Course code	Course Name	L-T-P - Credits	Year of Introduction
**341	DESIGN PROJECT	0-1-2-2	2016

Prerequisite : Nil

Course Objectives

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products, processes or systems
- To develop design that add value to products and solve technical problems

Course Plan

Study : Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected.

Note : The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.

Expected outcome .

The students will be able to

i. Think innovatively on the development of components, products, processes or technologies in the engineering field
ii. Analyse the problem requirements and arrive workable design solutions

Reference:

Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc

Evaluation

First evaluation (Immediately after first internal examination) 20 marks
Second evaluation (Immediately after second internal examination) 20 marks
Final evaluation (Last week of the semester) 60 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

Course code	Course Name	L-T-P - Credits	Year of Introduction
**352	Comprehensive Examination	0-1-1-2	2016
Prerequisite : Nil			

Course Objectives

- To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- To comprehend the questions asked and answer them with confidence.

Assessment

Oral examination – To be conducted weekly during the slot allotted for the course in the curriculum (@ three students/hour) – 50 marks
Written examination - To be conducted by the Dept. immediately after the second internal examination– common to all students of the same branch – objective type (1 hour duration)– 50 multiple choice questions (4 choices) of 1 mark each covering all the courses up to and including semester V – no negative marks – 50 marks.

Note: Both oral and written examinations are mandatory. But separate minimum marks is not insisted for pass. If a students does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments.
The two hours allotted for the course may be used by the students for library reading and for oral assessment.

Expected outcome .

- The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them

Course code	Course Name	L-T-P - Credits	Year of Introduction
**451	Seminar and Project Preliminary	0-1-4-2	2016
Prerequisite : Nil			

Course Objectives

- To develop skills in doing literature survey, technical presentation and report preparation.
- To enable project identification and execution of preliminary works on final semester project

Course Plan

Seminar: Each student shall identify a topic of current relevance in his/her branch of engineering, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare own report and present in the class.

Project preliminary:

Identify suitable project relevant to the branch of study. Form project team (not exceeding four students). The students can do the project individually also. Identify a project supervisor. Present the project proposal before the assessment board (excluding the external expert) and get it approved by the board.

The preliminary work to be completed: (1) Literature survey (2) Formulation of objectives (3) Formulation of hypothesis/design/methodology (4) Formulation of work plan (5) Seeking funds (6) Preparation of preliminary report

Note: The same project should be continued in the eighth semester by the same project team.

Expected outcome .

The students will be able to

i. Analyse a current topic of professional interest and present it before an audience
ii. Identify an engineering problem, analyse it and propose a work plan to solve it.

Evaluation

Seminar : **50 marks**

(Distribution of marks for the seminar is as follows: i. Presentation : 40% ii. Ability to answer questions : 30% & iii. Report : 30%)

Project preliminary : **50 marks** (Progress evaluation by the supervisor : 40% and progress evaluation by the assessment board excluding external expert : 60%. Two progress evaluations, mid semester and end semester, are mandatory.)

Note: All evaluations are mandatory for course completion and for awarding the final grade.

Course code	Course Name	Credits	Year of Introduction
**492	PROJECT	6	2016

Prerequisite : Nil

Course Objectives

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Plan

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
Review and finalization of the approach to the problem relating to the assigned topic
Preparing a detailed action plan for conducting the investigation, including team work
Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
Final development of product/process, testing, results, conclusions and future directions
Preparing a paper for Conference presentation/Publication in Journals, if possible
Preparing a report in the standard format for being evaluated by the dept. assessment board
Final project presentation and viva voce by the assessment board including external expert

Expected outcome

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
iv. Apply knowledge gained in solving real life engineering problems

Evaluation

Maximum Marks : 100

(i) Two progress assessments	20% by the faculty supervisor(s)
(ii) Final project report	30% by the assessment board
(iii) Project presentation and viva voce	50% by the assessment board

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

Course code	Course Name	L-T-P-Credits	Year of Introduction
EE312	Electrical and Electronics Engineering	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To give exposure to the working of Electrical Machines that function as prime movers in industrial systems/machine-tools.
- To make aware on factors affecting the choice of motor for a given application
- To introduce power electronics which form the essential part of modern drives

Syllabus

Transformers, Induction motors, Direct current machines, Control system motors, Factors affecting the choice of motor, Power Electronics

Expected Outcome

The students will be able to

i. know about electrical machines that form part of various industrial systems
ii. understand the working of electric machine driven industrial systems and machine tools in a better way.

Text Book:

Hughes, Edward, et al. "*Hughes electrical and electronic technology"*. Pearson education, 2008.

References:

1. Gross, Charles A. "*Electric machines"*. CRC press, 2006.
2. Vithayathil, Joseph. "*Power electronics principles and applications"*. Tata McGraw-Hill Education, 1995.
3. Venkataratnam, K. "*Special electrical machines"*. Universities Press, 2009.
4. Mohan, Ned, and Tore M. Undeland. "*Power electronics: converters, applications, and design"*. John Wiley & Sons, 2007.
5. Guru, Bhag S., and Hüseyin R. Hiziroglu. "*Electric machinery and transformers"*, Oxford University Press, 2001.

Course Plan

Module	Contents	Hours	End Sem. exam marks
I	Transformers-Operating principle, ideal and practical transformers, EMF equation, No load phasor diagram, equivalent circuit, phasor diagram of a transformer on load. Approximate equivalent circuit of transformer and its simplification. Voltage regulation, efficiency, condition for maximum efficiency, transformer tests.	9	15%
II	Three phase Induction motors- principle of action, frequency of rotor emf and current. Factors determining the torque. Torque-slip curve, comparison of slip ring and cage rotors. Single phase induction motors-capacitor run induction motor, split phase motors, shaded pole motors.	6	15%
First Internal Exam			

III	Direct current machines-general arrangement of a dc machine, calculation of e.m.f. generated in an armature winding, armature reaction, commutation. Armature and field connections. A dc machine as generator or motor. Speed of a motor, speed characteristics of shunt, series and compound motors. Torque characteristics of shunt, series and compound motors.	8	15%
IV	Control system motors-Motors for regulators, RPC system requirements, Geneva cam, stepper motor, variable reluctance motor, hybrid stepping motor, drive circuits.	6	15%
Second Internal Exam			
V	Motor selection-Factors affecting the selection motors-speed, power rating and duty cycles, load torques. The motor and its environment.	4	20%
VI	Power electronics- introduction to power electronics, thyristor circuits, limitations to thyristor operation, thyristors in practice, The fully controlled a.c./d.c. converter, ac/dc inversion. Switching devices in inverters.	9	20%
End Semester Exam			

Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
EE336	Electrical and Electronics Engineering Lab	0-0-3-1	2016

Prerequisite : EE312 Electrical and electronics engineering

Course Objective

- To provide necessary practical knowledge related to the theory of electrical machines such as transformers, induction machines and dc machines.
- To study the characteristics of normal diodes and Zener diodes
- To familiarize with various instruments like CRO, multi-meters etc. used to measure electrical quantities..
- To do a simple project which can be performed in groups is given.

List of Experiments

1. Single phase transformer – load test
2. Single phase transformer-OC and SC test- determination of approximate equivalent circuits-pre-determination of efficiency and regulation.
3. Starting of three phase induction motor using different kinds of starters (squirrel cage and slip ring)-observation of currents and voltages.
4. Load test on three phase squirrel cage /slip ring induction motors.
5. DC shunt generator magnetization characteristics plot (determination of critical field resistance and critical speed).
6. DC shunt generator load test.
7. DC compound generator load test (cumulative and differential).
8. Observation of diode characteristics on CRO.
9. Zener diode characteristics.
10. **Project :** The students can do a project related to designing a timer using IC 555 to understand the application of such timer ICs. The timer should be able to keep a light on for a given period. They can do the project in groups. Any other interesting project using IC 555 can also be tried.

Expected outcome:

The students will be able to

i. Understand the principles of electrical machines
ii. Do characteristic tests on transformers, induction motors and DC generators
iii. Visualise diode characteristics on CRO
iv. Execute simple projects using IC 555

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME304	DYNAMICS OF MACHINERY	2-1-0-3	2016

Prerequisite: ME301 Mechanics of Machinery

Course Objectives:

- To impart knowledge on force analysis of machinery, balancing of rotating and reciprocating masses, Gyroscopes, Energy fluctuation in Machines.
- To introduce the fundamentals in vibration, vibration analysis of single degree of freedom systems.
- To understand the physical significance and design of vibration systems with desired conditions

Syllabus

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms. Flywheel analysis - static and dynamic balancing - balancing of rotating masses, gyroscopic couples. Vibrations – free vibrations of single degree freedom systems, damping, forced vibration, torsional vibration.

Expected outcome:

The students will be able to

1. Develop the design and practical problem solving skills in the area of mechanisms
2. Understand the basics of vibration and apply the concepts in design problems of mechanisms.

Text Books:

1. Ballaney P.L. Theory of Machines, Khanna Publishers,1994
2. S. S. Rattan, Theory of Machines, Tata McGraw Hill, 2009
3. V. P. Singh, Theory of Machines, Dhanpat Rai,2013

References :

1. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education, 2003
2. Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press, 2003
3. H. Myskza, Machines and Mechanisms Applied Kinematic Analysis, Pearson Education, 4e, 2012
4. Holowenko, Dynamics of Machinery, John Wiley, 1995
5. J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,1995
6. W.T.Thompson, Theory of vibration, Prentice Hall,1997

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	Introduction to force analysis in mechanisms - static force analysis (four bar linkages only) - graphical methods	4	15%
	Matrix methods - method of virtual work - analysis with sliding and pin friction	3	
II	Dynamic force analysis: Inertia force and inertia torque. D'Alemberts principle, analysis of mechanisms (four bar linkages only), equivalent dynamical systems	4	15%
	Force Analysis of spur- helical - bevel and worm gearing	3	
FIRST INTERNAL EXAM			
III	Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes	4	15%
	Balancing of reciprocating masses - balancing of multi-cylinder in line engines - V engines - balancing of machines	3	
IV	Gyroscope – gyroscopic couples	3	15%
	Gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships. Stability of an automobile – stability of a two wheel vehicle –Stabilization of ship.	4	
SECOND INTERNAL EXAM			
V	Introduction to vibrations – free vibrations of single degree freedom systems – energy Method	2	20%
	Undamped and damped free vibrations – viscous damping – critical damping - logarithmic decrement - Coulomb damping – harmonically excited vibrations	3	
	Response of an undamped and damped system – beat phenomenon - transmissibility	2	
VI	Whirling of shafts – critical speed - free torsional vibrations – self excitation and stability analysis - vibration control - vibration isolation – vibration absorbers	4	20%
	Introduction to multi-degree freedom systems - vibration measurement - accelerometer – seismometer – vibration exciters	3	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME304	DYNAMICS OF MACHINERY	2-1-0-3	2016

Prerequisite: ME301 Mechanics of Machinery

Course Objectives:

- To impart knowledge on force analysis of machinery, balancing of rotating and reciprocating masses, Gyroscopes, Energy fluctuation in Machines.
- To introduce the fundamentals in vibration, vibration analysis of single degree of freedom systems.
- To understand the physical significance and design of vibration systems with desired conditions

Syllabus

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms. Flywheel analysis - static and dynamic balancing - balancing of rotating masses, gyroscopic couples. Vibrations – free vibrations of single degree freedom systems, damping, forced vibration, torsional vibration.

Expected outcome:

The students will be able to

1. Develop the design and practical problem solving skills in the area of mechanisms
2. Understand the basics of vibration and apply the concepts in design problems of mechanisms.

Text Books:

1. Ballaney P.L. Theory of Machines, Khanna Publishers,1994
2. S. S. Rattan, Theory of Machines, Tata McGraw Hill, 2009
3. V. P. Singh, Theory of Machines, Dhanpat Rai,2013

References :

1. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education, 2003
2. Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press, 2003
3. H. Myskza, Machines and Mechanisms Applied Kinematic Analysis, Pearson Education, 4e, 2012
4. Holowenko, Dynamics of Machinery, John Wiley, 1995
5. J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,1995
6. W.T.Thompson, Theory of vibration, Prentice Hall,1997

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	Introduction to force analysis in mechanisms - static force analysis (four bar linkages only) - graphical methods	4	15%
	Matrix methods - method of virtual work - analysis with sliding and pin friction	3	
II	Dynamic force analysis: Inertia force and inertia torque. D'Alemberts principle, analysis of mechanisms (four bar linkages only), equivalent dynamical systems	4	15%
	Force Analysis of spur- helical - bevel and worm gearing	3	
FIRST INTERNAL EXAM			
III	Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes	4	15%
	Balancing of reciprocating masses - balancing of multi-cylinder in line engines - V engines - balancing of machines	3	
IV	Gyroscope – gyroscopic couples	3	15%
	Gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships. Stability of an automobile – stability of a two wheel vehicle –Stabilization of ship.	4	
SECOND INTERNAL EXAM			
V	Introduction to vibrations – free vibrations of single degree freedom systems – energy Method	2	20%
	Undamped and damped free vibrations – viscous damping – critical damping - logarithmic decrement - Coulomb damping – harmonically excited vibrations	3	
	Response of an undamped and damped system – beat phenomenon - transmissibility	2	
VI	Whirling of shafts – critical speed - free torsional vibrations – self excitation and stability analysis - vibration control - vibration isolation – vibration absorbers	4	20%
	Introduction to multi-degree freedom systems - vibration measurement - accelerometer – seismometer – vibration exciters	3	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME308	COMPUTER AIDED DESIGN AND ANALYSIS	3-0-0-3	2016

Prerequisite: ME201 Mechanics of solids

Course Objectives:

1. To impart basic knowledge on Computer Aided Design methods and procedures
2. To introduce the fundamentals of solid modelling
3. To introduce the concepts of finite element analysis procedures.

Syllabus

Introduction to CAD/CAM, Basics of geometric and solid modeling, transformation, representation points, lines, surfaces and solid models. Introduction to finite element analysis, solution procedures, interpolation, isoparametric formulation, applications.

Expected outcome:

The students will be able to

1. Gain a basic knowledge on Computer Aided Design methods and procedures
2. Understand the fundamentals of solid modelling
3. Have a basic knowledge in finite element analysis procedures.

Text Books:

1. M.P. Groover, E.M. Zimmers, Jr.CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall of India, 1987
2. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2001

References:

1. Chris Mcmahon and Jimmie Browne - CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England,1998
2. D. F. Rogers and J. A. Adams, Mathematical Elements in Computer Graphics, McGraw-Hill,1990
3. Daryl Logan, A First course in Finite Element Method, Thomson Learning,2007
4. David V Hutton, Fundamentals of Finite Element Analysis, THM,2003
5. Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with open GL, Pearson Education,2001
6. Grigore Burdea, Philippe Coiffet, Virtual Reality Technology, John Wiley and sons,2003
7. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill,2007
8. P. Radhakrishnan and S. Subramanyan, CAD / CAM / CIM, New Age Int. Ltd.,2008

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	Introduction to CAD , Historical developments, Industrial look at CAD, Comparison of CAD with traditional designing, Application of computers in Design	2	15%
	Basics of geometric and solid modeling, Packages for CAD/CAM/CAE/CAPP	1	
	Hardware in CAD components, user interaction devices, design database, graphic Standards, data Exchange Formats, virtual Reality.	4	
II	Transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling.	4	15%
	Shearing,rotation, reflection and translation, combined transformations, orthographic and perspective projections, reconstruction of 3-D objects.	3	
FIRST INTERNAL EXAM			
III	Algebraic and geometric forms, tangents and normal, blending functions, reparametrization, straight lines, conics, cubic splines, Bezier curves and B-spline curves.	4	15%
	Plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, bezier surface, B-spline surfaces and their modeling techniques.	3	
IV	Solid models and representation scheme, boundary representation, constructive solid geometry.	3	15%
	Sweep representation, cell decomposition, spatial occupancy enumeration, coordinate systems for solid modeling.	4	
SECOND INTERNAL EXAM			
V	Introduction to finite element analysis - steps involved in FEM- Preprocessing phase – discretisation - types of elements	2	20%
	Formulation of stiffness matrix (direct method, 1-D element) - formulation of load vector - assembly of global equations - implementation of boundary conditions - solution procedure - post processing phase	3	
	Simple problems with axial bar element (structural problems only)	2	
VI	Interpolation – selection of interpolation functions - CST element - isoparametric formulation (using minimum PE theorem) – Gauss-quadrature	4	20%

	Solution of 2D plane stress solid mechanics problems (linear static analysis)	3	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME312	METROLOGY AND INSTRUMENTATION	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:

- To understand the working of linear and angular measuring instruments.
- To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges.
- To give basic idea about various methods for measurement of screw thread and surface finish parameters.
- To give an exposure to advanced measuring devices and machine tool metrology.
- To provide students an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
- To provide basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Syllabus

Introduction to Metrology - Errors in Measurement- Basic standards of length - Linear Measurement, Comparators - Angular Measurement - Limits and Limit gauges - Optical Measuring Instruments - Screw thread measurement - Measurement of surface texture - Machine tool metrology - Coordinate Measuring Machine (CMM) and Machine Vision.
Introduction to Mechanical Measurement - Motion and Dimension measurement, Strain and Stress Measurement - Measurement of Force, Torque and Temperature Measurement.

Expected outcome:

The students will be able to

i. Understand the working of linear and angular measuring instruments.
ii. Know the fundamentals of limits and limit gauges, various methods for measurement of screw thread and surface roughness parameters and the working of optical measuring instruments.
iii. Get an exposure to advanced measuring devices and machine tool metrology.
iv. Acquire an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
v. Get basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Text books

1. Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009
2. Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems Application and Design, McGraw-Hill, 2004
3. Galyer J.F.W., Schotbolt C.R., Metrology for Engineers, ELBS,1990
4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E , Pearson Prentice Hall, 2007

Reference books

1. ASME, Hand book of Industrial Metrology,1998
2. Hume K. J., Engineering Metrology, Macdonald &Co. Ltd.,1990
3. J.P.Holman, Experimental Methods for Engineers,Mcgraw-Hill, 2007
4. Sharp K.W.B., Practical Engineering Metrology, Sir Isaac Pitman & Sons Ltd.,1958

Course Plan

Module	Contents	Hours	End Sem. Exam. Marks
I	Concept of measurement:-Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement-Precision, accuracy, sensitivity, calibration.	1	15%
	Errors in Measurement, types of errors, Abbe's Principle.	1	
	Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards.	1	
	Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calipers.	1	
	Comparators- mechanical, electrical, optical and pneumatic.	1	
	Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges.	1	
	Sprit level; Angle Dekkor; Clinometers.	1	
II	Limits and Limit gauges – Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system.	1	15%
	Standard systems of limits and fits; Shaft and Hole system; Tolerance, allowance and deviation (as per BIS).	1	
	Simple problems on tolerance and allowance, shaft and hole system.	1	
	Limit Gauges – GO and NO GO gauges; types of limit gauges.	1	
	Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance.	1	
	Optical Measuring Instruments: - Benefits of using light waves as standards; Monochromatic light; Principle of Interference.	1	
	Interference band using optical flat, application in surface measurement.	1	
	Interferometers – NPL flatness interferometer, Pitter-NPL gauge interferometer.	1	
	FIRST INTERNAL EXAMINATION		
	Screw thread measurement – Screw thread terminology; Measurement of major diameter; Measurement of minor or root diameter.	1	
	Measurement of pitch; Measurement of effective diameter with two wire method and three wire method.	1	
	Measurement of flank angle and form by profile projector and	1	

III	microscope.		**15%**
	Measurement of surface texture – Meaning of surface texture, roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and R_a value, Rt, Rz etc.	**1**	
	Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; Terms used in surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.	**1**	
	Interference method for measuring surface roughness – using optical flat and interferometers.	**1**	
	Autocollimator, principle and use of autocollimator.	**1**	
IV	Machine tool metrology – Alignment testing of machine tools like lathe, milling machine, drilling machine.	**1**	**15%**
	Advanced measuring devices – Laser interferometers.	**1**	
	Coordinate Measuring Machine (CMM) – Introduction to CMM; Components and construction of CMM.	**1**	
	Types of CMM; Advantages and application of CMM	**1**	
	CMM probes, types of probes – contact probes and non contact probes	**1**	
	Machine Vision – Introduction to machine vision, functions, applications and advantages of machine vision.	**1**	
	Steps in machine vision	**1**	
	SECOND INTERNAL EXAMINATION		
V	Introduction to Mechanical Measurement – significance of mechanical measurement; Fundamental methods of measurement; Classification of measuring instrument.	**1**	**20%**
	Stages in generalized measuring system – Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers.	**1**	
	Performance characteristic of measuring devices – Static characteristics – Accuracy, Precision, Repeatability, Sensitivity, Reproducibility, Drift, Resolution, Threshold, Hysteresis, Static calibration.	**1**	
	Dynamic characteristics- different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Types of errors in measurement.	**1**	
	Transducers – Working, Classification of transducers.	**1**	
	Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations.	**1**	
V1	Strain and Stress Measurement - Electrical resistance strain gauge - Principle, operation.	**1**	
	Measurement of Force and Torque – Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells – basic principle and three component force measurement using piezoelectric quartz crystal.	**1**	
	Torque Measurement – Dynamometers – Mechanical, Hydraulic and Electrical.	**1**	
	Vibration measurement – Vibrometers and Accelerometers – Basic principles and operation.	**1**	

	Temperature Measurement – Use of Thermal Expansion – Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers.	**1**	**20%**
	Thermocouples – Principle, application laws for Thermocouples, Thermocouple materials and construction, measurement of Thermocouple EMF.	**1**	
	Resistance Temperature Detectors (RTD); Thermistors; Pyrometers (Basic Principles).	**1**	
END SEMESTER EXAMINATION			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME332	COMPUTER AIDED DESIGN AND ANALYSIS LAB	0-0-3-1	2016

Prerequisite: ME308 Computer aided design and analysis

Course Objectives:

- To provide working knowledge on Computer Aided Design methods and procedures
- To impart training on solid modelling software
- To impart training on finite element analysis software

Syllabus

Introduction to solid modeling and Finite Element Analysis software.

Exercises on modeling and assembly.

a. Creation of higher end 3D solid models.(minimum 3 models)

b. Creation of assembled views of riveted joints, cotter joints and shaft couplings. (minimum 3 models)

Exercises on the application of Finite Element Method/Finite Volume Method to engineering systems:-

a. Structural analysis. (minimum 3 problems)

b. Thermal analysis. (minimum 2 problems)

c. Fluid flow analysis. (minimum 1 problem)

Expected outcome:

The students will be able to

i. Gain working knowledge in Computer Aided Design methods and procedures

ii. Solve simple structural, heat and fluid flow problems using standard software

Points to note:

- Any appropriate solid modeling software (like CATIA, Solids Works, ProE, IDEAS, Siemens Solid Edge and NX, free software, etc.) and package (like ANSYS, Comsol Multi Physics, NASTRAN, ABAQUS, ADINA, Siemens Femap Nastran,free software etc.) may be used.
- **Evaluation**

  Class exercises 60 marks
  Regular class viva 10 marks
  Final internal exam using software 30 marks
  All the above three evaluations are mandatory.

References Books:

1. Daryl Logan, A First course in Finite Element Method, Thomson Learning, 2007
2. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill,2003
3. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007
4. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education,1987
5. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012

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Course code	Course Name	L-T-P-Credits	Year of Introduction
MP302	ADVANCED MATERIALS & MANUFACTURING SYSTEMS	3-0-0-3	2016

Prerequisite: MP212 Machine Tools

Course Objectives:

- To develop a basic knowledge on powder metallurgy process of manufacturing.
- To introduce machining principles and processes in the manufacture of precision components and products that use conventional and nonconventional technologies.
- To give basic understanding of the machining capabilities, limitations, and productivity of advanced manufacturing process.
- To develop a basic knowledge on digital manufacturing.

Syllabus:-

Powder Metallurgy- Non-traditional and micro machining process - high velocity forming of metals-material addition process. Introduction to digital manufacturing and digital manufacturing science.

Expected outcome: At the end of the course the students will be able to

i. Develop a basic knowledge on powder metallurgy and its applications in fabrication of composite materials.
ii. Become conversant with non- traditional machining process and to appreciate the effect of process parameters on the surface integrity aspects during the non-traditional machining process.
iii. Appreciate the use of EDM as a non traditional method of machining complex and hard materials.
iv. Prescribe a laser processing technique suitable for a given product with material, size, precision, and surface quality requirements.
v. Select the tool material and machining process parameters.
vi. Get a basic knowledge on the importance of digital manufacturing.

Text books

1. ASTME, High velocity forming of metals, PHI, 1968.
2. Davies K and Austin E.R, Developments in high speed metal forming, The machinery publishing Co, 1970, ISBN -853332053.
3. Jain V.K., Introduction to Micromachining, Narosa publishers,2014
4. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited,2012

Reference books

1. Hajra Choudary, Elements of workshop technology, Vol I & II, Media Publishers,2010
2. Lihui Wang and Andrew Yeh Ching Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited,2009
3. Malkin Stephen, Grinding Technology: Theory and Applications of Machining with Abrasives, Industrial press,2008

Course Plan			
Module	**Contents**	**Hours**	**End. Sem. Exam. Marks**
I	Introduction to nano materials & manufacturing. Need and comparison between traditional, non-traditional and micro & nano machining processes.	1	15%
	Powder Metallurgy: Need of P/M - Powder Production methods:- Atomization, electrolysıs, Reduction of oxides, Carbonyls (Process parameters, characteristics of powder produced in each method).	1	
	Powder characteristics: properties of fine powder, size, size distribution, shape, compressibility, purity etc.	1	
	Mixing – Compaction:- techniques, pressure distribution, HIP & CIP.	1	
	Mechanism of sintering, driving force for pore shirking, solid and liquid phase sintering - Impregnation and Infiltration Advantages, disadvantages.	1	
	Applications in processing of metal matrix and ceramic matrix composites.	1	
II	Electric Discharge Machining (EDM):- Mechanism of metal removal, dielectric fluid, spark generation, recast layer and attributes of process characteristics on MRR, accuracy, HAZ etc, Wire EDM, applications and accessories.	3	15%
	Ultrasonic Machining (USM):-mechanics of cutting, effects of parameters on amplitude, frequency of vibration, grain diameter, slurry, tool material attributes and hardness of work material, applications.	2	
	Electro chemical machining (ECM):- Mechanism of metal removal attributes of process characteristics on MRR, accuracy and surface roughness, Application and limitations.	1	
	FIRST INTERNAL EXAMINATION		
III	Laser Beam Machining (LBM), Electron Beam Machining (EBM), Plasma arc Machining (PAM), Ion beam Machining(IBM) - Mechanism of metal removal, attributes of process characteristics on MRR , accuracy and structure of HAZ compared with conventional process; application, comparative study of advantages and limitations of each process.	3	15%
	Abrasive Jet Machining (AJM), Abrasive Water Jet Machining (AWJM) - Working principle, Mechanism of metal removal, Influence of process parameters, Applications, Advantages &	3	

	disadvantages.		
IV	High velocity forming of metals:-effects of high speeds on the stress strain relationship steel, aluminum, Copper – comparison of conventional and high velocity forming methods- deformation velocity, material behavior, stain distribution.	3	15%
	Stress waves and deformation in solids – types of elastic body waves- relation at free boundaries- relative particle velocity.	2	
	Sheet metal forming: - explosive forming:-process variable, properties of explosively formed parts, etc.	2	
	Electro hydraulic forming: - theory, process variables, etc, comparison with explosive forming.	1	
	SECOND INTERNAL EXAMINATION		
V	Micromachining: Diamond turn mechanism, material removal mechanism, applications.	1	20%
	Advanced finishing processes: - Abrasive Flow Machining, Magnetic Abrasive Finishing.	2	
	Magnetorheological Abrasive Flow Finishing, Magnetic Float Polishing, Elastic Emission Machining.	3	
	Material addition process:- stereo-lithography, selective laser sintering, 3D Printing, fused deposition modeling, laminated object manufacturing, laser engineered net-shaping, laser welding, LIGA process.	2	
V1	Introduction to Digital Manufacturing: Concepts and research and development status of digital manufacturing	1	20%
	Definition of digital manufacturing – Features and development of digital manufacturing.	1	
	Theory system of digital manufacturing science: Operation Mode and Architecture of Digital Manufacturing System	1	
	Operation reference mode of digital manufacturing system – Architecture of digital manufacturing system	1	
	Modeling theory and method of digital manufacturing science	1	
	Critical modeling theories and technologies of digital manufacturing science	1	
	Theory system of digital manufacturing science – Basic architecture model of digital manufacturing system.	1	
END SEMESTER EXAM			

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There should be 3 questions each from module V and VI
Each question carries 10 marks
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Note: In all parts, each question can have a maximum of four sub questions

Course code	Course Name	L-T-P-Credits	Year of Introduction
MP362	Precision Engineering	3-0-0-3	2016

Prerequisite: MP212 Machine Tools

Course Objectives:

- To provide an overview of the principles of precision and micro manufacturing
- To introduce principles applied to precision engineering systems, including: accuracy & errors

Syllabus

Concepts of accuracy and precision, Micro & Ultra precision Machining, Ultra precision Machine elements, Sources of error in location and machining, Principles of dimensioning, accuracy and surface finish, Micro manufacturing processes, Smart structures, sensors and micro actuators

Expected outcome:

The students will be able to

i. Apply design procedures for precision manufacturing.
ii. Select manufacturing processes to suit accuracy and precision

References Books:

1. Kalpakjian S., Manufacturing Engineering and Technology. 3rd Ed. Addision-Wesley Publishing Co.,New York, 2001.
2. Murthy R.L. Precision Engineering in Manufacturing, New Age International, 2005
3. Nakazawa, H. Principles of Precision Engineering, Oxford University Press, 1994.
4. Norio Tanigughi, Nano Technology, Oxford University Press, 1996.
5. Randy Frank, Understanding Smart Sensors, Artech House, Boston, 1996.
6. Stephen A. Campbell, The Science and Engineering of Micro Electronic Fabrication, Oxford University Press, 1996.
7. V.C.Venktesh, Precision Engineering, Tata Mc.Graw Hill, New Delhi 2007

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Need for having high precision,-Accuracy & precision- Four Classes of Achievable Machining Accuracy,- Precision Machining, High-precision, Ultra-precision Processes and Nanotechnology Thermal effects – Materials for tools and machine elements – carbides – ceramics, CBN & diamond.	6	15%
II	Ultra precision machine elements – Guide ways – Drive systems – Spindle drive – preferred numbers – Rolling elements – hydrodynamic & hydrostatic bearings – pneumatic bearings. Selective assembly – gauges acceptance tests for machine tools.	6	15%
FIRST INTERNAL EXAM			

III	Sources of error– Static stiffness – Variation of the cutting force – total compliance – Different machining methods – Thermal effects – heat source – heat dissipation – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control – errors due to locations – principle of constant location surfaces.	7	15%
IV	Dimensioning, accuracy and surface finish: Definition of terms – assigning tolerances in the constituent dimensions –Limits and fits- dimensional chains – concepts of precision machining - finish turning-boring-grinding.	7	15%
SECOND INTERNAL EXAM			
V	Micro manufacturing processes: Micro machining-photo resist process-lithography- optical. Processing of materials-electron beam machining-iron beam machining-micro forming, diamond turning-micro positioning devices. MEMS – principle – elements – characteristics – design – applications	8	20%
VI	Smart structures, sensors and micro actuators: Smart Structures-smart sensors-micro valves-MEMS- micro motors - micro pumps – micro dynamometer - micro machines – structures - cooling channels - micro optics-micro nozzles. Applications.	8	20%
END SEMESTER EXAM			

Question Paper Pattern

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Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts each question can have a maximum of four sub questions

Course code	Course Name	L-T-P - Credits	Year of Introduction
MP364	Rapid prototyping, Tooling & Manufacture	3-0-0-3	2016

Prerequisite : Nil

Course Objectives:

The course is meant to provide knowledge in:

- Concepts of rapid prototyping, (RP) rapid tooling and rapid manufacturing
- Features of polymer based and metal based rapid prototyping technologies
- Design considerations for additive manufacturing (AM)
- Recent developments and future trends in RP / AM
- Industrial applications of RP / AM

Syllabus:

Functional concepts in rapid prototyping (RP), Photo-polymerisation process and features, Extrusion and sheet lamination based processes, Power based RP methods, Post processing of RP products, Rapid tooling, Design for additive manufacturing, File types in RP technology, Latest developments anf future trends in additive manufacturing (AM), RP/AM applied in various industries.

Expected outcome:

The students will be able to:

- Compare the features of various polymer based and metal based rapid prototyping technologies
- Explain the mechanisms involved in product formation with various rapid manufacturing methods
- Describe the designs concepts involved in RP/AM
- Describe modern trends, developments in AM and the industrial applications

Text Book:

- Gibson, I, D. W. Rosen, and B. Stucker. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer Verlag, 2015

References:

Chee Kai Chua, Kah Fai Leong and Chu Sing Lim. 3D Printing and Additive Manufacturing: Principles and Applications (Fifth Edition of Rapid Prototyping),World Scientific, 5e, 2017

Pham D. and Dimov S.S. Rapid Manufacturing-The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer Verlag, 2001

Web References:

Module 1:
https://dupress.deloitte.com/dup-us-en/focus/3d-opportunity/the-3d-opportunity-primer-the-basics-of-additive-manufacturing.html
Module 2
http://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/
Module 3
http://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/powderbedfusion/
http://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/directedenergydeposition/
http://www.metal-am.com/introduction-to-metal-additive-manufacturing-and-3d-printing/metal-additive-manufacturing-processes/
Module 4
http://www.mansys.info/quality-metal-am/pagina%27/post-processing/

http://www.stratasys.com/solutions/additive-manufacturing/tooling
https://3dprint.com/55676/additive-manufacturing-tooling/
https://www.eos.info/tooling
http://usglobalimages.stratasys.com/Main/Secure/White%20Papers/Rebranded/SSYSWP3DPrintingJigsFixtures0313.pdf?v=635004364020117830
http://www.advice-manufacturing.com/3D-Printing-Jigs.html
Module 5:
https://www.stratasysdirect.com/wp-content/uploads/2015/07/fdm-basics.pdf
http://canadamakes.ca/design-additive-manufacturing-guidelines-case-studies-metal/
https://rpplatform.com/2017/03/03/additive-manufacturing-software-formats/
https://all3dp.com/what-is-stl-file-format-extension-3d-printing/
http://enac-oc.epfl.ch/files/content/sites/enacco/files/3D%20CAD%20CAM%20and%20Rapid%20PrototypingV1.1.pdf
Module 6:
https://dupress.deloitte.com/dup-us-en/focus/3d-opportunity/additive-manufacturing-3d-opportunity-in-aerospace.html
http://dupress.com/articles/additive-manufacturing-3d-opportunity-in-medtech/
https://dupress.deloitte.com/dup-us-en/focus/3d-opportunity/additive-manufacturing-3d-opportunity-in-automotive.html

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction and basic principles of Rapid Prototyping (RP), Advantages and applications of RP, Development of RP processes, Generalized RP process chain, Classification of RP Systems: Photo Polymer based systems, Powder based systems, Extrusion based systems, and Sheet material based systems. Transition of RP terminology to 3 dimensional printing (3DP)/Additive Manufacturing (AM).	7	15%
II	Photo polymerization Process: Introduction to Stereo lithography, Materials, Machines, Scan patterns, Resin curing process. Direct printing or material jetting: Introduction, Evolution of direct printing, materials for printing. Extrusion based process (Fused deposition modeling): Introduction, Process description, Process parameters, materials and application, Limitations Sheet lamination Processes: Introduction, Adhesive Bonding, Thermal Bonding, Ultrasonic Consolidation.	7	15%
FIRST INTERNAL EXAMINATION			
III	Powder bed fusion process: Introduction, Process description, Powder fusion mechanism, Variation of powder bed fusion processes- Selective Laser Melting (SLM) and Electron Beam Melting (EBM) for metals, Process parameters, materials and applications. Beam deposition process: Introduction, Material delivery: powder feed, wire feed, Beam deposition systems, process parameters, typical materials, benefits and draw backs.	7	15%
IV	Post processing: Support material removal, Surface texture		

	improvements, Accuracy Improvements, Aesthetic improvements, Property enhancements using non-thermal techniques and thermal techniques. Tooling: Introduction, RP for rapid tooling, investment casting patterns and sand casting patterns, tooling for injection molding, quality control molds, assembly molds, Jigs & fixture tooling, Tooling with conformal cooling channels	7	15%
SECOND INTERNAL EXAMINATION			
V	Design for Additive Manufacturing (AM): Design for Manufacturing and Assembly (DFMA), Concepts of Design for Additive Manufacturing, unique capabilities of AM, Design freedom, Design tools for AM. Software work flow in Additive Manufacturing: Preparation of CAD models and STL files, issues with STL files, STL file manipulation, other file formats such as .AMF, .3MF	7	20%
VI	Latest developments in AM: Hybrid manufacturing, Materials development in polymers for AM, Alloy development in metals for AM, Future trends and implications of AM: Mass customization and supply chain, Bio-printing Industry Focus: Aerospace components,Automobile parts, medical implants, tooling, and consumer goods.	7	20%
END SEMESTER EXAM			

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Course code	Course Name	L-T-P - Credits	Year of Introduction
MP366	Modern manufacturing Concepts	3-0-0-3	2016

Prerequisite : Nil

Course Objectives:

- To introduce modern trends in casting, methods of manufacturing composite material products and surface processing methods.
- To learn features and applications of powder metallurgy
- To know rapid prototyping methods and rapid tooling
- To make aware the recent developments in non-conventional surface finishing processes.

Syllabus:

Modern casting processes, Modern plastic shaping processes, Polymer matrix composite processes and features, Powder metallurgy – processes and mechanisms, Rapid prototyping methods for polymer and metals products, Recent developments in non-traditional surface finishing processes.

Expected outcome:

The students will be able to:

i. Know the features of various modern casting and plastic forming processes
ii. Suggest suitable polymer matrix composite process for the manufacture of selected industrial components.
iii. Understand features of various coating processes for metals and ceramics
iv. Explain the mechanisms involved in powder metallurgy process
v. Illustrate the functioning of various rapid prototyping processes
vi. Gain the functioning of recent non-conventional surface finishing processes

References:

1. Amstead B. H., Ostwald Phylips and R.L. Bageman, Manufacturing Processes, John Wileys Sons, 1987.
2. Brahem.T.Smith, Advanced machining, I.F.S., U.K., 1989.
3. Joao Paulo Davim, Machining – Fundamentals and recent advances, Ch-11 Advanced (Non-traditional) Machining Processes (VK Jain) pp.299-327, Springer, 2008
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Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Advances in casting: Newer casting processes - Plaster mold and ceramic mold casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming. Manufacturing processes for plastics: Thermoforming, Compression moulding, Transfer moulding, Foam moulding	7	15%
II	Shaping processes for polymer matrix composites (PMCs): Materials for PMCs, Classification of manufacturing processes for fiber-	7	15%

	reinforced polymer composites. Combining matrix and reinforcement, Prepregs, Open Mold Processes, Closed Mold Processes, Filament Winding, Pultrusion Processes. Other PMC Shaping Processes-Centrifugal casting, tube rolling, continuous laminating		
FIRST INTERNAL EXAMINATION			
III	Surface processing operations: Mechanical cleaning and surface treatments- Diffusion and Ion Implantation, Plating Processes- Electroplating and electroless plating, hot dipping. Conversion Coating, Vapor Deposition Processes –PVD, Sputtering, iron plating, CVD, Organic Coatings. Porcelain enameling and other ceramic coatings, Thermal surfacing and Mechanical plating.	7	15%
IV	Powder metallurgy - Characterization of engineering powders, production of metallic powders, conventional pressing and sintering.Alternative pressing and sintering techniques-isostatic pressing (CIP, HIP and its features), powder injection moulding, powder rolling, forging and extrusion, spark sintering. Materials and products for powder metallurgy, design considerations in powder metallurgy. Processing of ceramics and cermets- Processing of traditional and new ceramics, processing of cermets	7	15%
SECOND INTERNAL EXAMINATION			
V	Rapid prototyping and rapid tooling - Fundamentals of rapid prototyping, Rapid prototyping technologies- stereo lithography – Fused Deposition Moulding – Selective Laser Machining – Laminated Object Manufacturing – Solid Base Curing. Selective Laser Melting (SLM) and Electron Beam Melting (EBM) for metals. Direct manufacturing and rapid tooling.	7	20%
VI	Non-traditional surface finishing processes: Abrasive flow machining (AFM), Magnetic abrasive finishing (MAF), Magnetorheological finishing (MRF), Magnetic float polishing (MFP), Magnetorheological abrasive flow machining (MRAFF), Magnetorheological Abrasive Honing (MRAH). Features and potential applications of these processes.	7	20%
END SEMESTER EXAM			

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MP366	Modern manufacturing Concepts	3-0-0-3	2016

Prerequisite : Nil

Course Objectives:

- To introduce modern trends in casting, methods of manufacturing composite material products and surface processing methods.
- To learn features and applications of powder metallurgy
- To know rapid prototyping methods and rapid tooling
- To make aware the recent developments in non-conventional surface finishing processes.

Syllabus:

Modern casting processes, Modern plastic shaping processes, Polymer matrix composite processes and features, Powder metallurgy – processes and mechanisms, Rapid prototyping methods for polymer and metals products, Recent developments in non-traditional surface finishing processes.

Expected outcome:

The students will be able to:

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FIRST INTERNAL EXAMINATION			
III	Surface processing operations: Mechanical cleaning and surface treatments- Diffusion and Ion Implantation, Plating Processes- Electroplating and electroless plating, hot dipping. Conversion Coating, Vapor Deposition Processes –PVD, Sputtering, iron plating, CVD, Organic Coatings. Porcelain enameling and other ceramic coatings, Thermal surfacing and Mechanical plating.	7	15%
IV	Powder metallurgy - Characterization of engineering powders, production of metallic powders, conventional pressing and sintering.Alternative pressing and sintering techniques-isostatic pressing (CIP, HIP and its features), powder injection moulding, powder rolling, forging and extrusion, spark sintering. Materials and products for powder metallurgy, design considerations in powder metallurgy. Processing of ceramics and cermets- Processing of traditional and new ceramics, processing of cermets	7	15%
SECOND INTERNAL EXAMINATION			
V	Rapid prototyping and rapid tooling - Fundamentals of rapid prototyping, Rapid prototyping technologies- stereo lithography – Fused Deposition Moulding – Selective Laser Machining – Laminated Object Manufacturing – Solid Base Curing. Selective Laser Melting (SLM) and Electron Beam Melting (EBM) for metals. Direct manufacturing and rapid tooling.	7	20%
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Part A

There should be 2 questions each from module I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

There should be 2 questions each from module III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

There should be 3 questions each from module V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions

Course code	Course Name	L-T-P - Credits	Year of Introduction
MP366	Modern manufacturing Concepts	3-0-0-3	2016

Prerequisite : Nil

Course Objectives:

- To introduce modern trends in casting, methods of manufacturing composite material products and surface processing methods.
- To learn features and applications of powder metallurgy
- To know rapid prototyping methods and rapid tooling
- To make aware the recent developments in non-conventional surface finishing processes.

Syllabus:

Modern casting processes, Modern plastic shaping processes, Polymer matrix composite processes and features, Powder metallurgy – processes and mechanisms, Rapid prototyping methods for polymer and metals products, Recent developments in non-traditional surface finishing processes.

Expected outcome:

The students will be able to:

i. Know the features of various modern casting and plastic forming processes
ii. Suggest suitable polymer matrix composite process for the manufacture of selected industrial components.
iii. Understand features of various coating processes for metals and ceramics
iv. Explain the mechanisms involved in powder metallurgy process
v. Illustrate the functioning of various rapid prototyping processes
vi. Gain the functioning of recent non-conventional surface finishing processes

References:

1. Amstead B. H., Ostwald Phylips and R.L. Bageman, Manufacturing Processes, John Wileys Sons, 1987.
2. Brahem.T.Smith, Advanced machining, I.F.S., U.K., 1989.
3. Joao Paulo Davim, Machining – Fundamentals and recent advances, Ch-11 Advanced (Non-traditional) Machining Processes (VK Jain) pp.299-327, Springer, 2008
4. Mikell P. Groover, Fundamentals of modern manufacturing-Materials, Processes and Systems (4th Edition), John Wiley and Sons, 2010.
5. Muccic E. A., Plastic Processing Technology, Materials Park, OHIO, ASM Int., 1994.
6. Serope Kalpakjian, Manufacturing Engineering and Technology, Third Edition- Addison-Wesley Publication Co., 1995.
7. Serope Kalpakjian, Steven R. Schemid, Manufacturing processes for Engineering Materials, Fourth edition, Pearson Education, 2003.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Advances in casting: Newer casting processes - Plaster mold and ceramic mold casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming. Manufacturing processes for plastics: Thermoforming, Compression moulding, Transfer moulding, Foam moulding	7	15%
II	Shaping processes for polymer matrix composites (PMCs): Materials for PMCs, Classification of manufacturing processes for fiber-	7	15%

	reinforced polymer composites. Combining matrix and reinforcement, Prepregs, Open Mold Processes, Closed Mold Processes, Filament Winding, Pultrusion Processes. Other PMC Shaping Processes-Centrifugal casting, tube rolling, continuous laminating		
FIRST INTERNAL EXAMINATION			
III	Surface processing operations: Mechanical cleaning and surface treatments- Diffusion and Ion Implantation, Plating Processes- Electroplating and electroless plating, hot dipping. Conversion Coating, Vapor Deposition Processes –PVD, Sputtering, iron plating, CVD, Organic Coatings. Porcelain enameling and other ceramic coatings, Thermal surfacing and Mechanical plating.	7	15%
IV	Powder metallurgy - Characterization of engineering powders, production of metallic powders, conventional pressing and sintering.Alternative pressing and sintering techniques-isostatic pressing (CIP, HIP and its features), powder injection moulding, powder rolling, forging and extrusion, spark sintering. Materials and products for powder metallurgy, design considerations in powder metallurgy. Processing of ceramics and cermets- Processing of traditional and new ceramics, processing of cermets	7	15%
SECOND INTERNAL EXAMINATION			
V	Rapid prototyping and rapid tooling - Fundamentals of rapid prototyping, Rapid prototyping technologies- stereo lithography – Fused Deposition Moulding – Selective Laser Machining – Laminated Object Manufacturing – Solid Base Curing. Selective Laser Melting (SLM) and Electron Beam Melting (EBM) for metals. Direct manufacturing and rapid tooling.	7	20%
VI	Non-traditional surface finishing processes: Abrasive flow machining (AFM), Magnetic abrasive finishing (MAF), Magnetorheological finishing (MRF), Magnetic float polishing (MFP), Magnetorheological abrasive flow machining (MRAFF), Magnetorheological Abrasive Honing (MRAH). Features and potential applications of these processes.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

Part A

There should be 2 questions each from module I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

There should be 2 questions each from module III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

There should be 3 questions each from module V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions

Course code	Course Name	L-T-P-Credits	Year of Introduction
MP374	Industrial Hydraulics	3-0-0-3	2016

Prerequisite: NIL

Course Objectives:

- To apply laws of fluid mechanics in hydraulic systems.
- To study the working principle of various components used in hydraulic systems.
- To learn design and industrial applications of hydraulic circuits.

Syllabus

Introduction to Hydraulic Systems. Basic Components. Symbols, Types, classification, principle of working and constructional details Hydraulic valves, Hydraulic pumps/motors/actuators, Hydrostatic Transmission Systems, Development of hydraulic circuits, Application of Hydraulics in industrial Automation.

Expected Outcome

The students will have

i. The exposure in working principle of various components used for hydraulic systems.
ii. The ability to identify various components and able to select appropriate components required for hydraulic systems.
iii. The capability to design hydraulic system for industrial applications.
iv. The ability to understand industrial applications of hydraulic system.

Text book

J. J. Pipenger, Industrial Hydraulics, McGraw Hill

References

1. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books.
2. H.L.Stewart, Hydraulics and Pneumatics , Taraporewala Publication
3. ISO - 1219, Fluid Systems and components, Graphic Symbols
4. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
5. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall.

Course Plan

Module	Contents	Hours	End sem. exam marks
I	**INTRODUCTION TO HYDRAULIC POWER:** Definition of hydraulic system, advantages, limitations, applications, Properties of fluids, Fluids for hydraulic systems, governing laws, structure of hydraulic control system, Distribution of fluid power, ISO symbols, energy losses in hydraulic systems	6	15%
II	**PUMPS:** Construction and working of Gear pumps, Vane pumps, Piston pumps, radial and axial plunger pumps, screw pumps, pump Selection factors for hydraulic Power transmission. **ACCUMULATORS:** Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensors, Temperature switches/sensors, Level sensors.	8	20%

First Internal Exam			
III	**HYDRAULIC VALVES:** Flow control valves like pressure compensated and non pressure compensated. Directional control valves, two way valves, pressure control valves, venting and relief valves, unloading valves, unloading. Sequence, counter balance and brake valves with applications. Pressure reducing valve like direct and pilot operated.	8	20%
IV	**HYDRAULIC ACTUATORS AND MOTORS**: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators, single and double acting cylinders and mountings. Calculation of piston velocity, Design considerations for cylinders. Cushioning of cylinders.	5	10%
Second Internal Exam			
V	**DESIGN OF HYDRAULIC CIRCUIT:** Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed circuits, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit , motor breaking circuit.	8	20%
VI	**HYDRAULIC CIRCUITS IN INDUSTRIAL APPLICATIONS:** Hydraulic circuit of typical hydraulic systems such as hydraulic press, movable platform of machine tools, truck cranes, copying machines, hydraulic power steering**.**	7	15%
End Semester Exam			

Question Paper Pattern

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts each question can have a maximum of four sub questions

Course code	Course Name	L-T-P - Credits	Year of Introduction
MP376	Artificial Intelligence in Manufacturing	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To provides an elementary understanding of how knowledge and information can be processed for creating and maintaining automated manufacturing systems.

Syllabus

Introduction to Artificial Intelligence, Intelligent Manufacturing Systems, Knowledge base systems. Applications to process planning, flexible manufacturing system, technology based systems and group technology. Introduction to Neural Networks and Fuzzy Logic, Applications of Artificial Neural Networks in manufacturing related applications

Expected outcome.

The students will be able to:

- Comprehend concepts of Artificial Intelligence and Intelligent Manufacturing
- Explain knowledge base systems and components
- Demonstrate applications of AI in process planning
- Discuss applications of AI in flexible manufacturing systems and technology based systems
- Describe applications of AI in group technology
- Enumerate applications of fuzzy logic and ANN in aspects of manufacturing

Text Book :

1. Andrew Kusiak, Intelligent Manufacturing Systems, Prentice Hall, 1990

Reference books :

1. Elaine Rich. Artificial intelligence, Tata McGraw Hill, 1995
2. Ibrahim Zeid. CAD/CAM Theory and Practice, McGraw Hill, 1991
3. Mitsuogen Runwelding, General Algorithms in Engineering Design, John Wiley.1997
4. Mohammed Jamshidi, Design and Implementation of Intelligent Manufacturing Systems. Prentice Hall, 1995

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to artificial intelligence, history, general applications, Computer Integrated Manufacturing Manufacturing Communication Systems,Intelligent manufacturing: System components, system architecture and data flow system operation	7	15%
II	Components of knowledge base systems, knowledge representation, types, and comparison of knowledge representation schemes. Knowledge base system: Inference engine, knowledge acquisition, optimization and knowledge base systems for machines	7	15%
	FIRST INTERNAL EXAMINATION		
III	Process planning: Feature recognition, machining optimization Selection and sequencing of machinable volumes,Selection of process plans in automated manufacturing systems	7	15%
IV	Flexible machining system: Flexible assembly systems, tool management. Technology based systems: Design of mechanical	7	15%

	parts, refinement approach, and model based approach Design of mechanisms, feature based design, and knowledge based design for automated assembly		
SECOND INTERNAL EXAMINATION			
V	Group technology, models and algorithms, cluster analysis method, knowledge based systems for GT Models and algorithms for machine layout, knowledge based systems for machine layout, scheduling, models and algorithms	7	20%
VI	Application of artificial neural networks, fuzzy logic and genetic algorithms in manufacturing, ANN for tool wear monitoring, fuzzy control of machine tools, Introduction to neural networks, synaptic integration and neuron models, essential vector operators, back propagation algorithms Application of neural networks to process modelling control, Neural network based feed forward active control systems, neural network application to tool condition monitoring in turning machine, condition monitoring in tapping, neural networks in robotics.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions