E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

NAGAPATTINAM – 611 002.

(Affiliated to Anna University, Chennai | Accredited by NAAC with 'A++' Grade

Accredited by NBA | Approved by AICTE, New Delhi)

M.E MANUFACTURING ENGINEERING

First Year – Second Semester

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS	Max. Mark		
				L	T	P			CA	ES	Total
THEORY COURSES											
1.	2402MF201	Industrial Automation and Mechatronics	PCC	3	0	0	3	3	40	60	100
2.	2402MF202	Robot Design and Programming	PCC	3	0	0	3	3	40	60	100
3.	2402MF203	Materials Technology	PCC	3	0	0	3	3	40	60	100
4.	2403MF012	Production And Operations Management (Program Elective – III)	PEC	3	0	0	3	3	40	60	100
5.	2403MF013	Processing Of Polymers And Composites (Program Elective – III)	PEC	3	0	0	3	3	40	60	100
6.		Audit Course – II	AC	2	0	0	2	0			
LABORATORY COURSES											
7.	2402MF204	Industrial Automation and Mechatronics Laboratory	PCC	0	0	4	4	2	60	40	100
8.	2402MF205	Modeling and Simulation Laboratory	PCC	0	0	4	4	2	60	40	100
9.	2404MF206	Mini Project with Seminar	EEC	0	0	4	4	2	60	40	100
			TOTAL	**17**	**0**	**12**	**29**	**21**	**380**	**420**	**800**

2402MF201	INDUSTRIAL AUTOMATION AND MECHATRONICS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Mechatronics

COURSE OBJECTIVES:

1. This syllabus is formed to create knowledge in Industrial Automation and Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

COURSE OUTCOMES:

Students will be able to

CO1:	Understand and grasp the significance of modern machining process and its applications.
CO2:	Identify the selection of machining process and its parameters.
CO3:	Express and appreciate the cutting edge technologies and apply the same for research purposes.
CO4:	Measure the stages involved in fabrication of micro devices.
CO5:	Create new devices involved in micro fabrication and recent technology.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	2	2	-
CO2	-	-	-		2	1
CO3	1	2	-	3	-	-
CO4	2	-	-	-	1	2
CO5	-	-	-	-	3	1

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	INDUSTRIAL AUTOMATION	8 Hours

Role of automation in industries, Benefits of automation –Introduction to fluid power, Advantages of fluid power, Application of fluid power system -Types of fluid power systems -Introduction to automation tools:

Low cost automation, PLC, DCS, SCADA -Automation strategy evolution.		
MODULE II	**INTRODUCTION TO MECHATRONICS**	**8 Hours**
Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design – Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics – Mechatronics elements.		
MODULE III	**SENSORS AND TRANSDUCERS**	**12 Hours**
Introduction – Performance Terminology – Potentiometers – Strain gauges – LVDT – Eddy current sensor – Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors – Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.		
MODULE IV	**ACTUATORS**	**8 Hours**
Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge Circuits – Piezo electric actuators.		
MODULE V	**MECHATRONIC SYSTEMS**	**9 Hours**
Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic washing machine, Pick and place robots.		
		TOTAL: 45 HOURS

REFERENCES:

2. *R.K.Rajput. A Text Book of Mechatronics, Chand &Co,2007*
3. *W.Bolton, Mechatronics, Pearson Education Limited,2004*
4. *M.A. Mazidi & J.G. Mazidi, 8051 Microcontroller and embedded systems,2002*
5. *Devadasshetty, Richard A. Kolk, -Mechatronics System Design, PWS Publishing Company, 2001.*

2402MF202	ROBOT DESIGN AND PROGRAMMING	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Robotics

COURSE OBJECTIVES:

1. To gain knowledge on growth of robots since origin based on the application.
2. To study the kinematics of robot.
3. To study the dynamics of robot.
4. To expose the students in the various programming techniques in robot and illuminate thecuriosity over recent AI techniques.
5. To familiarize the sensors and actuators involved in the robot based the application.

COURSE OUTCOMES:

	Students will be able to
CO1:	Apply their knowledge on calculation of end effector coordinate position and angle based on the application.
CO2:	Calculate force involved in the robot while under operation (i.e. gripping force). **CO3 :** Compute the trajectory of robot based on both joint space and Cartesian space.**CO4 :** Understand the traditional programming in robot and Modern AI Techniques.
CO3:	Identify appropriate sensors and actuators based on the application.
CO4:	Apply their knowledge on calculation of end effector coordinate position and angle based on the application.
CO5:	Calculate force involved in the robot while under operation (i.e. gripping force). **CO3 :** Compute the trajectory of robot based on both joint space and Cartesian space.**CO4 :** Understand the traditional programming in robot and Modern AI Techniques.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	2	-	-	-
CO2	-	-		3	3	-
CO3	-	-	3	2	-	-
CO4	1	-	-	2	-	-
CO5	1	-	2	-	-	2

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	**INTRODUCTION**	**9 Hours**
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.		
MODULE II	**ROBOT KINEMATICS**	**9 Hours**
Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:		
MODULE III	**ROBOT DYNAMICS AND TRAJECTORY PLANNING**	**9 Hours**
Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning		
MODULE IV	**ROBOT PROGRAMMING AND AI TECHNIQUES**	**9 Hours**
Types of Programming – Teach Pendant programming – Basic concepts in AI techniques – Conceptof knowledge representations – Expert system and its components.		
MODULE V	**ROBOT SENSORS AND ACTUATORS**	**9 Hours**
Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors.		
		TOTAL: 45 HOURS

REFERENCES:

1. *Fu K S, Gonzalez, Lee C S G, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill Book Company, 1987.*
2. *Gordon Mair, 'Industrial Robotics', Prentice Hall U.K, 1998.*
3. *Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 2012.*
4. *John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson, 3rd edition, 2004.*
5. *Saeed.B.Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations,2010.*
6. *Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice HallInternational Edition, 2013.*

2402MF203	MATERIALS TECHNOLOGY	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Materials Science

COURSE OBJECTIVES:

1. To understand the elastic and plastic behaviour of materials.
2. To impart knowledge on fracture analysis.
3. To familiarize on modern metallic materials.
4. To review on polymeric and ceramics materials and their applications.
5. To enable student to select material for specific applications.

COURSE OUTCOMES:

Students will be able to

CO1:	Get knowledge of mechanism of failure of materials and methods.
CO2:	Fully appreciate modification of material property to suit the specific requirements.
CO3:	Express and appreciate the existing materials and development of upcoming new materials. **CO4 :** Have the knowledge to select the various non-metallic materials to suit required applications **CO5 :** Identify and select suitable material for relevant application.
CO4:	Get knowledge of mechanism of failure of materials and methods.
CO5:	Fully appreciate modification of material property to suit the specific requirements.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	3	-	1
CO2	-	-	1	2	-	-
CO3	-	-	3	-	2	-
CO4	-	-	-	-	2	-
CO5	-	-	1	3	-	1

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	ELASTIC AND PLASTIC BEHAVIOR	10 Hours

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre, dispersion and texture strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of polymeric, ceramic and non-crystalline materials.

MODULE II	**FRACTURE BEHAVIOUR**	**10 Hours**

Griffith's theory, stress intensity factor, J-Integral and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture in ceramics and polymers – Failure analysis, sources of failure, procedure of failure analysis.

MODULE III	**MODERN METALLIC MATERIALS**	**8 Hours**

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel, Super alloys –Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass nano crystalline materials and composite materials.

MODULE IV	**NON METALLIC MATERIALS**	**7 Hours**

Polymeric materials – Formation of polymer structure – Production techniques of fibres, foams, adhesives and coating – structure, properties and applications of Commodity and engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al_2O_3, SiC, Si_3N_4 CBN and diamond – properties, applications as abrasives and cutting tool- Properties and applications of CNT – Graphene based Material

MODULE V	**SELECTION OF MATERIALS**	**10 Hours**

Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for Atmospheric, water, Soil and chemical, corrosion Selection for adhesive and abrasive wear resistance – Relationship between materials selection and processing – Case studies in materialsselection with relevance to aero, auto, marine, machinery, chemical and nuclear applications.

TOTAL: 45 HOURS

REFERENCES:

1. *Ashby M.F., Material Selection in Mechanical Design, 5th Edition, Butter Worth 2017.*
2. *ASM Hand book, Vol.11, Failure Analysis and Prevention, 10th Edition, ASM, 2002.*
3. *Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, 3rd edition, Butterworth-Heiremann, 2001.*
4. *Thomas H. Courtney, Mechanical Behaviour of Materials, 2nd edition, McGraw Hill, 2000.*
5. *Marc Andre, Meyers and Krishan Kumar Chawla, Mechanical Behaviour of Materials, 2nd Edition, Cambridge University Press, 2009.*
6. *George E.Dieter, Mechanical Metallurgy, 3rd Edition,McGraw Hill, 2014.*

2403MF012	PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Manufacturing Technology
2. Production Planning

COURSE OBJECTIVES:

1. To familiarize with various forecasting models.
2. To impress upon the importance of sequencing problem in industries.
3. To design and develop inventory control models for a given industry.
4. To familiarize with project management techniques such as CPM and PERT.
5. To train on plant engineering techniques such as plant location, plant layout, materials handling and work study.

COURSE OUTCOMES:

Students will be able to

CO1:	Select an appropriate forecasting method for a given industry.
CO2:	Obtain optimal solutions for sequencing problem in industry.
CO3:	Design a suitable inventory system for any particular industry.
CO4:	Use the project management techniques to minimize the project time.
CO5:	Design plant layout and materials handling systems and can make use of the concepts of workstudy for work design.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	-	2
CO2	2	-	-	3	-	-
CO3	-	-	3	2	-	-
CO4	2	-	-	3	-	-
CO5	-	-	-	-	2	1

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	FORECASTING	9 Hours

Forecasts-Types-Purpose- opinion and judgmental method-Time series methods – moving average - weighted moving average – method of least squares – Exponential smoothing method- Regression and correlation methods – simple and multiple regression – Linear and Nonlinear regression.		
MODULE II	**SCHEDULING AND SEQUENCING**	**9 Hours**
Scheduling – Single Criterion rules –Sequencing –n job 2 machine problem – Johnson's algorithm –3 machine problem – M machine problem – Graphical method for 2 jobs M machine problems – Heuristic methods.		
MODULE III	**INVENTORY**	**9 Hours**
Inventory – purpose of inventory – Basic EOQ Model –Quantity discount model – Reorder level – Fixed order quantity inventory system – Periodic review system – ABC analysis – Materials requirement planning – EOQ models under constraints – Purchasing management – Stores management – Just In Time inventory system – Vendor evaluation - Inventory pricing –Supply chain Management – Aggregate planning.		
MODULE IV	**PROJECT MANAGEMENT**	**9 Hours**
Project network analysis – Activities – Events- critical path method – Method based on time estimates Programme Evaluation Review Technique –Optimistic, pessimistic time, most likely time - Probability of completion of projects – Time crashing of Projects –Optimum duration and cost.		
MODULE V	**PLANT ENGINEERING AND WORK STUDY**	**9 Hours**
Plant location – Factors affecting plant location – Break even analysis- Factors weighted rating method – Plant layout- Types- Selection – Plant layout Techniques – Travel chart method – Line balancing method– Work study – method study – Principles of Motion economy – steps in methods study - Charts – Micromotion study-memo motion study – multiple activity charts- therbligs – work measurement – stop watch time study – Production studies – PMTS – Work sampling – Materials handling – Principles – Selection.		
		TOTAL: 45 HOURS

REFERENCES:

1. *Chary S.N Production and Operations Management, Tata McGraw Hill, 3rd Edition 2012.*
2. *Kanishka Bedi, Production and Operations Management, Oxford University Press,3rdEdition 2016.*
3. *NormaGaither and Gregory Frazier, Operations Management, Cengage*
4. *Pannerselvam R, Production and Operations Management, Prentice Hall of India, 2ndEdition, 2008.*
5. *Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, McGraw Hill,14th edition, 2017.*
6. *William J Stevenson, Operations Management, McGraw Hill, 11th edition, 2012.*

2403MF013	PROCESSING OF POLYMERS AND COMPOSITES	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Materials science

COURSE OBJECTIVES:

1. To introduce the various processing methods of polymers.
2. To enlighten the students about the different types of fibres and matrix materials.
3. To analyse the different polymer matrix composites processing methods and their applications.
4. To expose the students to the various metal matrix composite processing methods.
5. To analyse the various processing techniques of various ceramic matrix composites.

COURSE OUTCOMES:

Students will be able to

CO1:	Get knowledge on various processing methods of polymers.
CO2:	Get knowledge about various types of fibres and matrix materials.
CO3:	Understand the various polymer matrix composites processing methods.
CO4:	Analyse the various processing methods of metal matrix composites.
CO5:	Analyse the various processing techniques of ceramic matrix composites.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-		3	-	1
CO2	-	-	1	2	-	-
CO3	-	-	3	-	2	-
CO4	1	-	-	-	2	-
CO5	-	-	1	3	-	1

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	PROCESSING OF POLYMERS	9 Hours

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics - Extrusion – Injection Moulding – Blow Moulding – Compression and Transfer Moulding – Casting – Thermo Forming. General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Thermal bonding – Applications.		
MODULE II	**FIBRES AND MATRIX MATERIALS**	**9 Hours**
Fibres – Fabrication, Structure, properties and applications – Glass fibre, Boron fibre, carbon fibre, organic fibre, ceramic and metallic fibres - whiskers–Fabrication of Matrix materials – polymers, metals and ceramics and their properties – interfaces – Wettability – Types of bonding at the interface – Tests for measuring interfacial strength - Physical and chemical properties.		
MODULE III	**PROCESSING OF POLYMER MATRIX COMPOSITES**	**9 Hours**
Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs structure, properties and application of PMCs –recycling of PMCs.		
MODULE IV	**PROCESSING OF METAL MATRIX COMPOSITES**	**9 Hours**
Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, in situ fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.		
MODULE V	**PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES**	**9 Hours**
Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – insitu chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel - interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites - applications.		
TOTAL: 45 HOURS		

REFERENCES:

1. *Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.*
2. *Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009.*
3. *Krishan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.*
4. *Mallick P.K. and Newman S, Composite Materials Technology, Hanser Publishers, 2003.*
5. *Mallick P.K., Fibre Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.*
6. *Seamour E.B, Modern Plastics Technology, Prentice Hall, 2002*

2402MF204	INDUSTRIAL AUTOMATION AND MECHATRONICS LAB	L	T	P	C
		0	0	4	2

PREREQUISITE:

1. Industrial Automation and Mechatronics Basic
2. Automation and mechatronics

COURSE OBJECTIVES:

1. To train the students to have a hands on training of the basic concepts of various industrial automation and Mechatronics systems.

COURSE OUTCOMES:

Students will be able to

CO1: Understand and grasp the significance of modern machining process and itsapplications through hands-on experience.

CO2: Identify the selection of machining processes and its process parameters.

CO3: Express and perform project related works.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	2	2	-
CO2	-	-	-	-	2	1
CO3	1	2	-	3	-	-
CO4	2	-	-	-	1	2
CO5	-	-	-	-	3	1

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

LIST OF EXPERIMENTS:

1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits
6. Software simulation of fluid power circuits using a software package.
7. Simulation of various Mechatronics systems using hardware components

TOTAL: 60 HOURS

REFERENCES:

1. *R.K.Rajput. A Text Book of Mechatronics, Chand &Co,2007*
2. *W.Bolton, Mechatronics, Pearson Education Limited,2004*
3. *M.A. Mazidi & J.G. Mazidi, 8051 Microcontroller and embedded systems,2002*
4. *Devadasshetty, Richard A. Kolk, -Mechatronics System Design, PWS Publishing Company, 2001.*

2402MF205	MODELLING AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

1. Modeling Basic
2. Simulation Basic

COURSE OBJECTIVES:

1. To study the fundamentals of finite element analysis from classical method to nodalapproximation method in various fields of manufacturing applications.
2. To make the students to design an element by Finite element analysis.
3. To develop the knowledge related to modelling and simulation in field of manufacturing.

COURSE OUTCOMES:

Students will be able to

CO1:	Apply The Principles Of Finite Element Analysis To Solve Problems In The Field Of Production Engineering.
CO2:	Design And Analyse Various Problems In Field Of Manufacturing
CO3:	Identify The Problems And Simulate Using Finite Element Analysis
CO4:	Relate To Finite Element Analysis In Various Manufacturing Applications.
CO5:	Develop Skills In Field Of Design And Simulation Using FEA.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	2	1
CO2	-	-	-	3	2	1
CO3	-	-	-	-	2	1
CO4	-	2	-	2	2	-
CO5	-	-	-	-	3	2

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

LIST OF EXPERIMENTS:

1. One Dimensional FEA Problem like beam, Truss etc.
2. Two Dimensional FEA Problems like plane stress, plane strain, axisymmetric andvibration.
3. Three Dimensional FEA Problems like shell and contact.

4. FEA Application in metal forming like superplastic forming, deep drawing etc
5. FEA Application in Metal cutting
6. FEA Application in Casting process
7. 3D Modelling and Assemble of Engine
8. Modelling of Crack Shaft
9. Modelling of Connecting Rod
10. Modelling of Cotter Joint
11. Modelling of Plummer Block and Coupling
TOTAL: 60 HOURS
REFERENCES:
1. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007
2. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education,1987
3. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012
4. Finite Element Analysis Theory and Applications with Ansys, SaeedMoaveni, Pearson Education, 2014.