice, length Gauge, machine drive belt guard, 1 H.P. A.C. 440/3/50/1440 rpm, Electric motor with starter. Capacity to cut 175 mm. round And 150x150 mm. square rod, Blade size 350x25 mm.
12.	Cylindrical grinding machine (Plain)
13.	Surface grinder table size 12"x8". (Planer type)

REFERENCE BOOKS :		
1.	Production Engineering & Science	Pandey & Singh
2.	Elements of Workshop Technology Vol – I	Choudhury Hajra S.K.
3.	Book of Production Engineering	PC Sharma; S Chand and Company
4.	Foundry Technology	KP Sinha and DB Goel

DIPME-223 MECHANICAL ESTIMATING AND COSTING

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:-
The Knowledge about estimation and costing is required for engineers. This subject is designed to develop understanding of various components of costs and making cost estimation.

UNIT	CONTENT	Contact Hrs.
Unit-I	**Introduction :** Estimating, Definition, Importance of estimating, Aims and functions, Estimating procedure, Costing, Definition, Aims of costing, Procedure of costing, Difference between estimating and costing, **Elements of Costs :**Material cost, Labor cost, Expenses, Direct expenses, Indirect expenses, Component of cost Overhead cost, Allocation of on cost	8
Unit-I II	**Break Even Analysis and Equipment Replacement Analysis :**Break even analysis (cost, volume, profit analysts), determination of Breakeven point, breakeven point theory, Equipment Replacement Analysts, Regions, Policy, Guide line Various methods, Hire Purchasing **Estimation of Material Cost :** Estimation of volumes, weights and cost of materials for Pulley, Spindle, Lathe centre, Fly wheel Crank shaft **Labor Costing :**Type of Wage and Incentive ,Wage Differentials Methods of wage Payments, Job Evaluation	7
Unit-I III	**Estimation in Machining :**Cutting speed, feed and depth of cut, Setup time, operation time, machining, time tear down time, handling time, Allowances Estimation of machining time for various lathe operations :Turning, Facing, Threading, Drilling, Chamfering, Estimation of machining time for Milling operation, Estimation of machining time for Shaping operation, Estimation of machining time for Grinding operation, Metal removal rates, **Estimation in Welding Shop :**Estimation of electric arc welding cost, Estimation of gas welding Estimation of gas cutting, Factors affecting welding cost	8
Unit-I IV	**Estimation in Forging Shop:** Hand forging, Machine forging, Estimation of losses in forging operation , net weight, Time, Estimation of cost of forging operation **Estimation in Pattern Making and Foundry Shop :**Pattern allowances Estimation of pattern cost, Estimation of foundry shop, **Estimation in Sheet Metal Shop :**Sheet metal operations, Sheet metal joints, Estimation of time and cost in sheet metal operations, Blank layout, Capacity for power press.	7

REFERENCE BOOKS :		
1.	Estimating & Costing	Banga & Sharma
2.	Mechanical Estimating & Costing	O.P. Khanna
3.	Mechanical Estimating & Costing	T.T.T.I.Madras

DIPMGM-221 BASICS OF ENTREPRENEURSHIP DEVELOPMENT

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:-
To achieve the target and goals in an organization it is essential to co-ordinate the entire system. For this purpose the knowledge of principles of management, human resources development, material management and financial management is required. Entrepreneurship will introduce the students about how to set up a small-scale industry. The subject includes the procedure for how to select, proceed and start the SSI, which also involves a concrete market survey report and project formulation.

UNITS	CONTENT	Contact Hrs.
Unit-I	**Principles of Management:** Management, administration and organization, difference between them. Scientific management: Meaning, characteristics, object and advantage: Taylor's scientific management, Fayol's principles of management, functions of management, Types of ownership, sole trading, partnership, and joint stock, co-operative and public enterprise, Types of organization, different types and their charts. Importance of human relation professional ethics, Need for leadership, leadership qualities, Motivation. **Human Resources Development :**Introduction, object and functions of human resource development department Recruitment, sources and methods of selection, need for effective training, method of training, duties of supervisor / Foremen, Role of HRD in industries. **Wages and Incentives:** Definition and requirements of good wage system methods of wage payment Wage incentives - type of incentive, difference in wage incentive and bonus. Incentive to supervisor.	6
Unit-II	**Material Management :** Purchasing Functions and duties of purchase department organization of purchase department, methods of purchasing, purchase order contracts, legality of contracts types of contracts i.e. piece work contract, lump sum contract, item rate contract, percentage contract, merits and limitation of each contract system, departmental execution of works, rate contract - D.G.S &D and C.S.P.O. tender, necessity, types of tenders, tendering procedure, earnest money and security money, Store and store keeping :Functions and duties of store department, location and layout of store, bin cards, store ledger, receipt and issue procedure of materials, physical verification of stores, disposal method of unserviceable articles and protection of stores. Sales: function and duties of sales department sales promotion advertisement service after sales. **Financial Management: Function** and duties of finance department, Brief idea of journal, ledger, trial balance, trading account, and profit and loss account, balance sheet. Cheque (crossed and bearer), draft, promissory note, letter of credit, brief idea of cost accounting. Numerical problems. **Marketing Management :**Concept of Marketing, Problems of Marketing, Pricing policy, Distribution channels and methods of marketing	8

Unit-III	**Entrepreneurship:** Entrepreneurship and Entrepreneur Need of Employment and Opportunities. Essential Characteristics of a good Entrepreneur, Industrial Policy. Classification of industries- Tiny, small scale, Medium scale, Large scale, Handicraft, Ancillary Type of industries- Production, Job based & Service. **Entrepreneurial Development:** Product identification/ selection Site selection Plant layout, Institutional support needed, Pre-market survey. **Entrepreneurship Support System:** Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML. Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc. **Setting up SSI:** Registration of SSI, Allotment of land by RIICO. Preparation of project report, Structure of organization, Building construction, Establishment of machines. **Tax System and Insurance:** Idea of income tax, sales tax, excise duty and custom duty, Industrial and fire insurance, procedure for industrial insurance.	**8**
Unit-IV	**Financial Sources for SSI: Various** institutions providing loans for industries, Various types of loans, Subsidies. **Labor Legislation and Pollution Control Acts :** Industrial acts : factory act 1948,Workmen's compensation act 1923,Apprentices act 1961,Water pollution contract act 1974 and 1981,Air pollution contract act 1981,Environmental protection act 1986,Forest (animal conservation act 1972), Pollution control provisions in motor vehicle act. **Project Report: Procedure** of preparing a project report, Format of project report, Preparation of project report for some SSI items. **ISO : 9000 Series of Quality System :** Definition of few important terms related to ISO quality system, Various models for quality assurance in ISO : 9000 series, Various elements of ISO : 9001 model (20 points) Benefits by becoming an ISO : 9000 company ,Introduction to total quality management (TQM)	**8**

REFERENCE BOOKS :		
1.	Industrial Management	K. Sharma & O.P. Harkut
2.	Industrial Engg. & Management	O.P. Khanana
3.	Industrial Engg. & Management	T.R. Banga
4.	Hand Book of Small Scale Industry	P.M. Bhandari
5.	Hand Book on Entrepreneurship Development	O.P. Harkut
6.	Entrepreneurial Development	S.S. Khanka
7.	Statistical Quality Control	Mahohar Mahajan
8.	ISO : 9000 Quality System	S. Dalela

DIPMEA-311 AUTOMOBILE ENGINE & MAINTENANCE SERVICES

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:-
This course deals with automobile engine and maintenance services.

UNITS	CONTENT	Contact Hrs
Unit-I	**GENERAL CONCEPT OF AUTOMOBILES**: Their classification name and make of some India made automobiles. Layout of chassis. Meaning of the terms: Front wheel drive, Rear wheel drive, four wheel drive, Front and Rear wheeled vehicles. Study of specifications of different engines used in Indian vehicles. I.C. ENGINE: Multi cylinder engine, Construction and material of its Piston and Connecting rod Assembly; Crank shaft, Fly wheel and Bearings; Engine valve and Valve operating mechanism (Cam shaft, Valve timing gears, Tappet, Push rod, Rocker and Valve springs).	8
Unit-II	**FUEL SUPPLY AND IGNITION SYSTEM:** (i) **PETROL ENGINE**: Fuel supply circuit components (fuel tank to engine), their function. Exhaust pipe and silencer. Construction and working of mechanical and electrical fuel pumps, Carburetor, its function. Carburetor Controls-Throttle, Choke (Conventional, Automatic). Air fuel ratio, its variation with speed. Magneto and Coil Ignition Systems-Working of coil ignition system for multi cylinder engine and electronic ignition system, Ignition timing, Ignition advance and retard-Their need and factors on which they depend. Spark Plugs-their types as used in automobile engines. Location of spark plug. (ii) **DIESEL ENGINE**: Fuel supply circuit for Diesel engine, Primary and secondary fuel filter, their positioning in the Circuit. Construction and working of fuel pump and fuel injection pump. Governor and injector, Solid and Air injection in Diesel engine. Distributor types of diesel injection pump. Turbulence in filters wet and dries types. Inlet and exhaust main folds arrangement. **MULTI POINT FUEL SUPPLY FOR PETROL ENGINE**: Construction, Fuel Supply system and working, Introduction to other fuels - CNG, Battery, etc.	8
Unit-III	**COOLING SYSTEM:** Necessity for cooling the engine Air cooling Shapes of cooling fins. Field of application for air cooling. Water Cooling- Thermos siphon system, Pump circulated water cooling system. Details of water cooling system-Water jackets, Hose, radiators and fans. Thermostat, Water pump and pressure type radiator cap, Anti-freeze and anti-corrosive additives. Engine cooling liquids other than water and their characteristics. **LUBRICATION SYSTEM OF AUTOMOBILE ENGINES:** Principle of lubrication on multi cylinder petrol/diesel engine. Types of lubrication systems-Splash type, Pressure type and Combined. Types of lubrication pumps pump drive, Relief valves, Oil pressure, Oil filters and their location in lubrication system, Crank case ventilation, and Crank case dilution.	8

Unit-IV	**MAINTENANCE & REPAIRING:** Maintenance, Maintenance schedule, Routine Maintenance schedule for petrol engine and diesel engine, lubricating chart, cleaning and adjustment, preventive maintenance, trouble shooting for faults in engines. Overhauling of engines, Adjusting the engine timing, Maintenance and adjustment of carburetor and fuel injection pump. Checking the valve clearance and adjustment, valve grinding and lapping, engine tuning, detection and rectification of faults use compression gauge and vacuum gauge, general methods of redelivery inspection of vehicle	**8**
Unit-V	**REPAIRING PROCESSES:** Cylinder rebooting and relieving, Removal of liners and fitting, inspection; Repair and fitting of valve and valve guides, checking the connecting rod for bending and connecting rod alignment, inspection of crank shaft frivolity and regrinding, Phasing and calibration of fuel injection pump, nozzle testing, cleaning and grinding. Chassis repair and maintenance. Basic concept about Electrical system repair, and vehicle air conditioning system.	**8**

PRACTICALS

1.	Study and sketch of (i) Battery Ignition System (ii) Magnetic Ignition System
2.	Study and sketch of (i) Head Light Model (ii) Wiper and Indicator
3.	Study and Sketch of (i) Radiator (ii) Water Pump (iii) Oil Pump (iv) Shock Absorber
4.	Study and sketch of (i) A. C. Pump (iii) S. V. Pump (ii) Master Cylinder
5.	Study and sketch of (i) Rear axle (ii) Differential (iii) Steering System (iv) Bendix Drive
6.	Checking and setting of ignition on timing using timing light for advance and retard
7.	Fault finding practice of an automobile vehicle four wheelers (Petrol and Diesel vehicle)
8.	Driving practice of four wheeler.
9.	Charging of Automobile battery and measuring cell voltage and specific gravity of electrolyte.
10.	Determination of gear ratio of an auto engine tachometer/stroboscope
11.	Cleaning and adjustment a carburetor
12.	Automobile engine cylinder boring practice.
13.	Valve face grinding, tapping and reaming of valve guide
14.	Nozzle cleaning, testing and adjustment.
15.	Assemble and dissemble of petrol and diesel engine of an automobile vehicle

REFERENCE BOOKS :

1.	Automobile Engineering Vol – I & II,	Singh Kirpal
2.	Objective I.C. Engines & Automobile Engineering	Poonia M.P
3.	Automobile I & II	S. Gill –(S.K. Kataria)
4.	Automotive Chassis	P.M. Heldt
5.	Mechanism of the car	A.W. Judge
6.	Automotive mechanism	Joseph Heitner
7.	The Automobile	Harbansigh Reyat
8.	Automotive Engineering	G.B.S. Narang
9.	An introduction to Automobile	N.R. Khatawate Engine
10.	Automobile Technology	Sethi H.M.

DIPMEB-311 PRODUCTION TECHNOLOGY-II

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:-
This course focuses on production technology advanced steps like machine tools, mechanical process, electro-chemical process etc.

UNITS	CONTENT	Contact Hrs.
Unit-I	**PRODUCTION MACHINE TOOLS:** Machine tools used for quantity production. Semi-automatic multi tools Centre lathe. Auto lathes: Single spindle automatics. Sliding head types. Single spindle automatics. Multi spindle automatics, Ultra high speed machining. External center less grinding. Internal center less grinding. Mechanical copying systems. Hydraulic servo copying systems for lathe. Electric copying systems, special purpose machines - Brake Drum Turning Lathe.	**10**
Unit-II	**Unconventional Machining Processes-** **(A) MECHANICAL PROCESS-** (i) Abrasive Jet Machining (A.J.M.): Fundamental principles, basic mechanisms of material removal, application& process. (ii) Ultrasonic machining (U.S.M): Fundamental Principles, basic mechanism of material removal application, uses& its limitations. **(B) CHEMICAL MACHINING**: Introduction, fundamental principles, process & its advantages & limitations. **(C) ELECTRO CHEMICAL PROCESS:** Electrochemical machining (E.C.M.): Fundamental, principles, basic mechanism of material removal, application, uses and its limitations. **(D) ELECTRIC DISCHARGE MACHINING (E.D.M.)**: Fundamental principles, basic mechanism of metal removal, application its limitations. **(E) LASER BEAM MACHINING (L.B.M.)**: Fundamental principles, basic mechanism of material removal, uses& its applications. **(F) ELECTRON BEAM MACHINING (E.B.M.)** Fundamental principles, basic mechanism of material removal, uses& its applications. **(G) PLASMA ARC MACHINING (P.A.M):** Fundamental, principle, basic mechanism of material removal. Uses and its application.	**10**
Unit-III	**PRODUCTION OF PLASTICS:** Polymers. Thermos plastics. Molding of thermoplastic. Extrusion process. Sheet forming process. Machining of thermoplastics. Thermosetting Plastics. Molding of Thermosetting plastics. Machining of thermosetting plastics. Other processing methods for plastics. Plastic component design. Moulds design. **CUTTING TOOLS FOR MACHINING:** Elementary theory of metal cutting, Single point tools-Basic angles. Chip formation and their classification, basic mechanism of chip formation, geometry of chip formation, forces on chip. Effect of manipulating factors such as velocity, size of cut, effect of tool geometry, Specific power consumption. Tool material. Tool wear and Tool life.	**10**

	Tailor's tool life equation. Machining economics. Properties of tool materials. Tool materials. Tool steels. High speed steel. Cast cobalt alloys. Carbides or centered carbide. Ceramics. UCON. Surface treatment of cutting tools- Its advantage. Tin coated high speed steel, diamonds, and Cubic boron nitrides.	
Unit-IV	**PRESS TOOLS:** Elements of Press tools, Factors affecting press tool design. Shearing. Bending. And Drawing operation. Combination. Progression and compound die. Rubber die forming. **MODERN CONCEPT OF QUALITY CONTROL**: Do it right first time, just in time (JIT), Process Control, ZD production (Zero Defect Production).	10

PRACTICALS

1.	Inspection of casting (a) Flange of pipe (b) Pulley (c) Gear blank (d) Bush
2.	Turning, boring, internal threading of cost iron flange.
3.	Marking and drilling holes in cost iron flange 75 mm. size pipe.
4.	Boring hole in cast iron pulley and cutting key way slot.
5.	Turning bottom shaft of cycle and milling cotter slot
6.	Turning hub axle of cycles.
7.	Turning and internal threading of cone of cycle.
8.	Turning bearing races and cups of cycle.
9.	Turning plug gauge.
11.	Gear milling, internal whole boring, and key way slot cutting for Auto (scooter/jeep/truck/gear box).
12.	Milling of snap gauge plate
13.	Inspection practices (a) Flange after each operation. (c) Gear after each operation (b) Pulley after each operation. (d) Gauges after each operation (e) Cycle parts after each operation
14.	Hardness testing
15.	Cr, Plating
16.	Packing practices
17.	Few examples as case study such as schedule for complete overhaul of Centre lathe, reciprocal or centrifugal pumps and compressor etc. giving work distribution, planning repair estimate.
18.	Heat treatment of small tools, coining tools and forgoing dies

REFERENCE BOOKS :		
1.	Production Technology	Tata Mc-Graw Hill Pabla B. S. , M. Adithan
2.	Industrial maintenance	S. Chand & Co. Ltd. P. K. Mistra
3.	Manufacturing Science	Amitabh Ghosh, Mallik

DIPME-312 MANUFACTURING PROCESSES AND MACHINE DESIGN

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE
Manufacturing processes are developing very fast with rapid changes in technology and Knowledge of method of finding shapes and sizes of various machine elements is also very essential from their strength and stiffness/rigidity viewpoints . This subject will provide insight to the students regarding metal forming methods, plastic process, design of welding joints, screw and bolts, key and coupling. This subject would impart the basic knowledge about the manufacturing process as well as designing of various machine elements.

UNIT	CONTENT	Contact Hrs.
Unit-I	**Metal Forming Process :**Forging Forging process, open die forging, closed die forging (drop forging) Press forging, upset forging, Swaging, up setters, roll forging Cold and hot forging, forging defects and their remedies Rolling, Elementary theory of rolling, types of rolling mills, Roll passes, rolling defects and remedies, Press forming ,Types of presses, working, selection of press dies, die material. Press operations - shearing piercing, trimming, punching, Notching, shaving, guering or rubber ,forming, embossing, stamping ,Deep Drawing Extrusion ,Types of extrusion - Hot and Cold, Direct and Indirect, Drawing , Pipe drawing, Tube drawing,	8
Unit-II	**Conventional Metal Cutting Processes: Metal** Cutting, Elementary theory of metal cutting, Merchant's diagram Tool life, Economics of tool life, Machinability, Factors affecting Machinability. **Metallic Coating Processes:** Metal spraying, galvanizing, Electroplating and anodizing. **Plastic Process (Working principle, Advantages and limitation of following process:** Injection moulding, Blow moulding, Compressive moulding**.**	7
Unit-III	**Design of Welding Joints :** Types of welded joint and Design of lap joint and butt joint, Strength of transverse and parallel fillet welded joints in axial loading, Basic welding symbols, Welded joint subjected to twisting moment and bending moment, Eccentrically loaded welded joints,. **Design of Screw and Bolts: Initial** stresses due to screwing up Stress due to external forces, Stress due to combined forces, Bolt of uniform strength, Screw thread, designations and its dimensions. Design of Power screw Design of screw jack. **Design of Joints :**Design of simple cotter joints, Design of knuckle joints, Design of turnbuckle,	8
Unit-IV	**Design of Keys and Couplings: Design** of sunk key, Design of rigid flange coupling, Design of pin type flexible couplings. **Bearings (no numerical problems) :**Introduction and Classification, Material used for bearings and their properties, Types and uses of rolling contact bearings, Standard dimension and designations of ball bearings, Selection of rolling elements bearings, **Lever:** Introduction, Design of a hand lever, Design of a foot lever, Design of Lever for safety valve	7

	PRACTICALS
1	Exercise on forging operation by power hammers.
2.	Experiment on black smithy.
3.	Experiment on press forming.
4.	Study of wire drawing.
5.	Exercises on Electro plating.
6.	Study of different types of screw and bolts.
7.	Study of different types of keys.
8.	Experiment on lap & butt joint.
9.	Study of different types of coupling.
10.	Study of journal bearing.

	REFERENCE BOOKS :	
1.	Production Engineering .	R.K. Jain
2.	Manufacturing Science	Amitabha Ghosh & A.K. Mallik
3.	Production Technology	Pandey.Singh
4.	Production Engineering	P.C. Sharma (S. Chand)
5.	Metal Forming Process	G.R. Nagpal (Khanna Pub.)
6.	Machine Design	Pandya & Shah
7.	Machine Design	R.S.Khurmi
8.	Machine Design	Sharma & Aggrawal
9.	Machine Design	V. B. Bhandari

DIPME-313 THERMAL ENGINEERING AND I. C. ENGINE

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE
For technical education in Mechanical & Auto mobile engineering field the subject of Thermal engineering and IC Engine is very important for understanding the basic principles and concept of thermodynamics and knowledge of thermal engineering is essential in order to understand the working of the Steam Generator, Steam Turbine, Petrol engines and Diesel engines.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Basic Concept and Gas Laws:** Thermodynamics, property-Intensive and Extensive, system - open, closed and isolated, Energy - Internal energy, potential energy, kinetic energy, heat, work, specific, heat, enthalpy, Boyle's law, Charles's law, Joule's law, Characteristics gas equation, gas constant, mol, universal gas constant and molar, specific heats Simple numerical problems. **Laws of Thermodynamics:** Zeroth law of thermodynamics, First law of thermodynamics. Second law of thermodynamics Concept of entropy, Constant volume, constant pressure, isothermal, adiabatic polytrophic processes, throttling and free expansion, work done during these processes. Simple numerical problems.	7
Unit-II	**Formation of Steam and its Properties :** Generation of steam at constant pressure, various stage of steam- wet steam, dry steam saturated steam, dryness fraction, super heated steam, degree of super heat. Critical point, triple point, thermodynamic properties of steam - specific volume, specific enthalpy, specific internal energy, specific entropy. Steam property diagram: enthalpy- entropy, diagram, Heating and expansion of steam during thermodynamic processes, Change of internal energy and entropy of steam during processes Simple numerical problems Use of steam tables and Mollier charts. **Steam Generators:** Definition of boiler according to I.B.R., classification of boilers, Comparison of water tube and fire tube boilers. Special characteristics of high-pressure boilers Introduction to Indian Boiler Act.	8
Unit-III	**Steam nozzles:** Flow of steam through convergent- divergent nozzle, Velocity of steam leaving nozzles, Mass of steam discharged through nozzles. Critical pressure ratio. Area of cross section of throat and exit for maximum discharge. Length of nozzle, Super saturated flow, Numerical problems. **Steam Turbines:** Classification and industrial application of steam turbines. Principle and operation of impulse and reaction turbine, Compounding of turbines, Description of simple De-Laval turbine, velocity diagram, work done and efficiency. Description of Parson's reaction turbine, velocity diagram, work done and efficiency, Bleeding of steam, Lubrication system for steam turbines, Blade materials and defects in blades, Simple numerical problems.	7
Unit-IV	**Principles of Internal Combustion Engines :** Introduction and Classification of I.C Engines, Working principle of four stroke and two stroke cycle and their comparison, Working and special features of petrol and diesel engines and their comparison and applications I.C. engine terms - Bore, stroke, dead centers, crank throw, compression ratio, clearance volume, piston displacement and piston speed, Valve timing diagrams (Theoretical & Actual), firing order, Super charging of I.C. engines. **Petrol Engines:** Concept of Carburetion, Air fuel ratio, Simple carburetors and its limitations, Multi point fuel injection system, Mechanical and electrical feed pump. **Diesel Engines:** Description and working of Fuel feed pump Injection of fuel, Introduction to swirl and open combustion chambers. **Cooling, Lubrication and Governing:** Necessity of engine cooling, Properties of coolants, Methods of cooling and their merits and demerits, Function of Lubrication, lubrication systems of I.C. Engines, Properties of lubricants, Governing methods of I.C. Engines.	8

1	Study of Cochran's boiler & Lancashire boiler
2.	Study of Blackcock & Wilcox boiler
3.	Study of Boiler mountings
4.	Study of Boiler accessories
5.	Study of impulse turbine
6.	Study of reaction turbine
7.	Study of two-stroke Petrol engine.
8.	Study of four stroke Petrol engine.
9	Study of two-stroke & four stroke Diesel engine.
10.	Study of carburetors

REFERENCE BOOKS:		
1.	Thermal Engineering (Hindi)	Arpit Singh
2.	Thermal Engineering (Hindi)	Verma & Gulecha
3.	Thermal Engineering	R.K.Purohit.
4.	Thermal Engineering	R.S. Khurmi
5.	Elements of Heat Engines -Vol.1	Patel & Karam Chandani
6.	Internal Combustion Engine	Mathur & Sharma
7.	Internal Combustion Engine	V. Ganesan

DIPME-314 MACHINE TOOL TECHNOLOGY & MAINTENANCE

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE
For technical education in Mechanical & Auto mobile engineering field the subject of machine tool technology & maintenance is very important for understanding the basic principles and concept of various types of machining operations and machine tools is essential in order to understand the working of the Lathe, Drilling, Milling machines etc.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Basic Features And Kinematics:** Various types of machining operations and machine tools. Common features of all basic machine tools, work holding and tool holding devices, Drive systems, sources of power, Bed, body or frame. Mechanical drive system for providing reciprocating, oscillating and rotational movement. Systems of stepped and steeples, friction and positive drives. Principle of setting upper, lower and intermediate speeds. Mechanical methods of providing automaticity in machine tools.	07
Unit-II	**Centre Lathe:** The Centre lathe and its principle of working. Types of lathes, Lathe specification and size, Features of lathe bed. Head stock and tail stock. Feed mechanism and change-gears, carriage saddle, Cross slide, Compound rest, Tools post, Apron mechanism, lathe accessories, Chucks, Face plate, Angle plate, Driving plate, Lathe dogs, mandrills, Steady rest, Lathe attachments. Lathe operations-plane and step turning, Taper turning, Screw cutting, Drilling, Boring, reaming, Knurling, Parting off, under cutting, Relieving. Types of lathe tools and their uses. Brief description of semi-automatic and automatic lathes such as capstan and turret lathes, their advantages and disadvantages over Centre lathe, types of job done on them. General and periodic maintenance of a Centre lathe.	08
Unit-III	**Shaping, Planing & Slotting Machines:** Working principles of planer, shaper and slotter. Differences and similarities among them, quick return mechanism applied to the machines. Types of work done on them, types of tools used, their geometry. General and periodic maintenance of a shaper. **Drilling & Boring Machines:** Types of tools used in drilling and boring. Classification of drilling and boring machines, principle of working and constructional details of simple and radial drilling M/C and general and periodic maintenance. Operations like facing, counter boring, tapering.	07
Unit-IV	**Milling Machines:** Types of milling machines, constructional features of horizontal milling M/C. general maintenance of the machine, types of milling cutters, milling operations like plane milling, space milling, angular milling form milling, straddle milling, gang milling, Negative rack milling, cutting speed and speed for different tools in up and down milling. Simple compound and differential indexing, milling of spur gears and racks. General and periodic maintenance of milling machine. **Grinding Machines:** Common abrasive grinding wheel materials, Bonds, Grain or grits of abrasive, Grain structure and shapes of common wheels, various speeds and feeds, Use of coolants, Methods of grinding. Types of grinding machines, precision finishing operations like honing.	08

Jigs and Fixtures: Object of Jigs and Fixture. Difference between jigs and fixtures. Principle of location. Principle of clamping. Locating and clamping devices. Types of jigs -Simple open and closed (or box) jigs. Drill jigs- Bushes (Fixed liner, Renewal slip). Template. Plate jigs. Channel jigs, Leaf jigs. Simple example of milling, turning, grinding, horizontal boring fixtures and broaching fixtures. Welding fixtures. Devices.

	REFERENCE BOOKS:	
1.	Machine Tool Technology & Maintenance	Ajay Kumar Bansal
2.	Machine Tool Technology & Maintenance	Sushil Kumar and Anil Kumar
3.	Machine Tool Technology	J. K. Kapoor
4.	Machine Tool Technology	S. K. Bhatnagar

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE

Knowledge of chassis layout, IC engine, ignition system, fuel supply system, cooling and lubricating system imparted in this subject.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**General Concept of Automobiles:** Their classification name and make of some India made automobiles. Layout of chassis. Meaning of the terms: Front wheel drive, Rear wheel drive, four wheel drive, Front and Rear wheeled vehicles. Basic requirements of an automobile. Study of specifications of different engines used in Indian vehicles. **Choice of Power Unit For an Automobile:** Torque and power requirements of an automobile in various conditions. Torque characteristics of some power units such as Gas turbine, Electric motor and I.C. engine; their suitability to automobile needs. Drawback of I.C. engine to meet these needs. Measures taken to make it suitable to these needs.	10
Unit-II	**I.C. Engine:** Multi cylinder engine, Construction and material of its Piston and Connecting rod Assembly; Crank shaft, Fly wheel and Bearings; Engine valve and Valve operating mechanism (Cam shaft, Valve timing gears, Tappet, Push rod, Rocker and Valve springs). Advantage of multi cylinder engine for automobiles use, Firing order, Arrangement of cylinders. Valve positions and design of combustion chamber cylinder head and gasket. Winkle rotary engine. Idea of super charging, its advantages phenomenon of knocking or detonation, its cause and effect on engine. Octane number and Cetane number.	10
Unit-III	**Fuel Supply and Ignition System:** **Petrol Engine:** Fuel supply circuit components (fuel tank to engine), their function. Exhaust pipe and silencer. Construction and working of mechanical and electrical fuel pumps, Carburetor, its function. Simple carburetor, its limitations. Modified carburetor-Zenith, Carter, Soledad S.U. carburetors, their construction and working. Carburetor Controls-Throttle, Choke (Conventional, Automatic). Air fuel ratio, its variation with speed. Magneto and Coil Ignition Systems-Working of coil ignition system for multi cylinder engine and electronic ignition system, Ignition timing, Ignition advance and retard-Their need and factors on which they depend. Spark Plugs-their types as used in automobile engines. Location of spark plug. **Diesel Engine:** Fuel supply circuit for Diesel engine, Primary and secondary fuel filter, their positioning in the Circuit. Construction and working of fuel pump and fuel injection pump. Governor and injector, Solid and Air injection in Diesel engine. Distributor types of diesel injection pump. Turbulence in filters wet and dries types. Inlet and exhaust main folds arrangement. Exhaust pipe and silencer. Concept of fuel energy saving. **Multi Point Fuel Supply For Petrol Engine:** Construction, Fuel Supply system and working, Introduction to other fuels - CNG, Battery, etc.	10

Unit-IV	**Cooling System:** Necessity for cooling the engine Air cooling Shapes of cooling fins. Field of application for air cooling. Water Cooling- Thermos siphon system, Pump circulated water cooling system. Details of water cooling system-Water jackets, Hose, radiators and fans. Thermostat, Water pump and pressure type radiator cap, Anti-freeze and anti-corrosive additives. Engine cooling liquids other than water and their characteristics. **Lubrication System of Automobile Engines:** Principle of lubrication on multi cylinder petrol/diesel engine. Types of lubrication systems-Splash type, Pressure type and Combined. Types of lubrication pumps pump drive, Relief valves,	10

REFERENCE BOOKS:		
1.	Basic Automobile Engineering	C.P.Nakra
2.	Automobile Engineering.	T.R.Banga & Nathu Singh.
3.	Automobile Engineering	H.S. Reyat
4.	Automobile Engineering (Hindi & English)	Kirpal Singh

DIPMEB-321 PRODUCTION AUTOMATION

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE

For technical education in production engineering field the subject of production automation is very important for understanding the basic principles and concept of production and knowledge of automation is essential in order to understand the working of the CNC machine, DNC machine, CAD, CAM etc.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Introduction:** Automation-Definition, Scope, its types and their merits, Reasons for automation. Its appreciation and criticism. Introductory Idea and meaning of the terms CNC, DNC, Adaptive control, FMS & CIM and machining Centre. Current trends in NC, CAD, CAM. Introduction to Robotics.	10
Unit-II	**Fundamentals of Manufacturing and Automation:** Types of Industries- Manufacturing, Processing; Basic producers, Converter, Fabricators. Manufacturing-Functions- Processing- Basic processing, secondary processing; Operations enhancing physical properties and finishing operations; Assembly, Material handling and Storage; Inspection and test and control, their meaning with automation point of view.	08
Unit-III	**Manufacturing Process Inputs:**- Raw materials, Equipment's (Machine tools), Tooling and fixtures, Energy and Labor. Outputs- Finished product and Scrap/Waste. Plant Layout- Its meaning and concept of fixed position layout, Process layout, Product layout and Group technology layout. Organization and Information Processing Business functions, Product design, manufacturing planning and manufacturing control. Production Concept- Such as-Manufacturing Lead Time (MLT), Production rate, Components of Operation Time, Production Capacity (PC), Utilization and availability, Work in Process (WIP), Time in Plant (Tip), WIP Ratio, Tip ratio, their meaning and significance. Simple numerical problems. Automation Strategies and Their Effect- Specification of operation, Combined operations, Simultaneous operations, Integration operations, Increase flexibility, improved, Material handling and storage, on-line inspection, process control and optimization, Plant operation control, Computer integrated manufacturing.	10
Unit-IV	**Assembly System and Line Balancing:** The assembly process, Assembly system, Manual assembly lines, Line balancing problems. Computerized line balancing methods. Other ways to improve the line balancing, flexible manual assembly line, Partial Automation. **Automated Assembly Systems:** Design for automated assembly, Types of automated assembly systems, Parts feeding devices, Part orienting devices, Feed tracks, Escapements and Part placing mechanism, Role of industrial robot in automatic assembly. **Numerical Control Production System:** Numerical machine Tool, Binary System, Coordinate system and Machine motions, Types of N.C. systems, Machine tool applications, Economics of NCS. **N.C. Part Programming:** Tape and Tape format, Methods of N. C. part programming, Computer assisted part programming, The APT Language, Manual data inputs, N. C. part programming	12

	using CAD/CAM, use of computer as support in design and manufacturing, and Case study.	

REFERENCE BOOKS:

1.	Production Automation	H.K. Sharma
2.	Production Automation	Ravi NAndan Garg
3.	Production Automation and CIM	Radha Krishna & S. Subramanyam
4.	Production Automation & Numeric Control	Leone, William C

DIPME-323 BASICS OF DESTRUCTIVE AND NON DESTRUCTIVE TESTING

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE
To provide a basic understanding on different destructive and non destructive testing techniques and apply them for inspecting materials in accordance with industry specifications and standards.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Introduction:** Introduction of DT, Some common DT methods and its application, Scope and advantages of NDT, Some common NDT methods used since ages, Comparison of NDT with Destructive Testing, Terminology, Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.	10
Unit-II	**Magnetic Particle Testing:** Magnets and magnetic materials, Magnetization and its methods, Magnetic fields, Detection media, Application of magnetic particles testing, Testing equipments machines and accessories, Application in industry. **Liquid Penetrant Testing:** Principle of liquid penetrant testing, Methods, Their advantages and disadvantages, Equipment used, Penetrant materials, Testing procedures, Inspection and interpretation, Applications in industry.	10
Unit-III	**Electromagnetic Methods:** Eddy current theory, Magnetic flux leakage theory, Principle of electromagnetic testing, Various types of eddy current techniques used and advantages of various electromagnetic methods for crack detection etc.	10
Unit-IV	**Ultrasonic Testing Methods:** Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements.	10

REFERENCE BOOKS:		
1.	Handbook on Non-destructive Testing of Concrete	Malhotra, Publisher: CRC Press, 2002
2.	Non-destructive Testing	Abhishek Agarwal, Gaurav Pundir & Shyam Singh
3.	Electrical and Magnetic Methods of Nondestructive Testing	Blitz and Jack, Institute of Physics Publishing, 2001
4.	Non Destructive Testing and Evaluation for Manufacturing and Construction	Henrique L M, Hemisphere Publishers, New York, 2001

DIPME-322 INDUSTRIAL ENGINEERING SAFETY

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE

Industrial engineering safety is very essential subject for the safety point of view in the industries. This subject will provide insight to the students regarding inspection, material handling, plant layout, accident and safety.

UNIT	CONTENTS	Contact Hrs.
Unit-I	**Inspection:** Inspection, Need and its planning, objective. Types of inspection. Inspection standards. Duties of inspector in inspection. Inspection needs. **Work Study:** Method Study-Process chart, Flow process chart, Flow diagram, Man and Machine chart, Gang process Chart. Work Measurement-Time study, Tools used in time study, Performance rating, Allowance and use of time standard, Time and Motion study. Principle of human motion economy, Micro motion study, Memo motion study, Therbligs, left hand and right hand chart	10
Unit-II	**Production, Planning and Control:** Methods of production-Unit, Batch, mass. Sales forecasting and its use. Planning-Products, process parts, materials, Optimum Batch quantity for production and Inventory, Theory and Analysis of M/C capacity, Batch quantity, loading and balancing-Scheduling M/C loading. Preplanning activities, Routing, Dispatching, Follow up activities. **Material Handling and Material Handling Equipment:** Factors in material handling problems, Cost reduction through improved material handling, Reduction in time of material handling, Material handling equipment's Lifting lowering devices, Transporting devices, Combination devices, Maintenance of material handling equipment.	10
Unit-III	**Plant Layout:** General plant location factors, Influence of location on Plant layout, selection of plant site, Product layout, Process layout. Advantages and disadvantage of process layout **Standard and Code:** National and International code, value of standardization. Standardization programme, Role of Standardizations department, standardization techniques and problems.ISO-9000. **Quality Control:** Concept of quality control, Quality assurance elements of quality control, Statistical quality control, Acceptance sampling, control chart for variable and attributes, Uses of X, R, "P" and "C" chart - O.C. curve, Concept of Total Quality Management.	10
Unit-IV	**Cost Estimation:** Introduction and function of cost estimation, estimation procedure, elements of cost, depreciation - methods of Calculating depreciation, overhead expenses, distribution of overhead expenses, calculation of cost for machining and metal forming process and break even analyzer. **Value Engineering:** Concept of value engineering and technique. **Accidents And Safety:** Classification of accidents causes of accidents, Effects of accidents, Action to be taken in case different types of accidents, Safety - needs, consciousness, procedures, measures. General safety devices used on machines, Safe working condition and productivity	10

	REFERENCE BOOKS:	
1.	Industrial Engineering Safety	Basudeo Panda
2.	Industrial Engineering Safety	A.K.Gupta
3.	Industrial Safety and Environment	R.K Jain & Sunil S. Rao
4.	Industrial Safety and Environment	Anupma Parashar & Pratibha Bansal

DIPME-324 INDUSTRIAL TRAINING/PROJECT

L	T	P	Cr
-	-	12	6

UNITS	CONTENTS	Contact Hrs.
INDUSTRIAL TRAINING/ PROJECT	The student will complete the training/project by the end of the semester and a comprehensive training/project report will be submitted by the student under the signature of his/her supervisor. The external examination shall be taken by a panel of examiners comprising of concerned supervisor, the training and placement officer and an external examiner (from the relevant field) nominated / approved by the competent authority. Hard copies of report are required to be submitted by the student before the external examination. The candidate shall appear before the evaluation committee for oral examination and presentation on the scheduled date.	**60**

DIPME-325   VIVA-VOCE

L	T	P	Cr
-	-	-	2

UNITS	CONTENTS	Contact Hrs.
	A viva–voce for every student for his/her academic and General Proficiency for the Profession shall be carried out by a committee comprising of three members including Principal/Director, Head of Department, and an External Examiner appointed by the University. The evaluation will be made in the light of various parameters including Academic Performance, Extra Curricular Activities, Educational tours / visits / Membership of Professional Societies, Contribution in NSS Social Welfare Floor Relief / draught relief / Adult Literacy mission / Literacy Mission / Blood Donation / any other Social Service, other achievements in the Institution and the performance in viva voce before the committee.	

MONAD UNIVERSITY

School of Engineering & Technology

(Mechanical Engineering)

SCHEME AND CURRICULUM

B. Tech: 4 Year Programme

Effective from 2019-20

Course Structure

Year	Semester	Course Code	Course Title	L	T	P	C
1	1	BS-111	Engineering Chemistry	3	1	2	5
		BS-112	Engineering Mathematics-I	3	1	0	4
		ES-111	Basics Electrical Engineering	3	1	2	5
		ES-112	Engineering Graphics & Design	1	0	4	3
		HS-111	Professional Communication	2	1	2	4
		MC-111	**Induction Programme**	**2**	**0**	**0**	**0**
			Total				**21**
	2	BS-121	Engineering Physics	3	1	2	5
		BS-122	Engineering Mathematics-II	3	1	0	4
		ES-121	Programming for Problem Solving	2	1	4	5
		ES-122	Workshop Practices	1	0	4	3
		MC-121	Environmental Science	2	1	0	3
			Total				**20**
Year	Semester	Course Code	Course Title	L	T	P	C
2	1	**BS-211**	**Engineering Mathematics- III**	**3**	**1**	**0**	**4**
		ES-211	**Basic Electronics Engineering**	**2**	**1**	**2**	**4**
		ES-212	Engineering Mechanics	2	1	2	4
		BTME-211	Thermodynamics	3	1	0	4
		BTME-212	Materials Engineering	2	1	2	4
		BTME-213	Computer Aided Drawing Lab	0	0	2	1
		HS-211	**Organization Behavior**	**2**	**1**	**0**	**3**
		MC-211	**Disaster Management**	**2**	**0**	**0**	**0**
			Total				**24**
	2	BTME-221	Applied Thermodynamics	2	1	2	4
		BTME-222	Fluid Mechanics & Fluid Machines	3	1	2	5
		BTME-223	Strength of Materials	2	1	0	3
		BTME-224	Manufacturing Processes	2	1	2	4
		BTME-225	Computer Aided Machine Drawing Lab	0	0	2	1
		MC-221	**Positive Psychology**	**2**	**0**	**0**	**0**
			Total				**17**

Year	Semester	Course Code	Course Title	L	T	P	C
3	1	BTME-311	Heat Transfer	2	1	2	4
		BTME-312	Composite Materials	2	1	0	3
		BTME-313	Instrumentation & Control	2	1	2	4
		BTME-314	Theory of Machines	3	1	2	5
		BTME-315	Internal Combustion Engines	2	1	0	3
		HS-311	**Industrial Management**	**2**	**1**	**0**	**3**
		BTME-316	Project –I (Summer Internship)	0	0	2	1
		MC-311	**GST**	**2**	**0**	**0**	**0**
			Total				**23**
	2	BTME-321	Manufacturing Technology	2	1	2	4
		BTME-322	Design of Machine Elements	3	1	2	5
		BTME-323	Refrigeration & Air Conditioning	2	1	2	4
		BTME-324	Elective -I	2	1	0	3
		BTME-325	Elective-II	2	1	0	3
		HS-321	**Entrepreneurship Development Program**	**2**	**1**	**0**	**3**
		BTME-326	Project-II (Summer Internship)	0	0	4	2
		MC-321	**Indian Constitution**	**2**	**0**	**0**	**0**
			Total				**24**

Course Code	Elective – I	Course Code	Elective - II
BTME-324(1,2)	Mechatronics Systems	BTME-325(1,2)	Non Conventional Energy Resources
	Gas Dynamics and Jet Propulsion		Energy Conservation and Management

Year	Semester	Course Code	Course Title	L	T	P	C
4	**1**	BTME-411	Automobile Engineering	2	1	2	4
		BTME-412	**Elective -III**	2	1	0	3
		BTME-413	**Elective - IV**	2	1	0	3
		BTOE-414	**Open Elective –I**	2	1	0	3
		BTME-415	Project-III	0	0	6	3
		MC-411	**Essence of Indian Traditional Knowledge**	**2**	**0**	**0**	**0**
			Total				**16**
	2	BTME-421	**Elective - V**	2	1	0	3
		BTOE-422	**Open Elective –II**	2	1	0	3
		BTOE-423	**Open Elective –III**	2	1	0	3
		BTME-424	Project -IV	-	-	12	6
			Total				**15**

Course Code	Elective - III	Course Code	Elective - IV
BTME- 412 (1,2)	Automation in Manufacturing	BTME- 413 (1,2)	Power Plant Engineering
	Computer Aided Design		Automation & Robotics

Course Code	Open Elective – I
BTOE-414(1,2)	Total Quality Management
	Non Destructive Testing

Course Code	Departmental Elective - V
BTME-421(1,2)	Mechanical System Design
	Modern Machine Process

Course Code	Open Elective – II	Course Code	Open Elective – III
BTOE- 422 (1,2)	Six Sigma & its Application	BTOE- 423 (1,2)	Mechanical Vibrations
	Solar PV Technology		Numerical Analysis & Optimization Techniques

BS-111 ENGINEERING CHEMISTRY

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:

- Use of different analytical instruments.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
- Measure hardness of water.
- Estimate the rate constant of reaction.

UNIT	CONTENT	Contact Hrs.
I	**Atomic and Molecular Structure:** Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nonmaterial and its application.	**8**
II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet& Visible and Raman spectroscopy.	**8**
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system.	**8**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methos).	**8**
V	**Polymer:** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, and Terylene). General methods of synthesis of organ metallic compounds (Grignard reagent) and their applications.	**8**

TEXT BOOKS:		
1.	University chemistry	B. H. Mahan, "", Addison-Wesley Publishing Company, 1975
2.	Chemistry: Principles and Applications	M. J. Sienko and R. A. Plane, McGraw Hill
3.	Engineering Chemistry	B. L. Tembe, Kamaluddin and M. S. Krishnan" (NPTEL)

75

EXPERIMENTS	• Determination of alkalinity in the given water sample.
	• Determination of temporary and permanent hardness in water sample using EDTA.
	• Determination of iron content in the given solution by Mohr's method.
	• Determination of viscosity of given liquid.
(At least 8 of the following)	• Determination of surface tension of given liquid.
	• Determination of chloride content in water sample.
	• Determination of available chlorine in bleaching powder.
	• Determination of pH by pH-metric titration.
	• Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
	• Determination of Cell constant and conductance of a solution.
	• Determination of rate constant of hydrolysis of esters.
	• Verification of Beer's law.

BS-112 ENGINEERING MATHEMATICS- I

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:
The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT	CONTENT	Contact Hrs.
I	**Calculus:** Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	6
II	**Calculus:** Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6
III	**Sequences and series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	10
IV	**Multivariable Calculus (Differentiation):** Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	8
V	**Matrices:** Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and Eigen vectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation	10

TEXT BOOKS:		
1.	Higher Engineering Mathematics	Grewal B S
2.	Engineering Mathematics, Vol. I	Sastry S S, Prentice Hall of India

ES-111 BASIC ELECTRICAL ENGINEERING

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:
• To understand and analyze basic electric and magnetic circuits. • To study the working principles of electrical machines and power converters. • To introduce the components of low voltage electrical installations.

UNIT	CONTENT	Contact Hrs.
I	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8
II	**AC Circuits:** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	8
III	**Transformers:** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	6
IV	**Electrical Machines :**Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	8
V	**Power Converters:** DC-DC bucks and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation. **Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthling. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	10

TEXT BOOKS:		
1.	Basic Electrical Engineering	D. P. Kothari and I. J. Nagrath, Tata McGraw Hill
2.	Basic Electrical Engineering	D. C. Kulshreshtha, McGraw Hill, 2009

3.	Fundamentals of Electrical Engineering	L. S. Bobrow, Oxford University Press

Basic Electrical Engineering Laboratory

EXPERIMENTS **(At least 8 of the following)**	• Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors. • Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage (oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits. • Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power. • Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits. • Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine. • Torque Speed Characteristic of separately excited dc motor. • Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed. • Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation. • Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

ES-112 ENGINEERING GRAPHICS & DESIGN

L	T	P	Cr
1	0	4	3

COURSE OBJECTIVE:
• To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
• To prepare you to communicate effectively
• To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

UNIT	CONTENT	Contact Hrs.
I	Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Orthographic Projections covering, Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;	8
II	Projections of Regular Solids covering, those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	8
III	Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions; Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];	8

IV	Customisation & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	6
V	Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	10
VI	Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	10

TEXT BOOKS:		
1.	Engineering Drawing	Bhatt N D, Charotar Publishing House.
2.	Engineering Graphics	Agrawal B. & Agrawal C. M. (2012), TMH Publication
3.	Engineering Drawing	Shah M B and Rana B C, Pearson Education
4.	Graphic Science	French T E and Vierck C J, McGraw-Hill, New York
5.	Text book on Engineering Drawing	Narayana, K.L. & P Kannaiah (2008)

HS-111 PROFESSIONAL COMMUNICATION

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNITS	CONTENTS	Contact Hrs.
I	**Vocabulary Building** • The concept of Word Formation • Root words from foreign languages and their use in English • Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. • Synonyms, antonyms, and standard abbreviations.	6
II	**Basic Writing Skills** • Sentence Structures • Use of phrases and clauses in sentences • Importance of proper punctuation • Creating coherence • Organizing principles of paragraphs in documents • Techniques for writing precisely	6
III	**Identifying Common Errors in Writing** • Subject-verb agreement • Noun-pronoun agreement • Misplaced modifiers • Articles • Prepositions • Redundancies • Clichés	6
IV	**Nature and Style of sensible Writing** • Describing • Defining • Classifying • Providing examples or evidence • Writing introduction and conclusion	6
V	**Writing Practices** • Comprehension • Précis Writing • Essay Writing **Oral Communication** (It involves interactive practice sessions in Language Lab) • Listening Comprehension • Pronunciation, Intonation, Stress and Rhythm • Common Everyday Situations: Conversations and Dialogues • Communication at Workplace • Interviews • Formal Presentations	6

TEXT BOOKS:		
1.	Practical English Usage	Michael Swan. OUP. 1995
2.	Remedial English Grammar	F.T. Wood. Macmillan.2007
3.	On Writing Well	William Zinsser. Harper Resource Book. 2001
4.	Practical English Usage	Michael Swan. OUP. 1995
5.	Communication Skills	Sanjay Kumar and Pushp Lata. Oxford University Press. 2011

PROFESSIONAL COMMUNICATION LAB

EXPERIMENTS **(At least 8 of the following)**	• Group Discussion: Practical based on Accurate and Current Grammatical Patterns. • Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics. • Communication Skills for Seminars/Conferences/ Workshops with emphasis on Paralinguistic/ Kinesics. • Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics. • Official/Public Speaking based on suitable Rhythmic Patterns. • Theme- Presentation/ Key-Note Presentation based on correct argumentation methodologies. • Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes. • Argumentative Skills/Role Play Presentation with Stress and Intonation. • Comprehension Skills based on Reading and Listening Practical's on a model Audio-Visual Usage.

MC-111 INDUCTION PROGRAM

Induction program	3 weeks duration
Induction program for students to be offered right at the start of the first year	**Physical activity** • **Creative Arts** • **Universal Human Values** • **Literary** • **Proficiency Modules** • **Lectures by Eminent People** • **Visits to local Areas** • **Familiarization to Dept. /Branch & Innovations**

BS-121   ENGINEERING PHYSICS

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:

- To solve the classical and wave mechanics problems.
- To develop the understanding of laws of thermodynamics and their application in various processes.
- To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory.
- To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams.

UNIT	CONTENT	Contact Hrs.
I	**Relativistic Mechanics:** Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Mass less particle.	8
II	**Electromagnetic Field Theory:** Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell's equations in vacuum and in non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.	8
III	**Quantum Mechanics:** Black body radiation, Stefan's law, Wien's law, Rayleigh-Jeans law and Planck's law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.	8
IV	**Wave Optics:** Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh's criterion of resolution, Resolving power of grating.	8
V	**Fiber Optics & Laser:** Fiber Optics: Introduction to fiber optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fiber, Attenuation and Dispersion in optical fibers. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.	8

TEXT BOOKS:

1.	Introduction to Electrodynamics	David Griffiths,
2.	Physics	Halliday and Resnick
3	Electricity, magnetism and light	W. Saslow,

ENGINEERING PHYSICS LAB

EXPERIMENTS **(At least 8 of the following)**	• To determine the wavelength of sodium light by Newton's ring experiment. • To determine the wavelength of different spectral lines of mercury light using plane transmission grating. • To determine the specific rotation of cane sugar solution using polar meter. • To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses. • To measure attenuation in an optical fiber. • To determine the wavelength of He-Ne laser light using single slit diffraction. • To study the polarization of light using He-Ne laser light. • To determine the wavelength of sodium light with the help of Fresnel"s bi-prism. • To determine the coefficient of viscosity of a given liquid. • To determine the value of acceleration due to gravity (g) using compound pendulum. • To determine the energy band gap of a given semiconductor material. • To study Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup. • To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil. • To verify Stefan's law by electric method. • To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge. • To study the resonance condition of a series LCR circuit. • To determine the electrochemical equivalent (ECE) of copper. • To calibrate the given ammeter and voltmeter by potentiometer. • To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss. • To measure high resistance by leakage method.

BS-122 ENGINEERING MATHEMATICS –II

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:
The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

UNITS	CONTENTS	Contact Hrs.
I	**Multivariable Calculus(Integration):**Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10
II	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	6
III	**Ordinary differential equations of higher orders:** Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	8
IV	**Complex Variable – Differentiation:** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	8
V	**Complex Variable – Integration:** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula(without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.	8

TEXT BOOKS:		
1.	Higher Engineering Mathematics	Grewal B S
2.	Engineering Mathematics,	N.P.Bali And MamishGoyal
3	Higher Engineering Mathematics	Ramana B.V

ES 121   PROGRAMMING FOR PROBLEM SOLVING

L	T	P	Cr
2	1	4	5

COURSE OBJECTIVE:

The student will learn

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
  To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Programming** Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.).Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	6
II	**Arithmetic expressions and precedence** Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching ,Iteration and	6
III	**Arrays (**-Arrays (1-D, 2-D), Character arrays and Strings. **Basic Algorithms** -Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)	6
IV	**Function** Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. **Recursion** Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	6
V	**Structure** Structures, Defining structures and Array of Structures. **Pointers** Idea of pointers, Defining pointers, Use of Pointers in self-referential	6

	structures, notion of linked list (no implementation) **File handling** (only if time is available, otherwise should be done as part of the lab)	

TEXT BOOKS:	
1.	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2.	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3.	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

PROGRAMMING FOR PROBLEM SOLVING LAB

EXPERIMENTS **(At least 8 of the following)**	[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.] Tutorial 1:Problem solving using computers: Lab1:Familiarization with programming environment Tutorial 2:Variable types and type conversions: Lab 2:Simple computational problems using arithmetic expressions Tutorial 3:Branching and logical expressions: Lab 3: Problems involving if-then-else structures Tutorial 4:Loops, while and for loops: Lab 4:Iterative problems e.g., sum of series Tutorial 5:1D Arrays: searching, sorting: Lab 5:1D Array manipulation Tutorial 6:2D arrays and Strings Lab 6:Matrix problems, String operations Tutorial 7:Functions, call by value: Lab 7:Simple functions Tutorial 8 &9:Numerical methods (Root finding, numerical differentiation, numerical integration): Lab 8 and 9:Programming for solving Numerical methods problems Tutorial 10:Recursion, structure of recursive calls Lab 10:Recursive functions Tutorial 11:Pointers, structures and dynamic memory allocation Lab 11:Pointers and structures Tutorial 12:File handling: Lab 12:File operations

ES-122   WORKSHOP

L	T	P	Cr
1	`0	4	3

COURSE OBJECTIVE:
Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

CONTENTS	Contact Hrs.
Detailed contents 1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures) 2. CNC machining, Additive manufacturing (1 lecture) 3. Fitting operations & power tools (1 lecture) 4. Electrical &Electronics (1 lecture) 5. Carpentry (1 lecture) 6. Plastic moulding, glass cutting (1 lecture) 7. Metal casting (1 lecture) 8. Welding (arc welding & gas welding), brazing (1 lecture)	**10**

TEXT BOOKS:	
1.	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology"
2.	Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology"
3.	Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008
4.	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

WORKSHOP PRACTICE

EXPERIMENTS	1. Machine shop (10 hours)
	2. Fitting shop (8 hours)
	3. Carpentry (6 hours)
	4. Electrical & Electronics(8 hours)
	5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
	6. Casting(8 hours)
	7. Smithy (6 hours)
	8. Plastic moulding& Glass Cutting (6 hours)
	Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

MC-121   ENVIRONMENTAL SCIENCE

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

This course will help students to develop an understanding of various environmental issues, Need for sustainable development, Solid waste disposal, Degradation of environment, Global warming, The depletion of ozone layer, Loss of biodiversity and various environmental laws.

UNIT	CONTENTS	Contact Hrs.
I	**Environment:** Definition, scope and importance of Environmental Science; Interaction between man and environment; Components of environment (atmosphere, hydrosphere, lithosphere and biosphere). **Ecosystem:** Structure and components; Aquatic Ecosystems (Freshwater, Marine, Wetlands), Terrestrial ecosystem (Forest, Grassland, Agro & Desert); Energy flow in ecosystem; Bio geo- chemical cycles (Nitrogen, Carbon, Phosphorus, Water); Food Chain, Food Web and Ecological Pyramids.	10
II	**Population and Biotic Community:** Characteristics of population; Population growth (vis-a-vis the concept of Carrying capacity); Concept and characteristics of Biotic-communities (concept of habitat, niche, keystone species, dominant species, flagship species, ecotones, edge effect). **Self Sustenance of Ecosystem: Homeostasis in natural ecosystems**; Ecosystem stability and resilience; Biodiversity and ecosystem stability; Ecological succession (primary and secondary); Climax communities and trends in succession.	10
III	**Biodiversity and Conservation:** Concept and value of biodiversity; Biodiversity at different levels (genetic, species and ecosystem); Threats to biodiversity; Hotspots of biodiversity; Biodiversity protection (a sustainable approach), Biodiversity Act. 2002.	10

	TEXT BOOKS:
1.	Joseph Benny, Environmental Studies, the Tata McGraw-Hill Publishing Company Limited, New Delhi.
2.	Deswal S and Deswal A, A basic course of environmental studies, Dhanapath Rai & Co
3.	Rao C S, Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Age International Ltd.
4.	Rajagopalan R, Environmental studies, Oxford university press.
5.	Joseph Kurian and Nagendram R, Essentials of environmental studies, Pearson Education Pte. Ltd., Delhi
6.	Bharucha Erach, Text Book of environmental studies, UGC

BS-211 ENGINEERING MATHEMATICS-III

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:
- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering.   - To provide an overview of probability and statistics to engineers.

UNITS	CONTENTS	Contact Hrs.
I	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.	16
II	Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	12
III	Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	12

TEXT BOOKS:		
1.	Higher Engineering Mathematics	Grewal B S
2	Higher Engineering Mathematics	Ramana B.V

ES-211 BASIC ELECTRONICS ENGINEERING

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:
• To provide an overview of electronic device components to Mechanical engineering students.

UNITS	CONTENTS	Contact Hrs.
I	**Semiconductor Devices and Applications:** Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	6
II	**Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.	6
III	**Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	6
IV	**Digital Electronics Fundamentals:** Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.	6
V	**Electronic Communication Systems:** The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	6

TEXT BOOKS:	
1.	Floyd," Electronic Devices" Pearson Education 9th edition, 2012.
2.	R.P. Jain, "Modern Digital Electronics" , Tata Mc Graw Hill, 3rdEdition, 2007.
3.	Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rdEdition, 2001

BASIC ELECTRONICS ENGINEERING LAB

EXPERIMENTS (At least 8 of the following)	- CRO-Applications. - Characteristics of Silicon & Germanium PN Junction diodes. - Characteristics of Zener Diode. - Characteristics of BJT in Common Emitter Configuration. - Characteristics of JFET in Common Source Configuration. - Half Wave and Full Wave Rectifier without Filter. - Half Wave and Full Wave Rectifier with Filter. - Common Emitter BJT Amplifier. - Hartley & Colpitts Oscillator. - Applications of Operational Amplifier. - Logic Gates. - Combinational Circuits. - Sequential Circuits.

ES-212 ENGINEERING MECHANICS

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

UNITS	CONTENTS	Contact Hrs.
I	**Two-dimensional force systems:** Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium. Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.	6
II	**Beam:** Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams. **Trusses:** Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.	6
III	**Centroid and moment of inertia:** Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.	6
IV	**Kinematics of rigid body:** Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity. **Kinetics of rigid body:** Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.	6
V	**Simple stress and strain:** Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. **Pure bending of beams:** Introduction, simple bending theory, stress in beams of different cross sections. **Torsion:** Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.	6

TEXT BOOKS:	
1.	Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2.	F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3.	R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press
4.	Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

ENGINEERING MECHANICS LAB

EXPERIMENTS (At least 8 of the following)	- To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen. - To determine the compression test and determine the ultimate compressive strength for a specimen - To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the toughness. - To determine the hardness of the given specimen using Vickers/ Brinell/Rockwell hardness testing machine. - Friction experiment(s) on inclined plane and/or on screw-jack. - Worm & worm-wheel experiment for load lifting. - Torsion of rod/wire experiment. - Experiment on Trusses.

BTME-211 THERMODYNAMICS

L	T	P	Cr
3	1	0	4

COURSE OBJECTIVE:
- To learn about work and heat interactions, and balance of energy between system and its surroundings.   - To learn about application of I law to various energy conversion devices.   - To evaluate the changes in properties of substances in various processes.   - To understand the difference between high grade and low grade energies and II law limitations on energy conversion.

UNIT	CONTENTS	Contact Hrs.
I	**Fundamentals-** System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. **Temperature:** Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	10
II	**Pure substance:** Definition, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart	8
III	**First Law for Flow Processes**: Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. **Second law:** Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	10
IV	**Clausius inequality:** Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.	8
V	**Thermodynamic cycles:** Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	4

	TEXT BOOKS:
1.	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6thEdition, Fundamentals of Thermodynamics, John Wiley and Sons.
2.	Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3.	Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
4.	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

BTME-212   MATERIALS ENGINEERING

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To understand the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams.
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

UNITS	CONTENTS	Contact Hrs.
I	**Crystal Structure:** Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **Mechanical Property measurement:** Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	8
II	**Static failure theories:** Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. **Fatigue failure:** High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT)	6
III	**Alloys, substitutional and interstitial solid solutions**- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron	6
IV	**Heat treatment of Steel:** Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening	5
V	**Alloying of steel:** properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys	5

TEXT BOOKS:	
1.	W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2.	Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3.	V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999
4.	U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

MATERIALS ENGINEERING LAB

EXPERIMENTS	• Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
	• Other tests such as shear, bend tests on UTM.
	• Impact test on impact testing machine like Charpy, Izod or both.
	• Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
	• Spring index test on spring testing machine.
(At least 8 of the following)	• Fatigue test on fatigue testing machine.
	• Creep test on creep testing machine.
	• Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
	• Torsion test of a rod using torsion testing machine.
	• Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

BTME- 213 COMPUTER AIDED DRAWING LAB

L	T	P	Cr
0	0	2	1

COURSE OBJECTIVE:

- To provide an overview of how computers can be utilized in mechanical drawing.
- Upon completion of this course, the students can use computer and CAD software for modelling mechanical drawing.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction (1 drawing sheets):** Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning. **Orthographic Projections (3 drawing sheets):** Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.	5
II	**Computer aided drafting (1 drawing):** Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.	5
III	**Riveted joints (1 drawing sheet):** Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc. **Free hand sketching (1 drawing sheet):** Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.	5
IV	**Fasteners (2 drawing sheets):** Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.	5

TEXT BOOKS:	
1.	Engineering Drawing, Pathak, Wiley.
2.	AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY.
3.	Textbook of Machine Drawing, K C John, PHI.
4.	Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.

L	T	P	Cr
2	**1**	**0**	**3**

COURSE OBJECTIVE:

To help the students lay a foundation to an understanding of Management and Organizational behavior which are essential fields of study to make a success of both their professional and personal lives.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Concept, nature, scope & importance of organization behavior. Its interdisciplinary nature. Individual & group behavior. Emerging challenges in OB	6
II	Inter-personal behavior: importance of inter-personal relationships in organization. Role of communication. Transactional analysis & its applications in organizations. **Group Dynamics:** Concept of groups & teams. Types of groups. Stages of group development. Group norms & roles. Organizational leadership. Leadership theories, skills & styles. Leadership training	8
III	**Motivation:** Importance of motivation. Theories of motivation-Maslow's, Hertzberg's, McClelland's. Expectancy theory. Merits & demerits. **Learning:** principles of learning. Factors in human learning. Behavior modification. Theories of learning.	8
IV	**Perception:** Definition & importance of perception. Perceptual process. **Attitude:** Concept of attitude. Attitude & behavior. Attitude formation, factors determining attitude formation. Attitude measurement	8

TEXT BOOKS:	
1.	Essentials of Management Koontz , Tata McGraw Hill
2.	Management Robbins and Coulter, PHI, 8th Ed.
3.	Organizational Behavior Robbins and Judge, Pearson
4.	Understanding Organizational Behavior Pareek , Oxford
5.	Organizational Behavior Luthans, , McGraw Hill Education

L	T	P	Cr
2	0	0	0

COURSE OBJECTIVE:

- To understand basic concepts in Disaster Management.
- To understand definitions and terminologies used in Disaster Management.
- To understand types and categories of Disasters.
- To understand the challenges posed by Disasters.
- To understand impacts of Disasters.

UNITS	CONTENTS	Contact Hrs.
I	Concepts of Hazard, Vulnerability, Risks, and Natural Disasters Bomb threat, Earthquake, Explosion.	4
II	Principles of psychosocial issues and recovery during emergency situations Hazardous material spill/release Natural and man-made Disaster.	4
III	Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis Campus Shooting, Terrorist incidence ,Death in family	4
IV	To identify existing and potential public health problems before, during and after disasters ,Financial emergency such as (a) A sudden health emergency (b) Unexpected loss of Income (c) Rent in arrears and risk of eviction.	4
V	Concepts of Hazard, Vulnerability, Risks, Natural Disasters, Bomb threat, Earthquake, Explosion.	4

TEXT BOOKS:	
1.	Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2.	Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC
3.	Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
4.	Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5.	Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

BTME-221   APPLIED THERMODYNAMICS

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To learn about of I law for reacting systems and heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn the about reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines.

UNITS	CONTENTS	Contact Hrs.
I	Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy	6
II	Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties	6
III	Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	6
IV	Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser.	6
V	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines	6

TEXT BOOKS:	
1.	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6Th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2.	Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3.	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4.	Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd

APPLIED THERMODYNAMICS LAB

EXPERIMENTS	- Study of Fire Tube boiler. - Study of Water Tube boiler. - Study and working of two stroke petrol Engine. - Study and working of four stroke petrol Engine. - Determination of Indicated H.P. of I.C. Engine by Morse Test. - Prepare the heat balance sheet for Diesel Engine test rig. - Prepare the heat balance sheet for Petrol Engine test rig. - Study and working of two stroke Diesel Engine. - Study and working of four stroke Diesel Engine. - Study of Velocity compounded steam turbine. - Study of Pressure compounded steam turbine. - Study of Impulse & Reaction turbine. - Study of steam Engine model. - Study of Gas Turbine Model.
(At least 8 of the following)	

BTME-222   FLUID MECHANICS & FLUID MACHINES

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.

UNITS	CONTENTS	Contact Hrs.
I	Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications	9
II	Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.	9
III	Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.	6
IV	Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps Reciprocating pump – working principle.	8
V	Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles –draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	8

TEXT BOOKS:

1.	Fluid Mechanics and Fluid power Engineering	Kumar D S, S K Kataria & Sons Publishers
2.	Fluid Mechanics and Hydraulic Machines	Bansal R K, Laxmi Publications
3.	Fluid Mechanics and Machinery	Agrawal S K, Tata McGraw-Hill
4.	Fluid Mechanics and Hydraulic Machines	Rattan S S, Khanna Publications
5.	Foundation of Fluid Mechanics	Yuan S W, Prentice Hall
6.	Introduction to Fluid Mechanics and Machinery	Som and Biswas, Tata McGraw Hill

FLUID MECHANICS & FLUID MACHINES LAB

EXPERIMENTS	• To determine the coefficient of impact for vanes.
	• To determine coefficient of discharge of an orifice meter.
	• To determine the coefficient of discharge of Notch (V and Rectangular types).
	• To determine the friction factor for the pipes.
	• To determine the coefficient of discharge of venturi meter.
(At least 8 of the following)	• To determine the coefficient of discharge, contraction & velocity of an orifice.
	• To verify the Bernoulli's Theorem.
	• To find critical Reynolds number for a pipe flow.
	• To determine the meta-centric height of a floating body.
	• To determine the minor losses due to sudden enlargement, sudden contraction and bends.
	• To show the velocity and pressure variation with radius in a forced vertex flow.

BTME-223 STRENGTH OF MATERIALS

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading.

UNITS	CONTENTS	Contact Hrs.
I	Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains principal stresses and principal planes- Mohr's circle.	6
II	Beams and types transverse loading on beams- shear force and bend moment diagrams Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads	6
III	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems	6
IV	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at ends, stresses and deflection of helical springs.	6
V	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure	6

	TEXT BOOKS:
1.	Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2.	R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3.	Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005

BTME-224 MANUFACTURING PROCESSES

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNITS	CONTENTS	Contact Hrs.
I	Conventional Manufacturing processes: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	4
II	Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.	8
III	Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining	6
IV	Additive manufacturing: Rapid prototyping and rapid tooling. Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.	6
V	Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.	6

TEXT BOOKS:	
1.	Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition) Pearson India,
2.	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3.	Degarmo, Black &Kohser, Materials and Processes in Manufacturing

MANUFACTURING PROCESSES LAB

EXPERIMENTS	
(At least 8 of the following)	• Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine. • Bolt (thread) making on Lathe machine. • Tool grinding (to provide tool angles) on tool-grinder machine. • Gear cutting on milling machine. • Machining a block on shaper machine. • Finishing of a surface on surface-grinding machine. • Drilling holes on drilling machine and study of twist-drill. • Study of different types of tools and its angles & materials. • Experiment on tool wear and tool life. • Experiment on jigs/Fixtures and its uses. • Gas welding experiment. • Arc welding experiment. • Resistance welding experiment. • Soldering & Brazing experiment. • Experiment on casting.

BTME- 225 COMPUTER AIDED MACHINE DRAWING LAB

L	T	P	Cr
0	0	2	1

COURSE OBJECTIVE:

- To provide an overview of how computers can be utilized in mechanical component design.
- Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM). **Limits, Fits and Tolerances:** General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.	5
II	**Assembly drawing (2 drawing sheets)** Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.	5
III	**Part Modelling:** Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).	5
IV	**Part Modelling & Assemblies:** Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.	5

TEXT BOOKS:	
1.	Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.
2.	Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.
3.	Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.
4.	Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.

MC-221 POSITIVE PSYCHOLOGY

L	T	P	Cr
2	0	0	0

COURSE OBJECTIVE:

- To make the students understand the basic concepts of positive psychology & the scientific study of human strengths, include optimism, creativity, well-being, and resilience.

UNITS	CONTENTS	Contact Hrs.
I	Meaning and definition: positive psychology, Practical strategies to increase your psychological wellbeing, Memory building.	4
II	Positive Education: Positive emotions, Positive engagement, Positive Accomplishment, Positive purpose, Positive relationship, Positive health: Psychosocial Adjustment to Illness Scale (PAIS) Sickness Impact Profile (SIP) Functional Status Questionnaire (FSQ) Social and Occupational Functioning Assessment Scale (SOFAS)	4
III	Paradox in positive psychology: Vedanta &positive psychology, Recent researches on positive psychology. Positive Assessment	4
IV	Positive Psychotherapy: i. What is good in my life? ii. What am I grateful for? iii. What went well?	4
V	Positive Organizations: A Positive organizational culture emphasizes: i. Building on employee strengths. ii. Rewards more than is punishes. iii. Emphasizes individual vitality growth.	4

TEXT BOOKS:	
1.	Positive Psychology: The Science of Happiness and Human Strengths Alan car
2.	Exploring Positive Psychology: The Science of Happiness and Well-Being Erik M. Gregory, Pamela B. Rutledge
3.	Positive Psychology in the Elementary School Classroom Patty O'Grady

BTME-311 HEAT TRANSFER

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

UNITS	CONTENTS	Contact Hrs.
I	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.	10
II	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	10
III	Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	5
IV	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and εNTU methods. Boiling and Condensation heat transfer, Pool boiling curve Introduction mass transfer, Similarity between heat and mass transfer	5

TEXT BOOKS:	
1.	A. Bejan, Heat Transfer John Wiley, 1993.
2.	J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3.	F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, ~~2007~~
4.	MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5.	Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

HEAT TRANSFER LAB

EXPERIMENTS	- Determination of thermal conductivity of a metal rod. - Determination of thermal conductivity of an insulating powder. - Determination of thermal conductivity of a solid by guarded hot plate method. - Determination of thermal resistance of a composite wall. - Temperature distribution of a pin fins in free-convection. - Temperature distribution of a pin fin in forced-convection. - Forced convection heat transfer from a cylindrical surface. - Determination of Effectiveness of a Heat Exchanger. - Determination of Stefan-Boltzmann constant. - Determination of the water side overall heat transfer coefficient on a cross-flow heat exchanger. - Measure the emissivity of the gray body (plate) at different temperatures and plot the variation of emissivity with surface temperature.
(At least 8 of the following)	

BTME-312 COMPOSITE MATERIALS

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the mechanical behaviour of composite materials.
- To get an overview of the methods of manufacturing composite materials.

UNITS	CONTENTS	Contact Hrs.
I	Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, and transformed stiffness.	6
II	Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes	6
III	Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses	6
IV	Maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.	6
V	Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies	6

TEXT BOOKS:	
1.	Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2.	Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

BTME-313   INSTRUMENTATION & CONTROL

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To provide a basic knowledge about measurement systems and their components.
- To learn about various sensors used for measurement of mechanical quantities.
- To learn about system stability and control.
- To integrate the measurement systems with the process for process monitoring and control.

UNITS	CONTENTS	Contact Hrs.
I	Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements.	8
II	Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric.	8
III	Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers.	6
IV	System models, transfer function and system response, frequency response; Nyquist diagrams and their use. (Practical group based project utilizing above concepts)	8

TEXT BOOKS:	
1.	Instrumentation and control systems by W. Bolton, 2nd edition, Newnes
2.	Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) Pearson Education India, 2007
3.	Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999

INSTRUMENTATION & CONTROL LAB

EXPERIMENTS	
(At least 8 of the following)	- Light sensor & Humidity sensor. - Microprocessor controlled pick & place robot. - Position Indication (LVDT,Pot). - Proximity sensors (inductive). - Water flow and level detection circuitry - Open loop and close loop control system. - Experiment to draw the frequency response characteristic of a given lag- lead compensating network. - Frequency response of a second order system and evaluation of frequency domain specifications. - The effect of P, PI, PD and PID controller on the step response of a feedback control system using control engineering trainer. Verify the same using simulation.

BTME-314 THEORY OF MACHINE

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:
• To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
• To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
• To be able to design some linkage mechanisms and cam systems to generate specified output motion.
• To understand the kinematics of gear trains.

UNITS	CONTENTS	Contact Hrs.
I	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chainsLimit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	10
II	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation	10
III	Classification of cams and followers- Terminology and definitions- Displacement diagrams Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	10
IV	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes	10

TEXT BOOKS :	
1.	Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2.	CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3.	Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4.	Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated EastWest Pvt. Ltd, New Delhi, 1988.

THEORY OF MACHINE LAB

EXPERIMENTS **(At least 8 of the following)**	• Velocity ratios of simple, compound, epicyclic and differential gear trains • Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms • Cam & follower and motion studies • Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient • Determination of torsional natural frequency of single and double rotor systems undamped and damped natural frequencies. • Experiments on dead weight type governor. • Experiment on spring controlled governor • Experiment on critical speed of shaft. • Experiment on gyroscope. • Experiment on static/dynamic balancing. • Experiment on Brake. • Experiment on clutch.

BTME-315 INTERNAL COMBUSTION ENGINES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To familiarize with the terminology associated with IC engines.

- To understand the basics of IC engines.

- To understand combustion, and various parameters and variables affecting it in various types of IC engines.

- To learn about various systems used in IC engines and the type of IC engine required for various applications.

UNITS	CONTENTS	Contact Hrs.
I	Review of ideal cycles; Details of fuel-air cycles.	6
II	Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion.	8
III	Fuel supply systems in SI and CI engines, carburetors, Port fuel injection, Direct injection and Common rail injection. Ignition system	8
IV	Lubrication system and Cooling system. Testing of IC engines. Engine emissions and control. Advanced IC Engine concepts.	8

TEXT BOOKS :	
1.	Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2.	Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3.	Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989.
4.	Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5.	Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

HS-211 INDUSTRIAL MANAGEMENT

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• To understand the principles of management and their application to the functioning of an organization.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Concept, Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership	**6**
II	**Management Function:** Principles of Management- Management Tools – time and motion study, work simplification- process charts and flow diagrams, Production Planning, Specification of Production requirements	**6**
III	**Inventory control:** Inventory, cost, Deterministic models, Introduction to supply chain management	**6**
IV	**Quality control:** Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM	**6**
V	**Environmental Issues:** Environmental Pollution – various management techniques to control Environmental pollution – Various control acts for Air, Water, Solid waste and Noise pollution	**6**

TEXT BOOKS :	
1.	Khanna O.P.: Industrial Engineering
2.	T.R. Banga: Industrial Engineering and Management
3.	Sharma B.R.: Environmental and Pollution Awareness

BTME-316 PROJECT- I (30 HOURS)

L	T	P	Cr
0	0	2	1

COURSE OBJECTIVE:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

L	T	P	Cr
2	0	0	0

COURSE OBJECTIVE:
• Providing specialized and updated knowledge in the area of GST in a systematic manner.
• Enhancing analytical and problem solving skills for decision making.

UNITS	CONTENTS	Contact Hrs.
I	Brief Introduction of GST, Historical back ground of GST Constitutional Amendment ,Objective of GST, Rates of GST Model Law of GST	5
II	GST vs. the Current Indirect Tax Structure Why GST a big deal, Time, Value ,place of supply, Registering under GST, GST Returns-How and When to file return, Mixed Supply and Composite Supply, Composition Levy , What is aggregate Turnover, Input tax credit in detail, Reverse charge, GST compliance rating, Impact of GST on Manufacturers and FMCG industry, SGST,CGST,UGST	5
III	Exemption/composition scheme under GST, Calculation of net cost of imported goods, calculation of sale value after import ,IGST Apelles tribunal of GST,	5
IV	Threshold limit of GST, Impact of GST on north-eastern states ,GST and its dual effect, Impact of GST on E-commerce, Dispute handling mechanism Impact of GST on banking sector ,Impact of GST on SME	5

TEXT BOOKS :	
1.	Taxmann's GST Ready reckoner
2.	Taxmann GST How to Meet Your Obligations (Set of 2 Volumes) Enforced With Eefect from 3rd Edition By S.S GUPTA
3.	India GST for Beginners (2nd Edition, June 2017) By Jayaram Hiregange

BTME-321 MANUFACTURING TECHNOLOGY

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To provide knowledge on machines and related tools for manufacturing various components.
- To understand the relationship between process and system in manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

UNITS	CONTENTS	Contact Hrs.
I	**Tooling for conventional and non-conventional machining processes:** Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.	6
II	**Metrology:** Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and work piece quality.	6
III	**Assembly practices:** Manufacturing and assembly, process planning, selective assembly, Material handling and devices.	4
IV	**Linear programming:** objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model. **Project networks:** CPM and PERT, critical path scheduling; **Production planning& control:** Forecasting models, aggregate production planning, materials requirement planning. **Inventory Models:** Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.	14

	TEXT BOOKS :
1.	Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition) Pearson India, 2014.
2.	Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3.	Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

MANUFACTURING TECHNOLOGY   LAB

EXPERIMENTS **(At least 8 of the following)**	• Use of Tool Maker's Microscope. • Comparator and sine bar. • Surface finish measurement equipment. • Bore diameter measurement using micrometer and telescopic gauge. • Use of Autocollimator. • Identify activities of production, operation and different production systems. • Analyze and point out different sales forecasting techniques. • Observe measure and rearrange production planning and control activities. • Anticipate use of modern production management tools.

BTME-322   DESIGN OF MACHINE ELEMENTS

L	T	P	Cr
3	1	2	5

COURSE OBJECTIVE:
This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through • A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components. • An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations. • An overview of codes, standards and design guidelines for different elements. • An appreciation of parameter optimization and design iteration. • An appreciation of the relationships between component level design and overall machine system design and performance.

UNITS	CONTENTS	Contact Hrs.
I	Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure), Design of shafts under static and fatigue loadings	10
II	Analysis and design of sliding and rolling contact bearings, Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives	10
III	Design of springs: helical compression, tension, Torsional and leaf springs	08
IV	Design of joints: threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutches and brakes	12

TEXT BOOKS :	
1.	Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2.	Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3.	Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4.	Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5.	R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

DESIGN OF MACHINE ELEMENTS LAB

EXPERIMENTS	
(At least 8 of the following)	• Design & drawing of Cotter joint.
	• Design & drawing of Knuckle joint
	• Design of machine components subjected to combined steady and variable loads
	• Design of eccentrically loaded riveted joint
	• Design of boiler riveted joint
	• Design of shaft for combined constant twisting and bending loads
	• Design of shaft subjected to fluctuating loads
	• Design and drawing of flanged type rigid coupling
	• Design and drawing of flexible coupling
	• Design and drawing of helical spring
	• Design and drawing of screw jack

BTME-323 REFRIGERATION AND AIR CONDITIONING

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To familiarize with the terminology associated with refrigeration systems and air conditioning.
- To understand basic refrigeration processes.
- To understand the basics of Psychrometry and practice of applied psychometrics.
- To acquire the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components.

UNITS	CONTENTS	Contact Hrs.
I	Classification of refrigeration systems, Advanced vapor compression cycles.	06
II	Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - System components: Compressors, Condensers, Expansion devices and Evaporators - Performance matching of components of refrigeration systems	08
III	Advanced absorption refrigeration systems and their components.	06
IV	Review of Psychrometry and Air-conditioning processes - Comfort air conditioning and Cooling load calculations - Applications of AC systems - Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.	10

TEXT BOOKS :	
1.	Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2.	Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3.	Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4.	Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

REFRIGERATION AND AIR CONDITIONING LAB

EXPERIMENTS	• To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
	• To study the Mechanical heat pump and find its C.O.P.
	• To study the Air and Water heat pump and find its C.O.P.
	• To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
(At least 8 of the following)	• To study the various controls used in Refrigerating & Air Conditioning systems.
	• To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
	• To study the humidification, heating, cooling and dehumidification processes and plot them on Psychometric charts.
	• To determine the By-pass factor of Heating & Cooling coils and plot them on Psychometric charts on different inlet conditions.
	• To determine sensible heat factor of Air on re-circulated air-conditioning set up.
	• To study the chilling plant and its working cycle.

BTME-324(1) MECHATRONIC SYSTEMS

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the structure of microprocessors and their applications in mechanical devices.
- To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators.
- To understand the use of micro-sensors and their applications in various fields.

UNITS	CONTENTS	Contact Hrs.
I	Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronics approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface	6
II	Sensors and transducers: classification, Development in Transducer technology, Optoelectronics-Shaft encoders, CD Sensors, Vision System, etc	6
III	Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems	6
IV	Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.	6
V	Micro-Mechatronics systems: Micro-sensors, Micro-actuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronics Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	6

TEXT BOOKS :	
1.	Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2.	Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3.	A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited
4.	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

BTME-324 (2)   GAS DYNAMICS AND JET PROPULSION

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the features of compressible isentropic flows and irreversibilities like shocks.
- To provide a basic knowledge of jet and rocket propulsion technologies.

UNITS	CONTENTS	Contact Hrs.
I	Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow.	06
II	Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.	08
III	Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines	08
IV	Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights.	08

TEXT BOOKS :	
1.	Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2.	H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
3.	Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4.	Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5.	Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986

BTME-325(1) NON-CONVENTIONAL ENERGY RESOURCES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
- To understand the non-conventional energy resources from various sources and its utilization.

UNITS	CONTENTS	Contact Hrs.
I	**Energy resources and their utilization :** Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. **Solar energy:** Solar thermal power and its conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing . Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants. **Solar photovoltaic system:** Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.	8
II	**Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India. **Wind energy:** Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.	8
III	**Electrochemical effects and fuel cells:** Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells . **Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. **Hydrogen Energy:** Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.	7

IV	**Thermoelectric systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators. **Geothermal energy:** Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion. **Ocean energy:** Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics . Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.	7

TEXT BOOKS :	
1.	Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.
2.	Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.
3.	Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.
4.	Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

BTME-325(2) ENERGY CONSERVATION AND MANAGEMENT

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the energy data from industries and carry out energy audit for energy savings.

UNITS	CONTENTS	Contact Hrs.
I	Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing	6
II	Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.	8
III	Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.	6
IV	Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets. Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept	10

TEXT BOOKS :	
1.	Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988
2.	Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981
3.	Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987
4.	Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004

HS-321 ENTREPRENEURSHIP DEVELOPMENT PROGRAM

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
The purpose of the Entrepreneurship Development Program is to develop personal qualities and attitudes, and to impart knowledge and insight into how the students can see opportunities and develop these in sustainable business enterprises.

UNITS	CONTENTS	Contact Hrs.
I	Concept of Entrepreneurship, Development Evolution of the concept of an Entrepreneur, Entrepreneur Vs. Entrepreneur, Entrepreneur Vs. Entrepreneurship, Attributes and characteristics of a successful Entrepreneur, Role of Entrepreneur in India economy and developing economics with reference to self-Employment, Entrepreneurship Culture. Definition and types of Small scale industries, Role, Scope and performance in national economy, Problems of small scale industries, Industrial Sickness, Causes of sickness, Indian scenario, Government help, Management strategies, Need for trained entrepreneurs.	6
II	Engineering Economics, Importance of economics for engineers, Present value and future value, Wealth, Goods, Wants, Value and price, Capital, Money, Utility of consumer and producer goods, Cost, Elements of cost, Prime cost, Overhead, Factory cost, Total cost, Selling price, Nature of cost, Types of cost, Depreciation, Causes of depreciation, Methods of calculating depreciation, Economic analysis of investment and selection of alternatives, Nature of selection problem, Nature of replacement problem, Methods used in selection of investment and replacement alternatives. Tools for evaluation of techno economic feasibility project report, SWOT analysis.	8
III	Creating Entrepreneurial Venture, Business Planning Process, Environmental Analysis – Search and Scanning, Identifying problems and opportunities, Defining Business Idea, Basic Government Procedures to be complied with, Role of Central Government and State Government in promoting Entrepreneurship – Introduction to various incentives, Subsidies and grants – Export Oriented Units – Fiscal and Tax concessions, District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB) The FOUR Entrepreneurial Pitfalls (Peter Drucker)	6
IV	Business Incubation, Origin and development of business incubators in India and other countries, Types of incubators, Success parameters for a business incubator, Benefits to industries, Institutes, Government and Society, Future prospects. Special Aspects of Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.	10

TEXT BOOKS :	
1.	Strategic Entrepreneurship Gupta P K, Everest Publishing House
2.	Entrepreneurship Hisrich Peters (Tata Mc Graw)
3.	Entrepreneurship-New Venture Creation Holl H David, Prentice Hall of India

BTME-326 PROJECT- II (90 HOURS)

L	T	P	Cr
0	0	4	2

COURSE OBJECTIVE:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

MC- 321 INDIAN CONSTITUTIONS

L	T	P	Cr
2	0	0	0

COURSE OBJECTIVE:
To understand the Fundamental Rights, Directive Principles of State Policy in Indian Constitution.

UNITS	CONTENTS	Contact Hrs.
I	Nature of the Indian Constitution ,Special emphasis shall be placed on (a)Federal Structure and (b) Form of the Government. Preamble of the Constitution.	5
II	**Fundamental Rights –** **General:** Scheme of Fundamental Rights, Who can claim Fundamental Rights: Against whom Fundamental Rights are available, Suspension of Fundamental Rights.	5
III	**Specific Fundamental Rights-** - Right to Equality (Articles 14 to 18) - Right to Freedom of Speech and Expression (Article 19(1)(a)) - Protection in respect of Conviction for offences (Article 20) - Right to Life and Personal Liberty (Article 21) - Right to Education (Article 21A) - Right against Exploitation (Articles 23 to 24) - Right to Freedom of Religion (Articles 25 to 28) - Cultural and Educational Rights of Minorities (Articles 29 to 30) - Right to Constitutional Remedies (Article 32)	5
IV	Directive Principles of State Policy, their importance and relationship with Fundamental Rights, Fundamental Duties	5

TEXT BOOKS :	
1.	• Chander Pal, Centre State Relations and Indian Cooperative Federalism.
2.	• Chander Pal, State Autonomy in Indian Federation: Emerging Trends
3.	• Jain M.P., Constitutional Law.
4.	• Pandey J.N., Constitutional Law of India.

BTME-411 AUTOMOBILE ENGINEERING

L	T	P	Cr
2	1	2	4

COURSE OBJECTIVE:

- To understand the construction and working principle of various parts of an automobile.

UNITS	CONTENTS	Contact Hrs.
I	Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).	8
II	Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.	8
III	Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.	6
IV	Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells	8

TEXT BOOKS :	
1.	Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2.	Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3.	Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4.	Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

AUTOMOBILE ENGINEERING LAB

EXPERIMENTS	• Study and demonstration of Layout of an Automobile.
	• Study and demonstration of Fuels supply systems.
	• Study and Demonstration of Differential.
	• Study and Demonstration of Clutches.
(At least 8 of the following)	• Study and Demonstration of Brakes.
	• Study and Demonstration of Gear box.
	• Study and Demonstration of Steering Mechanism.
	• Study and Demonstration of Suspension System.
	• Study and Demonstration of Internal Combustion Engine.
	• Study and demonstration of Engine cooling & lubricating Systems.
	• Study and demonstration of Automotive Tyres & wheels.
	• Study and demonstration of Automotive Emission / Pollution control systems.

BTME-412 (1) AUTOMATION IN MANUFACTURING

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To understand the importance of automation in the of field machine tool based manufacturing.

- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC.

- To understand the basics of product design and the role of manufacturing automation.

UNITS	CONTENTS	Contact Hrs.
I	Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.	8
II	Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control.	8
III	Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies.	8
IV	Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.	6

TEXT BOOKS :	
1.	Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall
2.	SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition,Pearson
3.	YoramKoren, Computer control of manufacturing system, 1st edition
4.	Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

BTME-412(2) COMPUTER AIDED DESIGN

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• To provide an overview of how computers can be utilized in mechanical component design.

UNITS	CONTENTS	Contact Hrs.
I	Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation.	6
II	Geometric Modeling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep.	10
III	Visual realism- hidden line-surface-solid removal algorithms, shading, coloring, computer animation.	6
IV	Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checking CAD standards- Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., and Communication standards.	8

TEXT BOOKS :	
1.	Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
2.	C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.
3.	W. M. Neumann and R.F. Sproul, Principles of Computer Gra[hics, McGraw Hill, 1989.
4.	D. Hearn and M.P> Baker, Computer Graphics, Prentice Hall Inc., 1992.

BTME-413(1) POWER PLANT ENGINEERING

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To provide an overview of power plants and the associated energy conversion issues.

UNITS	CONTENTS	Contact Hrs.
I	Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.	6
II	Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.	6
III	Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.	6
IV	Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.	6
V	Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.	6

TEXT BOOKS :	
1.	Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2.	El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3.	Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

BTME-413(2) AUTOMATION AND ROBOTICS

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To provide an overview of automation, manufacturing automation, robotics, robot drives and power transmission systems.

UNITS	CONTENTS	Contact Hrs.
I	**Automation:** Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.	6
II	**Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.	6
III	**Robotics:** Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.	6
IV	**Robot Drives and Power Transmission Systems:** Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings. **Robot End Effectors:** Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.	6
V	**Robot Simulation:** Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. **Robot Applications:** Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.	6

TEXT BOOKS :	
1.	An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
2.	Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
3.	Fundamentals of Robotics: Analysis and Control, by Schilling, Pearson India.

BTOE-414 (1) TOTAL QUALITY MANAGEMENT

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To facilitate the understanding of total quality management principles and processes.

UNITS	CONTENTS	Contact Hrs.
I	Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality	6
II	TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.	6
III	The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.	6
IV	TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.	6
V	Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.	6

TEXT BOOKS : :	
1.	Total Quality management Lt. Gen. H.Lal, Wiley Eastern Limited, 1990. .
2.	Beyond Total Quality Management Greg Bounds. McGraw Hill, 1994.
3.	TQM in New Product manufacturing Menon, H.G,, McGraw Hill 1992

BTOE-414 (2) NON DESTRUCTIVE TESTING

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To provide a basic understanding on different NDT techniques and apply them for inspecting materials in accordance with industry specifications and standards.

UNITS	CONTENTS	Contact Hrs.
I	Magnetic Particle Testing, Magnets and magnetic materials, Magnetization and its methods, Magnetic fields, Detection media, Application of magnetic particles testing, Testing equipments machines and accessories, Inspection and interpretation, Application in industry. Liquid Penetrant Testing, Principle of liquid penetrant testing, Methods, Their advantages and disadvantages, Equipment used, Penetrant materials, Testing procedures, Inspection and interpretation, Applications in industry.	8
II	Electromagnetic Methods, Eddy current theory, Magnetic flux leakage theory, Eddy current sensing probes, Flux leakage sensing probes, Principle of electromagnetic testing, Mathematical analysis, Flaw detection in conductors, Various types of eddy current techniques used and advantages of various electromagnetic methods for crack detection etc.	8
III	Ultrasonic Methods, Physical principle of sound, Ultrasonic waves propagation and their characteristics, Generation of ultrasonic waves, Ultrasonic transducers, Ultrasonic testing equipment, Ultrasonic flaw detector, Fundamental of ultrasonic testing, Contract and immersion testing, Merits and demerits, Defect location in angle beam testing, Immersion testing techniques, Ultrasonic signal display, Detection of defects and their characterization, DGS methods, Time of flight diffraction method (TOFD).	8
IV	Principle of radiography, Types of radiography, Equipments for neutron radiography, X-ray radiography, Equipments for X-ray radiography, Advantages and applications of fluoroscopy and photo fluoroscopy. Hardness Testing, Brinell hardness testing, Rockwell hardness tests, Micro hardness testing, Vickers hardness testing, Theory behind hardness testing methods.	6

TEXT BOOKS : :		
1.	Handbook on Non-destructive Testing of Concrete	Malhotra, Publisher: CRC Press, 2002
2.	Introduction to Nondestructive Testing: A Training Guide	Mix, Paul E, John Wiley and Sons Ltd, 1999
3.	Electrical and Magnetic Methods of Nondestructive Testing	Blitz and Jack, Institute of Physics Publishing, 2001
4.	Non Destructive Testing and Evaluation for Manufacturing and Construction	Henrique L M, Hemisphere Publishers, New York, 2001

BTME-415 PROJECT- III (150 HOURS)

L	T	P	Cr
0	0	6	3

COURSE OBJECTIVE:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

MC- 411 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

L	T	P	Cr
2	0	0	0

COURSE OBJECTIVE:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	4
II	**Protection of traditional knowledge:** the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.	4
III	**Legal frame work and TK:** **A:** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); **B:** The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.	4
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.	4
V	**Traditional knowledge in different sectors:** Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.	4

TEXT BOOKS :	
1.	Traditional Knowledge System in India, by Amit Jha, 2009.
2.	Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3.	Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4.	Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2

BTME-421 (1) MECHANICAL SYSTEM DESIGN

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:

- To provide a basic understanding on System Theories, Problem Formulation, Graph Modeling and Analysis, System Simulation in mechanical system design.

UNITS	CONTENTS	Contact Hrs.
I	**Engineering process and System Approach:** Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing. **Problem Formulation:** Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.	6
II	**System Theories:** Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. **System modeling**: Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.	6
III	**Graph Modeling and Analysis:** Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system. Optimization Concepts: Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system.	6
IV	**System Evaluation:** Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. Calculus Method for Optimization Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.	6
V	**Decision Analysis:** Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. **System Simulation:** Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.	6

TEXT BOOKS :	
1.	Engineering Design, by Dieter, McGraw Hill
2.	An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
3.	Optimization Techniques-SS Rao
4.	System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

BTME-421 (2) MODERN MACHINING PROCESSES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• To provide a basic understanding on various modern machining process like Electrochemical and Chemical Metal Removal Processes, Thermal Metal Removal Processes, Plasma Arc Machining etc.

UNITS	CONTENTS	Contact Hrs.
I	Mechanical Processes, Ultrasonic Machining, Elements of process, Cutting tool system design, Effect of parameters, Economic considerations, Applications, Limitations, Advantages and disadvantages.	8
	Abrasive Jet Machining, Setup Variables in AJM, Gas Propulsion System, Abrasive Feeder, Machining Chamber, AJM Nozzle, Abrasives, Metal removal rate in AJM, Parametric analysis Stand-off-Distance, Abrasive Flow Rate, Nozzle Pressure, Mixing Ratio, Applications, Water Jet Machining, Process details, Process Performance advantages and applications.	
II	Electrochemical and Chemical Metal Removal Processes, Electrochemical Machining- Elements of ECM process, Tool work gap, Chemistry of the process, Metal removal rate, Accuracy, Surface finish and other work material characteristics, Economics, Advantages, Applications, Limitations.	8
	Electrochemical Grinding, Material removal, Process characteristics ECG machine tool surface finish, Accuracy, Advantages, Applications.	
	Electrochemical deburring, Definition of Burr - Types of Burrs - Basic Approach On Deburring, Principle Of Working, Classification of deburring processes, Applications.	
III	Thermal Metal Removal Processes, Electric Discharge Machining (EDM) or Spark erosion machining processes, Mechanism of metal removal, Spark erosion generators, Electrode feed control, Dielectric fluids, Flushing, Electrodes for spark erosion, Selection of electrode material, Tool electrode design, Surface finish, Machining accuracy, Machine tool selection, Applications, Wire Cut EDM, Advances In Wire Cut, Stratified Wire, Process Variables, Process Characteristics.	8
	Laser beam machining (LBM), Apparatus, Production of Lasers Working Principle Types of Lasers - Solid Lasers - Gas Lasers. Material removal, Cutting speed and accuracy of cut, Metallurgical effects, Advantages and Limitations, Applications (Drilling - Cutting – Marking), Miscellaneous Applications.	
IV	Plasma Arc Machining (PAM), Plasma, Non thermal generation of plasma, Mechanism of metal removal, PAM parameters, Equipments for D.C. plasma torch unit, Safety precautions, Economics, Other applications of plasma jets.	6
	Electron Beam Machining (EBM), Generation and control of Electron Beam, Theory of electron beam machining, Process capabilities and limitations, Focused Ion Beam Machining, Working Principle, FIB machining system - Parametric analysis - Applications - Problems.	

TEXT BOOKS : :		
1.	Modern Machining Processes	Pandey P C & Shan H S - Tata McGraw Hill
2.	Machining Science	Ghosh and Malik, Affiliated East-West Press
3.	Non Traditional Manufacturing Processes	Benedict G.F, Marcel Dekker
4.	Advanced Methods of Machining	Mc Geongh J A, Chapman and Hall

BTOE-422 (1) SIX SIGMA & ITS APPLICATIONS

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• To provide a basic understanding on various Methodology, tools in six sigma.

UNITS	CONTENTS	Contact Hrs.
I	**Quality Perception:** Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. **Descriptive statistics:** Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson Distribution	8
II	**Basics of Six Sigma:** Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.	7
III	**Methodology of Six Sigma:** DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects. **Six Sigma Tools:** Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments	10
IV	**Sustenance of Six Sigma:** Communication plan, Company culture, Reinforcement and control, Introduction to software's for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.	5

TEXT BOOKS : :		
1.	Six Sigma: SPC and TQM in manufacturing and service,	Geoff Tennant, Gower Publishing Co.
2.	Six Sigma for managers,	Greg Brue, TMH
3.	What is Six Sigma,	Pete Pande, and TMH
4.	The Six Sigma Way,	Peter S. Pande, TMH Team Field book

BTOE-422 (2) SOLAR PV TECHNOLOGY

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• This course focuses on solar photovoltaic (PV) energy systems, which convert solar energy into a convenient electrical energy form.
• We will mainly study the types of electrical components and schemes used in such PV systems.
• The course will cover the characteristics of solar radiation, PV cells, modules and arrays, stand-alone PV schemes with battery energy storage and grid-connected PV schemes.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems. **Solar radiation:** Extra terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky insulation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insulation from measured data.	8
II	**PV cells and modules:** Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays; effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; schemes for maximum power point tracking; solar PV concentrators.	7
III	**PV inverters:** Grid-connected single phase PV inverter schemes and control; power processing schemes based on single string, multi-string and ac module technologies; types of grid interface; power electronic converters used in single phase PV systems and their operation; transformer less inverters, centralized grid-connected three-phase inverters for large PV installations	7
IV	**Schemes with battery energy storage:** Power processing schemes and control for stand-alone applications; batteries for energy storage – types, charging, battery sizing and turn-around efficiency; other types of energy storage for PV systems; grid connected schemes with standby energy storage. **System level issues:** Design related issues; grounding, dc arcing and other safety related issues; islanding; harmonics; electro-magnetic interference; energy yield and economics of a PV installation.	8

TEXT BOOKS : :		
1.	Gilbert M. Masters: Renewable and Efficient Electric Power Systems	John Wiley & Sons, 2004
2.	Roger A. Messenger & Jerry Ventre: Photovoltaic Systems Engineering.	CRC Press, 2004, 2nded.
3.	Solanki: Solar Photovoltaics: Fundamentals, Technologies and Applications.	PHI Learning Pvt Ltd, 2009

BTOE-423 (1) MECHANICAL VIBRATION

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• This course focuses on different type of freedom system and critical speed of shaft.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Classification of Vibration Systems, Harmonic motion, Vector re[presentation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods. **Single Degree Freedom System:** Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.	8
II	**Single Degree Freedom:** Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments	7
III	**Two Degree Freedom systems:** Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.	7
IV	**Multi-degree Freedom system:** Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts. **Critical speed of shafts:** Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.	8

TEXT BOOKS : :		
1.	Mechanical Vibrations	G. K. Groover, Jain Brothers, Roorkee.
2.	Mechanical Vibrations- Theory & Practice,	S Bhave, Pearson Education.
3.	Theory of Vibrations with Applications	Thomson&Dahleh, Pearson Education.
4.	Elements of Vibration Analysis	L Meirovitch, McGraw-Hill Education.

BTOE-423 (2) NUMERICAL ANALYSIS AND OPTIMIZATION TECHNIQUES

L	T	P	Cr
2	1	0	3

COURSE OBJECTIVE:
• This course focuses on Interpolation problem, Numerical differentiation and integration, Basic concept of optimization, General non-linear programming problem etc.

UNITS	CONTENTS	Contact Hrs.
I	**System of linear algebraic equations and Eigen value problems:** Elimination method, Gauss method, Gauss-Jordan method, Eigen values and Eigen vectors, Bounds on Eigen values, Jacobi methods for symmetric matrices, Householder's method for symmetric matrices. **Interpolation problem:** Linear interpolation, Lagrange interpolation, Newton interpolation, Interpolation with equidistant points, Spline interpolation, Least square approximation.	8
II	**Numerical differentiation and integration:** Differentiation of continuous functions, Forward difference quotient, Central difference quotient, Error analysis, Derivatives from differences table, Higher-order derivatives, Richardson extrapolation techniques, Newton-Cotes method, Trapezoidal rule, Simpson's rule, Higher order rules, Romberg integration, Numerical solution of ordinary differential equations, Taylor's series method, Euler and modified Euler method, Runge-Kutta methods, Milne's method, Adam-Bashforth- Moultan method.	8
III	**Basic concept of optimization:** Classification of optimization, Optimization techniques, Engineering applications of optimization, Classical optimization techniques, Unconstrained optimization single-variable optimization, Multivariable optimization, Multivariable optimization, Multivariable optimization with equality constraints, Solution by direct search method, Solution by Lagrange-multipliers method, Multivariable optimization with inequality constraints, Kuhn-Tucker conditions.	6
IV	**General non-linear programming problem:** Classification of non-linear programming problem, Unconstrained optimization techniques, Direct search method, Gradient method. **Dynamic programming, Multistage decision process:** Representation of a multistage decision process, Conversion of non serial system to a serial system, Types of multistage decision problems, Principle of optimality, Computational procedure in dynamic programming, Linear programming as a case of dynamic programming, Applications of dynamic programming.	8

TEXT BOOKS : :		
1.	Engineering Optimization	Rao S S, New Age International Ltd
2.	Numerical Method	Balaguruswamy E, Tata McGraw Hill
3.	Numerical methods for Scientific & Engineering Computation	Jain M K, Iyengar S R K
4.	Applied Numerical Analysis	By Gerald Curtis F & Whealley G Patrick, Pearson Education Ltd

BTME-421 PROJECT- IV (255 HOURS)

L	T	P	Cr
0	0	12	6

COURSE OBJECTIVE:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

MONAD UNIVERSITY

School of Engineering & Technology

(Mechanical Engineering)

SCHEME AND CURRICULUM

M. Tech: 2 Year Programme

Effective from 2019-20

Course Structure

Year	Semester	Course Code	Course Title	L	T	P	C
1	**1**	MTME-111	Simulation, Modelling & Analysis	2	1	0	3
		MTME-112	Operations Research	2	1	0	3
		MTME-113(1,2)	Departmental Elective-I	2	1	0	3
		MTME-114(1,2)	Departmental Elective-II	2	1	0	3
		MTCC-111	Research Methodology & IPR	2	1	0	3
		MTME-115	Lab-I Simulation Modeling & Analysis Lab	0	0	4	2
		MTME-116	Lab-II Operations Research Lab	0	0	4	2
		MTAC-117	Personality Development through Life Enlightenment Skills	2	0	0	0
			Total				**19**
	2	MTME-121	Computer Integrated Manufacturing	2	1	0	3
		MTME-122	Advanced Mechanics of Solids	2	1	0	3
		MTME-123(1,2)	Departmental Elective-III	2	1	0	3
		MTME-124(1,2)	Departmental Elective-IV	2	1	0	3
		MTME-125	Lab-III Computer Integrated Manufacturing Lab	0	0	4	2
		MTME-126	Lab-IV Advanced Mechanics of Solids Lab	0	0	2	1
		MTME-127	Mini Project	0	0	4	2
		MTAC-126/MC-321	Indian Constitution	2	0	0	0
			Total				**17**

		Course Code	Course Title	L	T	P	C
2	**1**	MTME-211(1,2)	Departmental Elective-V	2	1	0	3
		MTOE-212(1,2)	Open Elective	2	1	0	3
		MTME-213	Dissertation Phase-I	0	0	20	10
		MTAC-214/MC-211	Disaster Management	2	0	0	0
			Total				**16**
	2	MTME-221	Dissertation Phase-II	0	0	32	16
			Total				**16**

Course Code	Departmental Elective – I	Course Code	Departmental Elective - II
MTME-113(1,2)	Advanced Finite Element Analysis	MTME-114(1,2)	Advanced Mechanical Vibrations
	Renewable Energy System		Industrial Tribology

Course Code	Departmental Elective - III	Course Code	Departmental Elective - IV
MTME-123(1,2)	Modern Manufacturing Process	MTME-124(1,2)	Fracture Mechanics
	Advanced Welding Technology		Computational Fluid Dynamics

Course Code	Departmental Elective - V
MTME-211(1,2)	Advanced Power Plant Engineering
	Advanced Mechanical Design

Course Code	Open Elective
MTOE-212(1,2)	Industrial Safety
	Cost Management of Engineering Projects

*For Project: 1 credit = 30 contact hours.

*This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a mini project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

MTME-111 SIMULATION, MODELLING & ANALYSIS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
The main aim of this subject is to make students familiar with the fundamentals of simulation, modelling & analysis. Students shall be able to formulate the practical problems in mathematical terms.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.	6
II	**Models In Simulation:** Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Binomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, Poisson process.	6
III	**Queueing Models:** Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.	6
IV	**Random Number Generation:** Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. Random Variate Generation: Inverse transforms technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.	6
V	**Input Modelling And Validation:** Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.	6

REFERENCE BOOKS :	
1.	Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2.	Simulation Model Design& execution by Fishwich, Prentice Hall.
3.	Discrete event system simulation by Banks, Carson, Nelson and Nicol.

MTME-112 OPERATIONS RESEARCH

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of the course, the student should be able to

- Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should be able to apply the concept of non-linear programming
- Students should be able to carry out sensitivity analysis
- Student should be able to model the real world problem and simulate it.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Definition and scope of OR; Techniques and tools; Model formulation; general methods for solution; Classification of optimization problems; Optimization techniques.	6
II	**Linear Optimization Models:** Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transshipment models; Traveling salesman problem as an Assignment problem; Integer and parametric programming; Goal programming. **Game Problems:** Mini-max criterion and optimal strategy; Two person zero sum game; Games by simplex dominance rules.	6
III	**Waiting Line Problems:** Classification of queuing situations; Kendall's notation, Poisson arrival with exponential or Erlang service time distribution; Finite and infinite queues; Optimal service rates; Application of queuing theory to industrial problems.	6
IV	**Dynamic Programming:** Characteristic of dynamic programming problems (DPPs); Bellman's principle of optimality; Problems with finite number of stages; Use of simplex algorithm for solving DPPs.	6
V	**Non-linear Programming:** One dimensional minimization methods; Unconstrained optimization techniques; Optimization techniques characteristics of a constrained problem; Indirect methods; Search and gradient methods.	6

REFERENCE BOOKS :	
1.	Operations Research, H.A. Taha, Prentice Hall
2.	Engg. Optimization, S.S. Rao, New Age Publication

MTME-113(1) ADVANCED FINITE ELEMENT ANALYSIS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
To develop the knowledge and skills needed to apply Finite Element Methods in Mechanical Engineering.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches, Shape functions.	7
II	**Natural co-ordinate system**: Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements. Application to plane stress and plane strain problems, Axis-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials.	8
III	**Structural stability**: Other applications e.g., Heat conduction and fluid flow problems. Idealization of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organization of the Finite Element programmes.	7
IV	**Data preparation:** Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems, FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.	8

REFERENCE BOOKS :	
1.	The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2.	An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3.	Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4.	Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
5.	Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley

MTME-113(2) RENEWABLE ENERGY SYSTEM

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To understand the various forms of conventional energy resources. • Learn the present energy scenario and the need for energy conservation. • Explain the concept of various forms of renewable energy. • Outline division aspects and utilization of renewable energy sources for both domestics and industrial application. • Analyze the environmental aspects of renewable energy resources.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Energy and Development; Energy demand and availability; Energy crisis; Conventional and Nonconventional energy; Renewable and Non-renewable energy resources; Environmental impacts of conventional energy usage; Basic concepts of heat and fluid flow useful for energy systems.	6
II	**Solar Energy Systems:** Solar radiations data; Solar energy collection, Storage and utilization; Solar water heating; air heating; Power generation; Refrigeration and Air-conditioning; Solar Energy system Economics.	6
III	**Micro and Small Hydro Energy Systems:** Resource assessment of micro and small hydro power; Micro, mini and small hydro power systems; Economics; Pump and turbine; Special engines for low heads; Velocity head turbines; Hydrams; Water mill; Tidal power.	6
IV	**Bio mass Energy Systems:** Availability of bio mass-agro, forest, animal, municipal and other residues; Bio mass conversion technologies; Cooking fuels; Biogas; producer gas; Power alcohol from biomass; Power generation; Internal engine modifications and performance; system economics.	6
V	**Wind Energy Systems:** Wind data; Horizontal and vertical axis wind mills; Wind farms; Economics of wind energy. **Integrated Energy Systems:** Concept of integration of conventional and non-conventional energy resources and systems; Integrated energy system design and economics.	6

REFERENCE BOOKS :	
1.	Energy Efficient Buildings in India Mili Majumdar Tata Energy Research Institute.
2.	Understanding Renewable Energy Systems Volker Quaschning.
3.	Renewablo Energy Systems Simmoes Marcelo Godoy CRC Press.
4.	Renewable Energy Resources John Twidell Taylor and Francis.
5.	Renewable Energy Sources and Their Environmental Impact Abbasi & Abbasi Prentice Hall of India.

MTME-114(1) ADVANCED MECHANICAL VIBRATIONS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
To introduce the mathematical models and solution methods to study vibration of the mechanical systems, thus, to be supplied of vibration information to designer.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations.	5
II	**Two-degree of Freedom Systems:** Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation.	7
III	**Multi-degree Freedom systems:** Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems.	7
IV	**Continuous systems:** Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/ bars. **Transient Vibrations:** Response to an impulsive, step and pulse input, Shock spectrum.	6
V	**Non-linear Vibrations:** Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.	5

REFERENCE BOOKS :	
1.	Theory and practice of Mechanical Vibrations J.S. Rao and K. Gupta New Age International.
2.	Mechanical Vibrations G.K. Groover Nem Chand & Brothers.
3.	Mechanical Vibration Practice V. Ramamurti Narosa Publications.
4.	Mechanical Vibrations V.P. Singh Dhanpat Rai & sons.
5.	Textbook of Mechanical Vibrations R.V. Dukkipati & J. Srinivas Prentice Hall of India.

MTME-114(2) INDUSTRIAL TRIBOLOGY

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To develop a solution oriented approach by in depth knowledge of Industrial Tribology. • To address the underlying concepts, methods and application of Industrial Tribology.

UNITS	CONTENTS	Contact Hrs.
I	**Surfaces and Friction:** Topography of engineering surfaces, contact between surfaces, sources of sliding Friction Energy dissipation mechanisms Friction Characteristics of metals, Friction of non metals. Friction of lamellar solids friction of Ceramic materials and polymers Rolling Friction, Source of Rolling Friction, Stick slip motion, Measurement of Friction.	8
II	**Wear:** Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.	7
III	**Lubricants and Lubrication:** Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.	7
IV	**Film Lubrication Theory:** Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Summerfield diagram.	8

REFERENCE BOOKS :	
1.	Bearing Design in Machinery, Marcel Dekker Inc, New York.
2.	M.M.Khonsari & E.R.Booser, "Applied Tribology", John Willey & Sons, New York.
3.	E.P.Bowden and Tabor.D., " Friction and Lubrication ", Heinemann Educational Books Ltd.
4.	A.Cameron, "Basic Lubrication theory ", Longman, U.K.
5.	"Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K.

MTCC-111 RESEARCH METHODOLOGY & IPR

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of this course, students will be able to • Understand research problem formulation. • Analyze research related information. • Follow research ethics. • Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity. • Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. • Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNITS	CONTENTS	Contact Hrs.
I	**Research problem:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	7
II	**Literature study**: Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	7
III	**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	7
IV	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	4
V	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	5

REFERENCE BOOKS :	
1.	Research methodology: an introduction for science & engineering students, Stuart Melville and Wayne Goddard.
2.	Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.
3.	Research Methodology: A Step by Step Guide for beginner, Ranjit Kumar, 2nd Edition.
4.	Resisting Intellectual Property, Halbert. Taylor & Francis Ltd, 2007.
5.	Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016.

MTME-115 SIMULATION MODELING & ANALYSIS LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
- To impart the fundamental knowledge on using various analytical tools like ARENA, MATLAB, etc., for Engineering Simulation.   - To know various fields of engineering where these tools can be effectively used to improve the output of a product.   - To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Experiment	
1.	Study of simulation software Like ARENA, MATLAB.
2.	Simulation of translational and rotational mechanical systems
3.	Simulation of Queuing systems
4.	Simulation of Manufacturing System
5.	Generation of Random number
6.	Modeling and Analysis of Dynamic Systems
7.	Simulation mass spring damper system
8.	Simulation of hydraulic and pneumatic systems.
9.	Simulation of Job shop with material handling and Flexible manufacturing systems
10.	Simulation of Service Operations

MTME-116 OPERATIONS RESEARCH LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
- Identify and develop operational research models from the verbal description of the real system.   - Understand the mathematical tools that are needed to solve optimization problems.   - Use mathematical software to solve the proposed models.

Experiment	
1.	Using queuing theory method to solve a given facility design problem.
2.	Writing a program to solve a sequencing problem.
3.	Using Monte Carlo simulation to solve a given problem.
4.	Solving a given product mix problem.
5.	Optimizing weight of a given truss or any machine element.
6.	To optimize operational time by using Genetic Algorithm method.
7.	To optimize system reliability by using simulated annealing method.
8.	Optimization of maintenance time by using artificial neural network method.
9.	Optimization of transport cost by using transportation problem.
10.	Optimization of life cycle costing.

MTAC-117 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

COURSE OBJECTIVE
- To learn to achieve the highest goal happily   - To become a person with stable mind, pleasing personality and determination   - To awaken wisdom in students

UNITS	CONTENTS	Contact Hrs.
I	**Neetisatakam-Holistic development of personality** • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	5
II	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,	5
III	• Chapter 18-Verses 45, 46, 48. • Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18	5
IV	• Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	5

REFERENCE BOOKS :	
1.	"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2.	Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

MTME-121 Computer Integrated Manufacturing

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To describe scope of C.I.M. in fabrication technology.   - To describe scope of group technology in fabrication industry. Prepare CAPP (Computer Aided Process Planning) for fabrication process equipment.   - To describe FMS (Flexible manufacturing System) in welding shop.   - To describe automated inspection system.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to CNC Machine Tools:** Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept.	4
II	**CNC Programming:** Co-ordinate System, Fundamentals of APT programming, Manual part programming-structure of part programme, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines-IDEAS, Unigraphics, Pro Engineer, CATIA, ESPIRIT, Master CAM etc., and use of standard controllers-FANUC, Heidenhain and Sinumeric control system.	7
III	**Tooling for CNC Machines**: Cutting tool materials, Carbide inserts classification; Qualified, semi qualified and preset tooling, Cooling fed tooling system, Quick change tooling system, Tooling system for machining centre and turning center, tool holders, Tool assemblies, Tool magazines, ATC mechanisms, Tool management. **Robotics and Material Handling Systems:** Introduction to robotic technology, and applications, Robot anatomy, material handling function, Types of material handling equipment, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Work-in-process storage, Interfacing handling and storage with manufacturing.	9
IV	**Group Technology and Flexible Manufacturing System:** group Technology-part families, Parts classification and coding, Production flow analysis, Machine Cell Design, Benefits of Group Technology, Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.	5
V	**Computer Integrated Manufacturing:** Introduction, Evaluation of CIM,CIM hardware and software, Requirements of computer to be used in CIM system, Database requirements, Concurrent engineering Principles, design and development environment, advance modeling techniques.	5

REFERENCE BOOKS :	
1.	Computer Numerical Control Machines P. Radahkrishnan New Central Book Agency.
2.	CNC Machines M.S. Sehrawat and J.S. Narang Dhanpat Rai and Co.
3.	CNC Programming Handbook Smid Peter Industrial Press Inc.
4.	Automation, Production systems and Computer M.P. Groover Prentice Hall of India Integrated Manufacturing.
5.	Computer Integrated Manufacturing Paul Ranky Prentice Hall of India.

MTME-122 ADVANCED MECHANICS OF SOLIDS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To understand the concepts of stress and strain, strength and stiffness, deformation and displacement and energy theorems.   - To predict the behavior of the solid bodies subjected to various types of loading.   - To design machine elements using theories of deformable bodies.

UNITS	CONTENTS	Contact Hrs.
I	**Mathematical Preliminaries:** Scalars, vectors and matrix variables, index notation and the related rules, Cartesian tensors and their algebra, coordinate transformation, transformation rules for the nth order tensors, elements of tensor calculus and the related theorems (divergence, Stokes' and Green's), principal value theorem, eigen values and eigenvectors, invariants of a 2nd order tensor.	6
II	**Kinetics of Deformation:** Types of forces (point, surface and body), traction vector, state of stress at a point, Cauchy's relation and its proof, conservation of linear and angular momentum, stress equilibrium equations, symmetry of stress tensor, stress transformation, principal stresses and the associated planes, 3D Mohr's circle representation, planes of maximum shear, octahedral planes, hydrostatic and deviatoric stress, first and second Piola-Kirchoff stress tensors and their properties.	6
III	**Kinematics of Deformation:** Material and spatial co-ordinates, Eulerian and Lagrangian description of motion; deformation and displacement gradients, Green-Lagrange and Almansi strain tensor; Cauchy's small strain tensor and the rotation tensor, geometrical interpretation of strain components and sign convention, principal strains and directions, strain invariants, octahedral strain, maximum shear strain, volumetric strain, strain compatibility equations.	6
IV	**Constitutive Modeling:** Thermodynamic principles, first and second law of thermodynamics, Generalized Hooke's law for isotropic materials, elastic constants and their relations, anisotropic, hyper elastic and visco elastic material models, strain hardening, constitutive relations for Elasto-plastic materials, flow and hardening rules. Boundary Value Problems in Linear Elasticity: Field equations and boundary conditions, Navier equations, Beltrami-Michell stress compatibility conditions, 2D approximations (plane stress and plane strain) and solution strategies.	6
V	**Variational Principles in Solid Mechanics:** Elements of variational calculus, extremum of a functional, Euler-Lagrange equation and its application, types of boundary conditions, principle of virtual work, Principle of total potential energy and complementary potential energy, Ritz method, time-dependent Problems and Hamilton's principle for continuum.	6

REFERENCE BOOKS :	
1.	Sadd, M.H., "Elasticity Theory Applications and Numerics", Elsevier Academic Press.
2.	Boresi, A.P., Sidebottom, O. M., "Advanced Mechanics of Materials", 5th Ed., John Wiley and Sons.
3.	Singh, A.K., "Mechanics of Solids", PHI Learning Private Limited.
4.	Timoshenko, S.P., and Goodier, J.M., "Theory of Elasticity", 3rd Ed., McGraw Hill.

MTME-123(1) MODERN MANUFACTURING PROCESSES

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To make acquainted the various unconventional manufacturing processes.   - To know about the applications of advanced manufacturing processes.   - To encourage the students for developing the models (experimental/theoretical) of Advanced Manufacturing Processes.

UNITS	CONTENTS	Contact Hrs.
I	**Metal cutting:** Need for rational approach to the problem of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers, Lathe tool dynamometer, Drill, Milling and grinding dynamometer, Heat distribution in machining-Effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.	6
II	**Tool Materials, Tool Life and Tool Wear & Wear Mechanisms:** Essential requirements of tool materials, Developments in tool materials, ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests, Concepts of Machinability and mach inability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force vs. Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Machinability data systems.	6
III	**Sheet Metal Forming & Special Forming Processes:** Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and Process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold isostatic pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.	6
IV	**Unconventional and special Welding Processes and Automation**: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots, Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding.	6
V	**Special Casting Processes & Recent Advances in Casting:** Shell moulding, precision investment casting, CO_2 moulding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mould casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.	6

REFERENCE BOOKS :	
1.	Metal Cutting Principles M.C.Shaw Oxford Clarendon Press.
2.	Metal Cutting Theory and Practice Bhattacharya New Central Book Agency.
3.	Fundamentals of Metal Cutting and Machine Tools B.L. Juneja and G.S. Sekhon New Age International.
4.	Principles of Metal Cutting G. Kuppuswamy Universities Press.
5.	Fundamentals of Machining and Machine Tools D.G. Boothroy and W.A. Knight Marcel Dekker, NY

MTME-123(2) ADVANCED WELDING TECHNOLOGY

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To understand the basic principles and methods utilized in the joining and welding technology of engineering materials.   - How to handle welding equipment and weld/join materials practically.

UNITS	CONTENTS	Contact Hrs.
I	**Welding Metallurgy:** Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lammellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.	6
II	**Weld Design & Quality Control:** Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.	6
III	**Modern Trends in Welding:** Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.	6
IV	**Mechanization in Welding:** Mechanization of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanization of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.	6
V	**Robotics in Welding:** Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.	6

REFERENCE BOOKS :	
1.	Advanced Welding Processes Nikodaco & Shansky MIR Publications.
2.	Welding Technology and Design VM Radhakrishnan New Age International.
3.	Source Book of Innovative welding Processes M.M. Schwariz Americal Society of Metals (Ohio).
4.	Advanced Welding Systems, Vol. I, II, III J. Cornu Jaico Publishers.
5.	Manufacturing Technology (Foundry, Forming and Welding) P.N. Rao Tata McGraw Hill.

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral, Crack tip opening displacement. • Students will be able to manage singularity at crack tip using complex variable. • Students will understand important role played by plastic zone at the crack tip. • Students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction and overview**: Concepts of fracture mechanics and strength of materials, Elements of solid mechanics, Elasticity and plasticity, Incremental plasticity and deformation theory.	7
II	**Elastic crack-tip fields**: Basic concepts of linear elastic fracture mechanics, Griffith's theory, stress intensity factor, Energy release rate, Plastic zone and fracture toughness, path invariant integrals and numerical approach.	8
III	**Plastic crack-tip fields:** Mode-I fields and fracture criterion, Engineering approach to plastic fracture, J integral approaches and numerical concepts, Tearing modulus, Time dependent fracture, non-linear aspects of fatigue crack growth, Theoretical models, Fatigue cracks in welds, standard tests and testing procedures.	7
IV	**Brittle fracture of welded structures:** Notch toughness, weld cracks and joint restrains, Weld defects and service behavior, Application of fracture mechanics concepts and limitations, Weld cracking tests and elimination of joint restraints, Residual stress and its interaction in fracture behavior, Numerical approaches for estimation of fracture parameters.	8

REFERENCE BOOKS :	
1.	Fracture Mechanics: Fundamentals and Applications Anderson, T. L CRC Press.
2.	Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue Dowling, Norman E Dowling Prentice Hall.
3.	Advanced Fracture Mechanics Kanninen, MelvinF Popelar, Carl H Oxford University Press.
4.	Analytical Fracture Mechanics Unger, David J Dover Publications.

MTME-124(2) COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of the course, the students will be able to:

- Understand the basic principles of mathematics and numerical concepts of fluid dynamics.
- Develop governing equations for a given fluid flow system.
- Adapt finite difference techniques for fluid flow models.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Conservation equation, Mass Momentum and Energy equations, Convective form of the equation and general description.	6
II	**Clarification into various types of equation:** Parabolic, Elliptic, Boundary and initial conditions, Overview of numerical methods.	6
III	**Finite difference methods**: Different means for formulating finite difference equations, Taylor series expansion, Integration over element, Local function method; Finite volume methods; Central, upwind and hybrid formulations and comparison for convection-diffusion problem, Treatment of boundary conditions; Boundary layer treatment; Variable property, Interface and free surface treatment, Accuracy of F.D. method.	6
IV	**Solution of finite difference equations:** Iterative methods; Matrix inversion methods, ADI method, Operator splitting, Fast Fourier Transform applications.	6
V	**Phase change problems:** Rayleigh-Ritz, Galerkin and Least square methods; Interpolation functions, One and two dimensional elements, Applications. Phase change problems; Different approaches for moving boundary; Variable time step method, Enthalpy method.	6

REFERENCE BOOKS :	
1.	Computational Methods for Fluid Dynamics Ferziger Joel H Springer-Verlog.
2.	Principles of Heat TransferKaviany M Wiley-International.
3.	Radiative Heat Transfer Modest Michael Academic Press.
4.	Middleman Stanley John Wiley.

MTME-125 COMPUTER INTEGRATED MANUFACTURING LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
To develop manual and APT part programs for 2D and 3D complex profiles and test the programs through simulation.

Experiment	
1.	3D Modeling using CAD software.
2.	CNC programming on turning.
3.	CNC programming on milling.
4.	Simulation of CNC programming on CAM.
5.	Study and demonstration on Robots.
6.	Basic Robot Programming and Simulation.
7.	Study of computer controlled business function.
8.	Study of interfacing requirements in CIMS.
9.	Generation of any surface using any CAD soft
10.	Design/ Thermal Analysis by CAD Software.

MTME-126 ADVANCED MECHANICS OF SOLIDS LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
Students will be able to:
• Predict the behavior of the solid bodies subjected to various types of loading.
• Design machine elements using theories of deformable bodies.
• Select material in engineering applications based upon experimental data.

Experiment	
1.	To perform uniaxial tension and compression tests for ductile and brittle materials, compare stress-strain curves for ductile and brittle materials, verify failure criterions for ductile and brittle materials and find out reasons of erratic failure, if any.
2.	To perform torsion tests for ductile and brittle materials, verify failure criterions for ductile and brittle materials and find out reasons of erratic failure, if any.
3.	To find out hardness value (Vickers/Rockwell/Brinell) of the given specimen and interpret the obtained experimental results and use them as a tool for material selection in engineering applications.
4.	To understand principle of fatigue testing machine in a reverse loading manner and to find the endurance limit of the given specimen on Fatigue Testing Machine. To construct an S-N curve (stress level -number of cycles to failure) of the test samples provided and interpret the obtained experimental results and use them as a tool for material selection in engineering applications.
5.	To prepare a given specimen (mild steel) for micro structural examination. To observe different micro-structures like ferrite, perlite, cementite, austenite, bainite and martensite and study their properties.

MTME-127 MINI PROJECT

L	T	P	C
0	0	4	2

COURSE OBJECTIVE

At the end of the course, the student will be able to:
- Identify structural engineering problems reviewing available literature.
- Study different techniques used to analyze complex structural systems.
- Work on the solutions given and present solution by using his/her technique applying engineering principles.

CONTENTS

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

MTAC-126/MC-321- INDIAN CONSTITUTION

L	T	P	C
2	0	0	0

COURSE OBJECTIVE:

In this course we will teach the evolution of the Indian constitution in the last two decades of the nineteenth and first half the twentieth century.

UNITS	CONTENTS	Contact Hrs.
I	**Nature of the Indian Constitution-** Special emphasis shall be placed on (a)Federal Structure and (b) Form of the Government. Preamble of the Constitution.	**05**
II	**Fundamental Rights –** **General:** Scheme of Fundamental Rights, Who can claim Fundamental Rights: Against whom Fundamental Rights are available, Suspension of Fundamental Rights.	**05**
III	**Specific Fundamental Rights-** • Right to Equality (Articles 14 to 18) • Right to Freedom of Speech and Expression (Article 19(1)(a)) • Protection in respect of Conviction for offences (Article 20) • Right to Life and Personal Liberty (Article 21) • Right to Education (Article 21A) • Right against Exploitation (Articles 23 to 24) • Right to Freedom of Religion (Articles 25 to 28) • Cultural and Educational Rights of Minorities (Articles 29 to 30) • Right to Constitutional Remedies (Article 32).	**05**
IV	**Directive Principles-** State Policy, their importance and relationship with Fundamental Rights, Fundamental Duties.	**05**

REFERENCE BOOKS :	
1.	Centre State Relations and Indian Cooperative Federalism Chander Pal.
2.	State Autonomy in Indian Federation: Emerging Trends ,Chander Pal.
3.	Constitutional Law Jain M.P.
4.	Constitutional Law of India, Pandey J.N.

MTME-211(1) ADVANCED POWER PLANT ENGINEERING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
After taking this course the students should be able to: • Select the suitability of site for a power plant. • Calculate performance of thermal power plant. • Propose ash handling, coal handling method in a thermal power plant. • Explain working principle of different types of nuclear power plant. • Calculate load factor, capacity factor, average load and peak load on a power plant.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Power Plants and Boilers:** Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection, Load duration Curves Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers.	6
II	**Steam Power Plant:** Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulverized, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers.	6
III	**Nuclear and Hydel Power Plants:** Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor, Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments.	6
IV	**Diesel and Gas Turbine Power Plant:** Types of diesel plants, components, Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles- reheating – Regeneration and intercooling – combines' cycle.	6
V	**Other Power Plants and Economics Of Power Plants:** Geo thermal- OTEC- tidal- Pumped storage –Solar central receiver system Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.	6

REFERENCE BOOKS :	
1.	A Course in Power Plant Engineering", Arora S.C and Domkundwar SDhanpat Rai, 2001.
2.	Power Plant Engineering", Nag P.K. Third edition Tata McGraw- Hill, 2007.

MTME-211(2) ADVANCED MECHANICAL DESIGN

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of the course:

- Students will realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centered market.
- Students will demonstrate the ability to identify needs of the customer and convert them in to technical specifications of a product.
- Students will be able to generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose.
- Students will understand the principals used while designing for manufacture, assembly, emotions and maintenance.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage.	6
II	**Kinematic Synthesis:** Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad, Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain.	6
III	**Path Curvature Theory:** Fixed and moving centrode, Inflection points and inflection circle, Euler'-savary Equation, Bobillier's and Hartsman construction.	6
IV	**Dynamic Force Analysis:** Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages.	6
V	**Spatial Mechanism:** Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.	6

REFERENCE BOOKS :	
1.	Fundamentals of applied Kinematics D.C. Tao Addison Wesley.
2.	Kinematic Synthesis of Linkages R.Hartenberg and Denavit McGraw Hill.
3.	Kinematic Analysis and Synthesis of Mechanisms A.K. Mallik and A. Ghosh CRC Press
4.	Theory of Mechanisms A.K. Mallik and A. Ghosh East west Press.
5.	Kinematics and Dynamics of Plane Mechanisms J. Hirschern McGraw Hill, NY.

MTOE-212(1) INDUSTRIAL SAFETY

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To identify hazard and potential hazard areas. • To develop safety programs to prevent or mitigate damage or losses. • To assess safety practices and programs. • To conduct safety audits.

UNITS	CONTENTS	Contact Hrs.
I	**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	6
II	**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	6
III	**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	6
IV	**Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	6
V	**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	6

REFERENCE BOOKS :	
1.	Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2.	Maintenance Engineering, H. P. Garg, S. Chand and Company.
3.	Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4.	Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-212(2) COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
To provide appropriate knowledge, skills and techniques that would be used to maximise project outcomes and success.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction and Overview of the Strategic Cost Management Process**: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	6
II	**Project:** meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.	6
III	**Cost Behavior and Profit Planning Marginal Costing**: Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach.	6
IV	**Material Requirement Planning:** Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	6
V	**Quantitative techniques for cost management:** Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	6

REFERENCE BOOKS :	
1.	Cost Accounting A Managerial Emphasis, Prentice Hall of India New Delhi.
2.	Advanced Management Accounting, Charles T. Horngren and George Foster.
3.	Management & Cost Accounting, Robert S Kaplan Anthony A. Alkinson.
4.	Principles & Practices of Cost Accounting, Ashish K. Bhattacharya, A. H. Wheeler publisher.
5.	Quantitative Techniques in Management, N.D. Vohra. Tata McGraw Hill Book Co. Ltd.

MTME-213 DISSERTATION PHASE-I

L	T	P	C
0	0	20	10

COURSE OBJECTIVE
At the end of the course: • Students will be exposed to self-learning various topics. • Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. • Students will learn to write technical reports. • Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines:
The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

MTAC-214/MC-211 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

COURSE OBJECTIVE:

- To understand basic concepts in Disaster Management.

- To understand definitions and terminologies used in Disaster Management.

- To understand types and categories of Disasters.

- To understand the challenges posed by Disasters.

- To understand impacts of Disasters.

UNITS	CONTENTS	Contact Hrs.
I	Concepts of hazard, vulnerability, risks, and natural disasters bomb threat, earthquake, and explosion.	5
II	Principles of psychosocial issues and recovery during emergency situations Hazardous material spill/release Natural and manmade disaster.	5
III	Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis Campus Shooting, Terrorist incidence, Death in family.	5
IV	To identify existing and potential public health problems before, during and after disasters Financial emergency such as (a) A sudden health emergency (b) Unexpected loss of Income (c) Rent in arrears and risk of eviction.	5

REFERENCE BOOKS :	
1.	Disaster Risk Reduction in South Asia, Pradeep Sahni, Prentice Hall, 2004.
2.	Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
3.	Handbook of Disaster Management: Techniques & Guidelines, Singh B.K., 2008, Rajat Publication.
4.	Disaster Management, Ghosh G.K., 2006, APH Publishing Corporation.
5.	Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

L	T	P	C
0	0	32	16

COURSE OBJECTIVE
At the end of the course: • Students will be able to use different experimental techniques. • Students will be able to use different software/ computational/analytical tools. • Students will be able to design and develop an experimental set up/ equipment/test rig. • Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them. • Students will be able to either work in a research environment or in an industrial environment. • Students will be conversant with technical report writing. • Students will be able to present and convince their topic of study to the engineering community.

Guidelines:
It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

MONAD UNIVERSITY

School of Engineering & Technology

(Mechanical Engineering)

Manufacturing Technology & Automation

SCHEME AND CURRICULUM

M. Tech: 2 Year Programme

Effective from 2019-20

Course Structure

Year	Semester	Course Code	Course Title	L	T	P	C
1	**1**	MTMA-111	Simulation, Modelling & Analysis	2	1	0	3
		MTMA-112	Advanced Manufacturing	2	1	0	3
		MTMA-113(1,2)	Departmental Elective–I	2	1	0	3
		MTMA-114(1,2)	Departmental Elective - II	2	1	0	3
		MTCC-111	Research Methodology & IPR	3	0	0	3
		MTMA-115	Lab-I Simulation, Modelling & Analysis	0	0	4	2
		MTMA-116	Lab-II Advanced Manufacturing	0	0	2	1
		MTAC-117	Personality Development through Life Enlightenment Skills	2	0	0	0
			Total				**18**
	2	MTMA-121	Modern welding & Casting Process	2	1	0	3
		MTMA-122	Advanced Industrial Engineering	2	1	0	3
		MTMA-123(1,2)	Departmental Elective-III	2	1	0	3
		MTMA-124(1,2)	Departmental Elective-IV	2	1	0	3
		MTMA-125	Lab-III Modern Welding & Casting Process	0	0	4	2
		MTMA-126	Lab-IV Advanced Industrial Engineering	0	0	4	2
		MTMA-127	Mini Project	0	0	4	2
		MTAC-126/MC-321	Indian Constitution	2	0	0	0
			Total				**18**
		Course Code	**Course Title**	**L**	**T**	**P**	**C**
2	**1**	MTMA-211(1,2)	Departmental Elective-V	2	1	0	3
		MTOE-212(1,2)	Open Elective	2	1	0	3
		MTMA-213	Dissertation Phase-I	0	0	20	10
		MTAC-214/MC-211	Disaster Management	2	0	0	0
			Total				**16**
	2	MTMA-221	Dissertation Phase-II	0	0	32	16
			Total				**16**

Course Code	Departmental Elective – I	Course Code	Departmental Elective - II
MTMA-113(1,2)	Rapid Prototyping & Tooling	MTMA-114(1,2)	Additive Manufacturing & Tooling
	Industrial Automation And Robotics		Maintenance Engineering

Course Code	Departmental Elective - III	Course Code	Departmental Elective - IV
MTMA-123(1,2)	Hybrid Manufacturing	MTMA-124(1,2)	Supply Chain Management
	Industrial Design & Ergonomics		Reliability Engineering

Course Code	Departmental Elective - V
MTMA-211(1,2)	Flexible Manufacturing System
	Composite Materials

Course Code	Open Elective
MTOE-212(1,2)	Operation Research
	Waste to Energy

*For Project: 1 credit = 30 contact hours.

*This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a mini project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

MTMA-111 SIMULATION, MODELLING & ANALYSIS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
The main aim of this subject is to make students familiar with the fundamentals of simulation, modelling & analysis. Students shall be able to formulate the practical problems in mathematical terms.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.	6
II	**Models In Simulation:** Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Binomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, Poisson process.	6
III	**Queueing Models:** Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in $G/G/1/\infty/\infty$ queues, server utilization in $G/G/C/\infty/\infty$ queues, server utilization and system performance, costs in queuing problems, Larkovian models.	6
IV	**Random Number Generation:** Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. Random Variate Generation: Inverse transforms technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.	6
V	**Input Modelling And Validation:** Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.	6

REFERENCE BOOKS :	
1.	Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2.	Simulation Model Design& execution by Fishwich, Prentice Hall.
3.	Discrete event system simulation by Banks, Carson, Nelson and Nicol.

MTMA-112 ADVANCED MANUFACTURING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- Explaining the details of types of advanced manufacturing and machining processes, their evolution and need   - Identifying the correct advanced manufacturing processes by formulating and determining the correct AMPs for development of various complex shaped geometries   - Hands on experiments on the Advanced Machines.

UNITS	CONTENTS	Contact Hrs.
I	**Unconventional Machining Processes:** Need for unconventional processes, Classifications of Unconventional Manufacturing Processes, Construction and working principal of unconventional machining processes such as USM, WJM,AJM, Chemical Machining, Electrolytic Grinding, EDM, LBM, EBM, Plasma Arc Cutting.	6
II	**High Speed Machining:** Introduction to high speed machining process, economics of high speed machining, material properties at high strain rates, influence of increasing speed on chip formation on stainless steel, aerospace aluminum and titanium and process parameter recommendations.	6
III	**Generative Manufacturing Processes (GMP) For Rapid Prototyping:** General features and classification, issues related to CAD and GMP software, Overviews of generative manufacturing processes, two dimensional layer-by-layer techniques and direct three-dimensional techniques for RP.	6
IV	**Group Technology And Flexible Manufacturing System:** Group Technology part families, Parts classification and coding, Production flow analysis, Machine cell design, Benefits of group technology, Flexible manufacturing systems-Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.	6
V	**Computer Integrated Manufacturing:** Introduction, Evaluation of CIM, CIM hardware and software, to be used in CIM system, Database requirements. Concurrent engineering-Principles, design and development environment, advance modeling techniques.	6

REFERENCE BOOKS :	
1.	Metal Cutting Principles, M.C. Shaw, Oxford Clarendon Press.
2.	Metal Cutting Theory and Practice, Bhattacharya, New Central Book Agency.
3.	Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja and G.S. Sekhon, New Age International.
4.	Principles of Metal Cutting, G. Kuppuswamy, Universities Press.
5.	Fundamentals of Machining and Machine Tools, D.G. Boothroy and W.A. Knight, Marcel Dekker, NY.

MTMA-113(1) RAPID PROTOTYPING & TOOLING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of the course, the student will be able to

- Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications.
- Explain direct metal laser sintering, LOM and fusion deposition modeling processes.
- Demonstrate solid ground curing principle and process.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission. The cost and effects of design changes during conceptual modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and its role in modern manufacturing mechanical design.	7
II	**Liquid and Powder Based RP Processes:** Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.	8
III	**Solid based RP Processes:** Principles and typical processes such as fused deposition modeling laminated object modeling and others. **Rapid tooling**: Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.	7
IV	**RP Interfacing with Manufacturing Processes**: Investment Casting, Vacuum Casting, Laser Additive Manufacturing. Rapid manufacturing processes like - Vacuum Casting Processes via RP Processes, Electroplated Prototypes, RTV Silicon Moulds, Direct Inkjet SL Tooling, Electron Beam Melting , 3D scanning, 3D digitizing and Data fitting,. High speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies.	8

REFERENCE BOOKS :	
1.	Rapid Prototyping: Principles and Applications in Manufacturing, Chua Chee Kai, Leong Kah Fai, Chu Sing Lim, World Scientific, 2010.
2.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2010.
3.	Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.
4.	Stereo lithography and other Rapid Prototyping and Manufacturing Technologies, Jacohs P.F.,, ASME, 1996.

MTMA-113(2) INDUSTRIAL AUTOMATION AND ROBOTICS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
After the successful completion of this course, the student will be able to:

- Describe and explain 3D translation and orientation representation & illustrate the robot arm kinematics and use of Robot Operating System usage.
- Design / simulate a robot which meets kinematic requirements.
- Apply localization and mapping aspects of mobile robotics.
- Demonstrate self-learning capability.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Automation:** Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation.	6
II	**High Volume Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines. **Programmable Manufacturing Automation:** CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.	6
III	**Flexible Manufacturing Automation:** Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system. **Assembly Automation:** Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems.	6
IV	**Robotics:** Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic, Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission method Rotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.	7
V	**Robot Applications:** Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.	5

REFERENCE BOOKS :	
1.	Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India.
2.	Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication.
3.	Automation in Production Engineering, Oates and Georgy Newness.
4.	Stochastic Models of Manufacturing Systems, Buzacott & shanty Kumar, Prentice Hall India.
5.	Robotics, K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill.

MTMA-114(1) ADDITIVE MANUFACTURING AND TOOLING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To demonstrate comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials that is available. • To understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.	7
II	**RP Systems:** Liquid polymer based rapid prototyping systems, Teijin Seikis' solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc., Power based rapid prototyping systems, selective Laser sintering, Soligen Diren's shell production casting (DSPC), Fraunhofer's multiphase jet solidification (MJS) and MIT's 3D printing (3DP) etc.	8
III	**RP Database:** Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.	7
IV	**RP Applications:** Development of dies for moulding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues, etc., RP materials and their biological acceptability.	8

REFERENCE BOOKS :	
1.	Rapid Prototyping Of Digital Systems: A Tutorial Approach Hamblen James O Kluwer Aca.
2.	Rapid Prototyping: Principles And Applications, Kai Chua Chee.
3.	Rapid System Prototyping With Fpgas: Accelerating The Design Process, R C Cofer Newnes.
4.	Rapid Prototyping of Digital Systems, James O Hamblen Springer.

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
On completion, you will be able to:

- Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment.
- Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.
- Manage the manufacturing organization with highest possible availability.

UNITS	CONTENTS	Contact Hrs.
I	**Maintenance**: Key to reliability & productivity. Basic elements of maintenance system – inspection, planning & scheduling, job execution, record keeping, data analysis, learning & improvement. Preventive, operating and shutdown maintenance; Condition based maintenance and Application of preventive maintenance for system of equipment.	6
II	**Vibration and signature analysis:** causes; remedy in rotating machinery. Fluid analysis for condition monitoring, various methods of fluid analysis. Vibration monitoring – Data acquisition, Transducers, Time domain and frequency domain analysis, Phase signal analysis, Fault diagnosis of rotating equipments, antifriction bearings and gears.	6
III	**Non-destructive testing:** Visual examination – optical aids, liquid penetrate testing, magnetic particle testing, eddy current testing, radiography, ultrasonic testing, acoustic emission testing, thermography, leak testing, corrosion monitoring, standards for NDT.	6
IV	**Lubrication:** Introduction to lubrication engineering, types, classification of lubricants with their Properties and characteristics. Bearing lubrication technique for minimization of friction and wear.	6
V	**Science of friction and wear:** Different types of wear, such as abrasive, corrosive, seizure, scoring, scuffing, pitting, spalling, adhesive, etc. and techniques for minimization of wear. Data collection and analysis, Introduction to computer-aided maintenance management system.	6

REFERENCE BOOKS :	
1.	Maintenance Engineering and Management, Mishra, R. C. and Pathak, K., Second Edition, Prentice Hall of India, New Delhi, 2004.
2.	Engineering Maintenance: A Modern Approach, Dhillon B.S., Taylor & Francis Group, 2002.
3.	An Introduction to Predictive Maintenance, Mobley R. K.,Second Edition, Butterworth-Heinemann, 2002.
4.	Machinery Vibration Analysis & Predictive Maintenance, Scheffer C. and Girdhar P., IDC Technologies, 2004.
5.	The Vibration Analysis Handbook, Taylor J. L., Vibration Consultants, 2003.

MTCC-111 RESEARCH METHODOLOGY & IPR

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information.
- Follow research ethics.
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNITS	CONTENTS	Contact Hrs.
I	**Research problem:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	7
II	**Effective literature studies approaches**: Analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	7
III	**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	7
IV	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	4
V	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	5

REFERENCE BOOKS :	
1.	Research methodology: an introduction for science & engineering students, Stuart Melville and Wayne Goddard.
2.	Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.
3.	Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd Edition.
4.	Resisting Intellectual Property, Taylor & Francis Ltd, 2007.
5.	Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016.

MTMA-115 SIMULATION MODELING & ANALYSIS LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
- To impart the fundamental knowledge on using various analytical tools like ARENA, MATLAB, etc., for Engineering Simulation.   - To know various fields of engineering where these tools can be effectively used to improve the output of a product.   - To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Experiment	
1.	Study of simulation software Like ARENA, MATLAB.
2.	Simulation of translational and rotational mechanical systems.
3.	Simulation of Queuing systems.
4.	Simulation of Manufacturing System
5.	Generation of Random number.
6.	Modeling and Analysis of Dynamic Systems.
7.	Simulation mass spring damper system.
8.	Simulation of hydraulic and pneumatic systems.
9.	Simulation of Job shop with material handling and Flexible manufacturing systems.
10.	Simulation of Service Operations.

MTMA-116 ADVANCED MANUFACTURING LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
To develop manual and APT part programs for 2D and 3D complex profiles and test the programs through simulation.

Experiment	
1.	Exercises on Manual CNC Part programming using G& M codes.
2.	Machining of parts on CNC Machines including preparation of part program, after simulation of tool path using suitable CAM software package.
3.	Part Programming using CAM software like MASTERCAM.
4.	CNC programming on Turning and Milling process.
5.	Experiments on micro-machining.
6.	Study and experimentation with CMM.
7.	Experiments with NDT techniques.
8.	Experiments with non conventional machining processes such as EDM, USM, Abrasive Machining etc.
9.	Use of Surface roughness meter and related experiments.
10.	Use of 3D scanner and experiments.

MTAC-117 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

COURSE OBJECTIVE
• To learn to achieve the highest goal happily.
• To become a person with stable mind, pleasing personality and determination.
• To awaken wisdom in students.

UNITS	CONTENTS	Contact Hrs.
I	**Neetisatakam-Holistic development of personality** • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	5
II	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35	5
III	• Chapter 18-Verses 45, 46, 48. • Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18	5
IV	• Personality of Role model. Shrimad Bhagwad Geeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	5

REFERENCE BOOKS :	
1.	Srimad Bhagavad Gita by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2.	Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

MTMA-121 MODERN WELDING & CASTING PROCESS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To understand the basic principles and methods utilized in the joining and welding technology of engineering materials.   - How to handle welding equipment and weld/join materials practically.   - To understand the basic principles and methods utilized in the casting and foundry technology of engineering materials.

UNITS	CONTENTS	Contact Hrs.
I	**Friction welding:** Concepts, types and applications. Friction stir welding: Metal flow phenomena, tools, process variables and applications and induction pressure welding: Process characteristics and applications. Explosive, diffusion and ultrasonic welding, principles of operation, process characteristics and applications.	6
II	**EBW:** Concepts, types and applications. **LBW:** Physics of lasers, types of lasers, operation of laser welding setup, advantages and limitations, applications.	6
III	**Welding Metallurgy:** Heat flow - temperature distribution-cooling rates - influence of heat input, joint geometry, plate thickness, preheat, significance of thermal severity number. Design requirements, allowable stress values, workmanship and inspection, introduction to welding codes and standards, AWSD.	6
IV	**Casting Processes:** classification, characteristics of sand casting processes, Solidification, Gating and Risering, Nucleation and grain growth, Solidification of pure metals, short and long freezing range alloys. Rate of solidification, macrostructure and microstructure. Solidification contraction; gating and risering design calculations. Fluidity and its measurement. Mould-metal interface reactions.	6
V	**Cast Metals and Alloys:** Family of cast irons, Melting and casting technology; Inoculation. Technology of steel and non-ferrous cast metals. Gases in metals. Melting furnaces and refractories. Casting defects Inspection, diagnosis and rectification. Mechanization and Automation (Use of robots) of Foundries,. Casting Design, Wear net shape castings, Numerical modeling applied to castings. Pollution Control, Energy and waste management in foundries.	6

REFERENCE BOOKS :	
1.	Materials and Applications - Schwartz M., Metal Joining Manual, McGraw-Hill, 1979.
2.	Modern Arc Welding Technology, Nadkarni S.V., Oxford IBH Publishers, 1996.
3.	Laser Welding - A Practical Guide, Christopher Davis, Jaico Publishing House, 1994.
4.	Welding Engineering and Technology, Parmar R S, Khanna Publishers, 1997.
5.	Friction Stir Welding and Processing, Mishra. R.S and Mahoney. M.W, ASM, 2007.

MTMA-122 ADVANCED INDUSTRIAL ENGINEERING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To design and conduct experiments, as well as to analyze and interpret data. • To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

UNITS	CONTENTS	Contact Hrs.
I	**Productivity:** Concept, Productivity improvement factors, Productivity appraisal, productivity analysis in the enterprise- The Kurosawa structural approach, Lawlor's approach, Gold's approach, Quick Productivity Appraisal approach (QPA), Inter-Firm Comparison (IFC).	8
II	**Work Design:** Work study, Method study, Work measurement, Standard output, Time study, Work sampling, Process analysis. Facility Layout: Principles of layout and facilities planning.	7
III	**Material:** Material flow patterns, Material handling systems, Types of material handling equipment. Value Engineering: Fundamental concepts and applications of value engineering, Function Analysis System Technique.	8
IV	**Systems Engineering:** Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.	7

REFERENCE BOOKS :	
1.	Productivity Management, A Practical Handbook, Prokopenko, J., International Labour Organization, 1992.
2.	Introduction to Work Study, ILO, George Kanawaty, 4th revised edition, Universal Book Corporation 2007.
3.	Plant layout and materials handling, Apple, J.M., Ronald Press Company, New York 1977.
4.	Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.

MTMA-123(1) HYBRID MANUFACTURING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
The course aims in identifying the classification of hybrid manufacturing processes.   • To understand the principle, mechanism of metal removal of various hybrid manufacturing processes.   • To study the various process parameters and their effect on the component machined on various hybrid manufacturing processes.

UNITS	CONTENTS	Contact Hrs.
I	**Hybrid Machining Processes:** Introduction, Needs of Hybridization of the machining process, Challenges and feasibility of process.	7
II	**Chemical and Electro-chemical Type Material Removal Processes:** Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing. Mechanical and Thermal interaction, Electrical Hybrid Machining Processes (ECDM, ECAM), Electrical Discharge Machining with Ultrasonic Assistance (EDMUS).	8
III	**Abrasive Hybrid Machining** (AHM) Processes, Abrasive Electrochemical Machining processes, Electrochemical assistance of Ultrasonic Machining (USMEC), Abrasive Electrical Discharge Grinding.	7
IV	**Laser Assisted Micromachining:** Laser-assisted etching (LAE), Electrochemical Micro machining with Laser Assistance (ECML). **Methods of Metal Deposition:** Thermal Spray Coating: Vapor Deposition Chemical Vapor Deposition.	8

REFERENCE BOOKS :	
1.	Advance Machining Processes V.K. Jain New Age.
2.	Modern Machining Processes P.C. Pandey New Age.
3.	Manufacturing Processes KalpakjianTata McGraw-Hill International.
4.	Manufacturing Science, Amitabh Gosh and A.K. Mallik, Affiliated East-West Press Pvt. Ltd.1985.

MTMA-123(2) INDUSTRIAL DESIGN & ERGONOMICS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To understand the fundamental issues involved with interface design.
• To apply design methods and generate process in the development of integrated product designs.
• To develop product designs in a systems context taking into account cognitive, social and behavioral human factors.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Ergonomics and Industrial Design:** An approach to industrial design- elements of design, Structure for industrial design in engineering; Application in modern manufacturing systems; General approach to the man-machine relationship, Work station design, Working position.	6
II	**Control and Displays:** Shapes and sizes of various controls and displays- Multiple displays and control situations; design of major controls in automobiles, machine tools etc.; Design of furniture; Redesign of instruments.	6
III	**Ergonomics and Production:** Ergonomics and product design, ergonomics in automated systems; Expert systems for ergonomic design; Anthropometrics data and its applications in ergonomic design; Limitations of anthropometric data, Use of computerized database; Case study.	6
IV	**Visual Effects of Line and Colour:** The mechanics of seeing; Psychology of seeing; General influence of line and form; Colour and light; Colour and objects; Colour and the eye; Colour consistency; Colour terms; Reaction to colour and colour continuation; Colour on engineering equipments.	6
V	**Aesthetic Concepts:** Concept of unity; Concept of order with variety; Concept of purpose style and environment; Aesthetic expressions; Style, Components of style; House style; Observation style in capital goods; Case study.	6

REFERENCE BOOKS :	
1.	Industrial design for Engineers W.H. Mayall London Hiffee Books Ltd.
2.	Introduction to Ergonomics R.C. Bridger McGraw Hill.
3.	Human Factor Engineering Sanders & McComlick.

MTMA-124(1) SUPPLY CHAIN MANAGEMENT

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
Students will be able to ...

- Analyze total system costs in supply chains.
- Know when and how to use various forecasting techniques.
- Compute tradeoffs between cost and responsiveness in supply chains.
- Understand the role of logistics in supply chains.

UNITS	CONTENTS	Contact Hrs.
I	**INTRODUCTION:** Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain Decision Phases in Supply Chain - Competitive and Supply chain Strategies Drivers of Supply Chain Performance and Obstacles.	6
II	**SUPPLY CHAIN NETWORK DESIGN:** Role of Distribution in Supply Chain, Factors influencing Distribution network design, Design options for Distribution Network Distribution Network in Practice Role of network Design in Supply Chain, Framework for network Decisions.	6
III	**LOGISTICS IN SUPPLY CHAIN:** Role of transportation in supply chain, factors affecting transportations decision, Design option for transportation network, tailored transportation, Routing and scheduling in transportation.	6
IV	**SOURCING AND COORDINATION IN SUPPLY CHAIN:** Role of sourcing supply chain supplier selection assessment and contracts-Design collaboration sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.	6
V	**SUPPLY CHAIN AND INFORMATION TECHNOLOGY:** The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.	6

REFERENCE BOOKS :	
1.	Supply Chain Management, Strategy, Planning, and Operation, Sunil Chopra, Peter Meindl and Kalra, Pearson Education.
2.	Modeling the Supply Chain, Jeremy F.Shapiro, Thomson Duxbury.
3.	Quantitative models in Operations and Supply Chain Management, Srinivasan G.S., PHI.
4.	David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics" PHI.
5.	Handbook of Supply Chain Management, James B.Ayers, St. Lucle press.

MTMA-124(2) RELIABILITY ENGINEERING

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To construct models for the estimation and improvement of reliability parameters of manufactured products and components.   • To provide concepts, methodology, and tools of reliability engineering.

UNITS	CONTENTS	Contact Hrs.
I	**Reliability Engineering:** System reliability - series, parallel and mixed configuration, Block diagram, r-out-of-n structure, Solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability, Reliability – Cost trade off, Prediction and analysis, Problems.	6
II	**Maintainability, Availability & Failure Analysis:** Introduction, Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability and analysis. Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.	6
III	**Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement.	6
IV	**Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terro technology.	5
V	**Condition Monitoring:** Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, concept of S/N ratio, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis. **Safety Aspects:** Importance of safety, Factors affecting safety, Safety aspects of site and plant, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.	7

REFERENCE BOOKS :	
1.	Concepts in Reliability Engineering L.S. Srinath Affiliated East West Press.
2.	Maintainability and Reliability Handbook Editors: Ireson W.A. and C.F. Coombs McGraw Hill Inc.
3.	Failure Diagnosis and Performance Monitoring L.F. Pau Marcel Dekker.
4.	Management of Industrial Maintenance Kellyand M.J. Harris Butterworth and Co.
5.	Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd.

MTMA-125 MODERN WELDING & CASTING PROCESS LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
- To study different testing methods for silica sand, moulding sand and design of pattern.   - To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes.

Experiment	
1.	Study of arc characteristics in simulated MMA welding; arc gap-arc voltage relationship; recording of voltage oscillograms and its study.
2.	Study of heat flow and temperature distribution in welding.
3.	Study of characteristics of TIG/MIG welding.
4.	Ultrasonic/dye penetrant inspection or computer simulation of welding heat flow/analysis of arc voltage pattern.
5.	Practice on CAD of gating and risering.
6.	Experiment to determine the effect of moulding variables in sand moulds.
7.	To determine the effect of mould additive on the properties of castings.
8.	To determine the characteristics of base sands.

MTMA-126 ADVANCED INDUSTRIAL ENGINEERING LAB

L	T	P	C
0	0	4	2

COURSE OBJECTIVE
• An ability to analyze a problem, and identify and formulate the industrial engineering principles appropriate to its solution. • An ability to design and conduct experiments using IE models and IT tools, to analyze and interpret data leading to feasible solutions.

Experiment	
1.	Preparation of operation process chart.
2.	Preparation of two-handed process chart.
3.	Preparation of multiple activity charts.
4.	Demonstration of work sampling.
5.	Experiment to demonstrate methods improvement.
6.	Experiment to draw learning curve.
7.	Demonstration of central limit theorem.
8.	Drawing control chart for variables.
9.	Drawing control charts for demerits.
10.	Drawing O-C curve.

MTMA-127 MINI PROJECT

L	T	P	C
0	0	4	2

COURSE OBJECTIVE

At the end of the course, the student will be able to:
- Identify structural engineering problems reviewing available literature.
- Study different techniques used to analyze complex structural systems.
- Work on the solutions given and present solution by using his/her technique applying engineering principles.

CONTENTS

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

MTAC-126/MC-321- INDIAN CONSTITUTION

L	T	P	C
2	0	0	0

COURSE OBJECTIVE:
In this course we will teach the evolution of the Indian constitution in the last two decades of the nineteenth and first half of the twentieth century.

UNITS	CONTENTS	Contact Hrs.
I	**Nature of the Indian Constitution-** Special emphasis shall be placed on (a)Federal Structure and (b) Form of the Government. Preamble of the Constitution.	05
II	**Fundamental Rights –** **General:** Scheme of Fundamental Rights, Who can claim Fundamental Rights: Against whom Fundamental Rights are available, Suspension of Fundamental Rights.	05
III	**Specific Fundamental Rights-** • Right to Equality (Articles 14 to 18) • Right to Freedom of Speech and Expression (Article 19(1)(a)) • Protection in respect of Conviction for offences (Article 20) • Right to Life and Personal Liberty (Article 21) • Right to Education (Article 21A) • Right against Exploitation (Articles 23 to 24) • Right to Freedom of Religion (Articles 25 to 28) • Cultural and Educational Rights of Minorities (Articles 29 to 30) • Right to Constitutional Remedies (Article 32).	05
IV	**Directive Principles-** State Policy, their importance and relationship with Fundamental Rights, Fundamental Duties.	05

REFERENCE BOOKS :	
1.	Centre State Relations and Indian Cooperative Federalism Chander Pal.
2.	State Autonomy in Indian Federation: Emerging Trends ,Chander Pal.
3.	Constitutional Law Jain M.P.
4.	Constitutional Law of India, Pandey J.N.

MTMA-211(1) FLEXIBLE MANUFACTURING SYSTEM

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
At the end of this course, students will be able to: • Understand the role of Flexible Manufacturing Systems (FMS) in manufacturing. • Understand the concept of Group Technology. • Understand the concept of Cellular Mfg Systems. • Understand the benefits of automation.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** FMS definition and classification of manufacturing systems, Automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.	6
II	**FMS Equipment:** Why FMS, Factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS, Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment, Automated material handling and storage equipment, cutting tool and tool management, Work holding considerations, Fixture considerations in FMS environment.	6
III	**Group Technology:** GT concepts, Advantages of GT, Part family formation-coding and classification systems; Part machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping, Cellular vs. FMS production. FMS related problem and Solution Methodology: · FMS design problems: Part assignment, Machine selection, Storage system selection, Selection of pallets and fixtures, Selection of computer hardware and software, designing for layout integration of machine storage, Material handling System and computer system, Communication networks.	6
IV	**FMS planning problems:** Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems. **Operational & Control problems:** Part scheduling, Machines robots & AGVS, Process monitoring & control.	6
V	**FMS Implementation:** Objectives, acceptance testing, Performance goals and expectation maintenance concerns.	6

REFERENCE BOOKS :	
1.	Automation, Production System & Computer Integrated Manufacturing Groover Englewood.
2.	Design and Operation of SMS Rankey IFS.
3.	Flexible Manufacturing System Wernecks Spring-Verlag.
4.	FMS in Practice Bonctto Northox Ford.
5.	Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India.
6.	Performance Modelling of Automated Manufacturing Systems, Vishwanathan.

MTMA-211(2) COMPOSITE MATERIALS

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
Upon successful completion of this course, the student will be able to:

- To identify and explain the types of composite materials and their characteristic features
- To understand the differences in the strengthening mechanism of composite and its corresponding effect on performance and application.
- To understand and explain the methods employed in composite fabrication.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Composite Materials:** Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications: Automobile, Aircrafts. Missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.	6
II	**Metal Matrix Composites:** Reinforcement materials, types, characteristics and selection of base metals. Need for production MMC's and its application. **Fabrication Process For MMC's:** Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.	6
III	**Polymer matrix composites (PMC):** Reinforcement materials, types, characteristics and selection base matrix, process design of PMC's and applications. Processing of Thermoplastic composites: Types of processing methods, solution, film, lamination, sandwich etc., Advantages and limitations of each method.	6
IV	**Processing of Thermoses composites:** Hand layup method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding of thermoses, SMC and DMC, Advantages and limitations of each method. **Mechanical testing of composites:** Tensile testing, Compressive testing, impact, bending strength. Basic concepts of fracture mechanism, Inter laminar shear testing, Fracture testing.	6
V	**Thermal Methods:** Introduction, principle, theory, applications, advantages and limitations of Differential scanning calorimeter (DSC), thermo gravimetric analysis (TGA), Dynamic mechanical analysis (DMA), and thermo mechanical analyzer (TMA). **Morphological studies:** Introduction, principle, theory, applications, advantages and limitations of - Optical microscopy, Scanning Electron Microscopy (SEM), TEM and AFM. **Introduction:** Hybrid polymer composite, Green composites and Nano composites - fabrication, Characterization and applications.	6

REFERENCE BOOKS :	
1.	Composite Science and Engineering, K. K. Chawla Springer Verlag 1998.
2.	Mechanics of composite materials, Autar K. Kaw CRC Press New York.
3.	Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker, Inc.
4.	Mechanics of Composite Materials, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998.

MTOE-212(1) OPERATION RESEARCH

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
- To understand the need for optimization and different techniques involved and also constraints.   - To know Linear/Non linear Programming.   - To understand the importance of optimization to solve Engineering problems.   - To know genetic algorithm for Engineering Optimization.

UNITS	CONTENTS	Contact Hrs.
I	**Introduction:** Definition and scope of OR; Techniques and tools; Model formulation; general methods for solution; Classification of optimization problems; Optimization techniques.	6
II	**Linear Optimization Models:** Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transshipment models; Traveling salesman problem as an Assignment problem; Integer and parametric programming; Goal programming. **Game Problems:** Mini-max criterion and optimal strategy; Two person zero sum game; Games by simplex dominance rules.	6
III	**Waiting Line Problems:** Classification of queuing situations; Kendall's notation, Poisson arrival with exponential or Erlang service time distribution; Finite and infinite queues; Optimal service rates; Application of queuing theory to industrial problems.	6
IV	**Dynamic Programming:** Characteristic of dynamic programming problems (DPPs); Bellman's principle of optimality; Problems with finite number of stages; Use of simplex algorithm for solving DPPs.	6
V	**Non-linear Programming:** One dimensional minimization methods; Unconstrained optimization techniques; Optimization techniques characteristics of a constrained problem; Indirect methods; Search and gradient methods.	6

REFERENCE BOOKS :	
1.	Operations Research, H.A. Taha, Prentice Hall.
2.	Engg. Optimization, S.S. Rao, New Age Publication.

L	T	P	C
2	1	0	3

COURSE OBJECTIVE
• To understand the problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc. • To get knowledge of legal, institutional and financial aspects of management of solid wastes. • To become aware of Environment and health impacts solid waste mismanagement • To understand engineering, financial and technical options for waste management

UNITS	CONTENTS	Contact Hrs.
I	**Introduction to Energy from Waste:** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, Gasifier, digesters.	6
II	**Biomass Pyrolysis:** Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	6
III	**Biomass Gasification:** Gasifier – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed Gasifier – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	6
IV	**Biomass Combustion:** Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	6
V	**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	6

REFERENCE BOOKS :	
1.	Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2.	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3.	Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4.	Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTMA-212 DISSERTATION PHASE-I

L	T	P	C
0	0	20	10

COURSE OBJECTIVE
At the end of the course: • Students will be exposed to self-learning various topics. • Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. • Students will learn to write technical reports. • Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines:
The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

MTAC-214/MC-211 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

COURSE OBJECTIVE:

- To understand basic concepts in Disaster Management.
- To understand definitions and terminologies used in Disaster Management.
- To understand types and categories of Disasters.
- To understand the challenges posed by Disasters.
- To understand impacts of Disasters.

UNITS	CONTENTS	CONTACT Hrs.
I	Concepts of hazard, vulnerability, risks, and natural disasters bomb threat, earthquake, and explosion.	5
II	Principles of psychosocial issues and recovery during emergency situations Hazardous material spill/release Natural and manmade disaster.	5
III	Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis Campus Shooting, Terrorist incidence, Death in family.	5
IV	To identify existing and potential public health problems before, during and after disasters Financial emergency such as (a) A sudden health emergency (b) Unexpected loss of Income (c) Rent in arrears and risk of eviction.	5

REFERENCE BOOKS :	
1.	Disaster Risk Reduction in South Asia, Pradeep Sahni, Prentice Hall, 2004.
2.	Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
3.	Handbook of Disaster Management: Techniques & Guidelines, Singh B.K., 2008, Rajat Publication.
4.	Disaster Management, Ghosh G.K., 2006, APH Publishing Corporation.
5.	Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

MTMA-221 DISSERTATION PHASE-II

L	T	P	C
0	0	32	16

COURSE OBJECTIVE
At the end of the course: • Students will be able to use different experimental techniques. • Students will be able to use different software/ computational/analytical tools. • Students will be able to design and develop an experimental set up/ equipment/test rig. • Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them. • Students will be able to either work in a research environment or in an industrial environment. • Students will be conversant with technical report writing. • Students will be able to present and convince their topic of study to the engineering community.

Guidelines:
It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.