E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with „A" Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

M.E. MANUFACTURING ENGINEERING

Full Time Curriculum and Syllabus

First Year – Second Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701MF201	Advanced Machining Technology	3	0	0	3	40	60	100
1702MF202	Flexible Tooling and Automated Inspection	3	0	0	3	40	60	100
1702MF203	Theory of Metal Forming	3	0	0	3	40	60	100
1702MF204	Advances in Casting and Welding	3	0	0	3	40	60	100
1702MF205	Precision Machining	3	0	0	3	40	60	100
	Elective-II	3	0	0	3	40	60	100
Laboratory Course								
1704MF206	Metal Forming Lab	0	0	4	2	50	50	100
1704MF207	Technical Seminar	0	0	2	1	100	-	100
1704MF208	Communication Skills Lab II	0	0	2	1	100	-	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1701MF201 ADVANCED MACHINING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge in the area of advanced machining processes.

UNIT I METAL CUTTING **8 Hours**

Metal Cutting Technology: Introduction to metal cutting - tool nomenclature and cutting forces - thermal aspects of machining - tool materials - tool life and tool wear - traditional and nontraditional machining – high speed machining.

UNIT II MECHANICAL ENERGY PROCESSES **10 Hours**

Mechanical Processes: Ultrasonic Machining - Water Jet Machining - Abrasive Jet Machining - Abrasive Water Jet Machining - Ice Jet Machining - Magnetic Abrasive Finishing

UNIT III CHEMICAL ENERGY PROCESSES **9 Hours**

Chemical and Electrochemical Processes: Chemical Milling - Photochemical Milling – Electropolishing - Electrochemical Machining - Electrochemical Drilling - Shaped Tube Electrolytic Machining.

UNIT IV THERMAL ENERGY PROCESSES **9 Hours**

Thermal Processes: Electric Discharge Machining - Laser Beam Machining - Electron Beam Machining - Plasma Beam Machining - Ion Beam Machining

UNIT V HYBRID PROCESSES **9Hours**

Hybrid Processes: Electrochemical Grinding, Honing, Superfinishing and Buffing – Ultrasonic and Laser Assisted ECM – Electroerosion Dissolution Machining - Abrasive Electrodischarge Machining - EDM with Ultrasonic Assistance

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Select suitable machining process for suitable materials
CO2: Select optimum parameters for the respective machining process
CO3: Summarizes the merits and demerits of the non-traditional manufacturing process

REFERENCES:

1. Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta1984.
2. Boothroy .D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.
3. Hassan Abdel – Gawad El-Hofy "Advanced Machining Processes", McGraw, New York, 2005.
4. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.
5. Metals Handbook. Vol. 16, Machining. Materials Park; OH: ASM International, 1995.
6. Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison-Wesley, 1997.
7. Brown, J "Advanced Machining Technology Handbook", New York: McGraw-Hill, 1998.
8. McGeough, J "Advanced Methods of Machining", London. New York: Chapman and Hall, London, 1988.
9. Rumyantsev, E and Davydov, A "Electrochemical Machining of Metals", Moscow:Mir Publishers, 1984.

1702MF202 FLEXIBLE TOOLING AND AUTOMATED INSPECTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge in the area of Tooling in Manufacturing and Inspection.

UNIT I INTRODUCTION **9 Hours**

Introduction to Principles of Tooling in Manufacturing-Economics of Tooling- Pre -Design Product and Process Analysis -Automated Tooling for Machining-Tool Changers-Tool Presets

UNIT II FLEXIBLETOOLING **9 Hours**

Flexible Tooling –Tooling for Forming- Evolution of Dies, Forging, Bending and Drawing and Extrusion Processes- Tooling for Casting processes –Mechanization –Flexible tooling in Non Traditional Manufacturing

UNIT III MICRO-MANUFACTURING **9 Hours**

Tooling for Micro Manufacturing-Tooling for Physical and Mechanical joining Processes-Tooling for CMM-Tool handling Robots.

UNIT IV VISUAL REALISM **9 Hours**

Principles of Gauging - New concepts for gaging, inspection, checking, machine vision, and robotic testing. Smart Inspection Systems - Techniques and Applications of Intelligent Vision -Stages of automated visual inspection (AVI) and "smart" inspection systems- examples

UNIT V ARTIFICIAL INTELLIGENCE **9 Hours**

Application of conventional and artificial intelligence techniques in AVI. AVI process, from illumination, image enhancement, segmentation and feature extraction, through to classification, and includes case studies of implemented AVI systems-Robots in Automated Inspection Tutorial: Design of Tooling Layout for Automats, Die Design, Modular Fixture Design Practice: Exercises in CMM and Robots for Inspection

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: State of Art in Tooling in Manufacturing and Inspection
CO2: Design and Develop tooling for Flexible Manufacturing
CO3: Design and Develop Automated Inspection Systems

REFERENCES:

1. Mikell P Groover Fundamentals of Modern Manufacturing: Materials, Processes, and Systems John Wiley and Sons 2012.
2. Stephen Murphy In-Process Measurement and Control: 32 (Series Manufacturing Engineering and Materials Processing) CRC Press 1990.
3. Boothroyd, G. (2005). Assembly automation and product design (Vol. 536). Boca Raton, FL: Taylor & Francis.
4. Stanley L. Robinson, Richard Kendall Miller Automated Inspection and Quality Assurance 1989 CRC Press
5. Duc T. Pham and R J Alcock Smart Inspection Systems: Techniques and Applications of Intelligent Vision Academic Press.
6. Black, J. Temple. The Design of the Factory with a Future. McGraw-Hill Companies, 1991.

1702MF203	THEORY OF METAL FORMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
2. To study the thermo mechanical regimes and its requirements of metal forming.

UNIT I THEORY OF PLASTICITY 9 Hours

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress- strain relation – Mohr,,s circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 8 Hours

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III SHEET METAL FORMING 8 Hours

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9 Hours

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9 Hours

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Fem applications in metal forming.
CO2: Plastic deformations and recent advances in design.
CO3: Powder metallurgy and metal forming applications.

REFERENCES:

1. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press,2012.
2. SAE Transactions, Journal of Materials and Manufacturing Section 5,1993-2007
3. Surenderkumar, Technology of Metal Forming Processes, Prentice Hall IndiaPublishers,2010
4. Marciniak,Z.,DuncanJ.L.,HuS.J.,MechanicsofSheetMetalForming,,,Butterworth-Heinemann An Imprint of Elesevier,2006.
5. Nagpal G.R., Metal Forming Processes- Khanna publishers,2005
6. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
7. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14,2003
8. Shiro Kobayashi, Soo-IK-oh-Altan, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
9. Proc.OfNational Seminaron—Advances in Metal Forming|MIT,March2000
10. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co.,1988
11. Altan.T, Soo-IK-oh, Gegel, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio,1995.

1702MF204	ADVANCES IN CASTING AND WELDING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of welding process.

UNIT I CASTING DESIGN 8 Hours

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating andrisering

UNIT II CASTING METALLURGY 8 Hours

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8 Hours

Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN 10 Hours

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V RECENT TRENDS IN WELDING 11 Hours

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under waterwelding.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Designing for directional solidification and minimum stresses.
CO2: Solidification and cast ability of steel.
CO3: Recent trends in welding.
CO4: Analysis of stress in welded structures.
CO5: Recent trends in casting technology.

REFERENCES:

1. ASM Handbook, Vol 15, Casting, 2004.
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003.
3. Jain P.L., Principles of Foundry Technology,TataMcGrawHill Publishers, 2003.
4. Parmer R.S., Welding Engineering and Technology, KhannaPublishers, 2002.
5. Srinivasan N.K., Welding Technology, Khanna Tech Publishers,2002
6. Heineloper& Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2000.
7. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002.
8. Cornu.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
9. Iotrowski, "Robotic welding-A guide to selection and application", Society of mechanical Engineers, 1987.
10. Schwariz, M.M., "Source book on innovative welding processes", American Society for Metals (OHIO), 1981.
11. Lancaster. J. F., "Metallurgy of welding", George Alien & Unwin Publishers, 1980.

1702MF205	PRECISION MACHINING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge on various micro/nano finishing techniques for the production of required components.

UNIT I INTRODUCTION **9 Hours**

Micro- manufacturing- types- micromachining- classification- mechanical advanced micro- machining processes.

UNIT II MEMS **9 Hours**

Advanced nano finishing processes-Micro Electro Mechanical Systems (MEMS) - Nano Electro Mechanical Systems (NEMS).

UNIT III MICRO MACHING - 1 **9 Hours**

Lithography-diamond turning- micro drilling - micro milling - Electrical Discharge Micro-Machining (EDMM) - Electro Chemical Micro-Machining (ECMM).

UNIT IV MICRO MACHING - 2 **9 Hours**

Wire Electrical Discharge Micro-Machining (EDMM)- Laser Micro-Machining (LMM) – Types of Lasers Nano finishing- magnetorheological finishing process-micro/nano finishing with flexible flow of abrasives- Electrolytic In-process Dressing (ELID) Grinding.

UNIT V ELECTRONMICROSCOPY **9 Hours**

Profilometers - optical microscopy - confocal laser scanning microscopy- Scanning Electron Microscope (SEM)-Atomic Force Microscope (AFM).

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Recognize the various micro machining techniques.
CO2: Apply various micro/nano finishing techniques for the production of required components
CO3: State the metrological principles and techniques for the evaluation of precision machined components.

REFERENCES:

1. M.J. Madou, “Fundamentals of Micro Fabrication”, CRC Press, 2002
2. V.K.Jain, “Introduction to Micromachining”, Narosa Publishing House, 2010
3. Mark J. Jackson, “Micro Fabrication and Nano machining”, Taylor and Francis, 2006
4. SeropeKalpakjian, “Manufacturing Engg. and Technology”, Pearson Education, 2005
5. Yi Qin, “Micro-Manufacturing Engineering and Technology”, Elsevier Publication,2010

1704MF206	METAL FORMING LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To train the students to have an hands on having the basic concepts of metal forming processes and to determine some metal forming parameters for a given shape.

LIST OF EXPERIMENTS:

1. Determination of strain hardening exponent.
2. Determination of strain rate sensitivity index.
3. Determination of tension test.
4. Determination of efficiency in water hammer forming.
5. Determination of interface friction factor.
6. Study of rolling process.
7. Determination of torque and force measurement in rolling mill.

TOTAL: 45 HOURS

1704MF208	COMMUNICATION SKILLS LAB II (Common to all M.E Progarmmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).
2. To communicate appropriately in business contexts.
3. To acquire skills for using English in business environment.

LIST OF EXPERIMENTS:

UNIT I SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

UNIT II WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

TOTAL: 30 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Enable students to acquire business terms for communication.

CO2: Use English confidently in the business contexts.

CO3: Take part in business discussion and write formal and informal business correspondences.

REFERENCES:

1. Guy Brook-Hart, BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book, 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, Cambridge BEC VANTAGE – Self-study Edition, Cambridge University Press, UK, 2005.