UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

MECHANICAL ENGINEERING

SCHEME -2013

VI SEMESTER
MECHANICAL ENGINEERING (M)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.601	Metrology & Instrumentation (MP)	4	3	1	-	50	3	100	150
13.602	Dynamics of Machinery (MP)	4	3	1	-	50	3	100	150
13.603	Computer Aided Design (MPU)	3	2	1	-	50	3	100	150
13.604	Heat and Mass Transfer (MSU)	4	3	1	-	50	3	100	150
13.605	Design of Machine Elements - I (M)	4	3	1	-	50	3	100	150
13.606	ELECTIVE II	4	3	1	-	50	3	100	150
13.607	Computer Aided Modeling and Analysis Lab (MPU)	3	-	-	3	50	3	100	150
13.608	Machine Tools Lab (M)	3	-	-	3	50	3	100	150
	Total	**29**	**17**	**6**	**6**	**400**		**800**	**1200**

13.606 ELECTIVE II

13.606.1	Artificial Intelligence Systems (MPU)
13.606.2	Mechanical Working Methods (MPU)
13.606.3	System Modeling & Simulation (MPU)
13.606.4	Materials Handling (MPU)
13.606.5	Total Quality Management (MPU)
13.606.6	Advanced Manufacturing Processes (MPU)
13.606.7	Material Characterisation (MPU)
13.606.8	Micromachining Methods (MPU)
13.606.9	New Energy Systems (MP)
13.606.10	Object Oriented Programming (MP)
13.606.11	Nuclear Engineering (MP)
13.606.12	Instrumentation and Control (MP)
13.606.13	Precision Engineering (MP)
13.606.14	Tool Engineering (M)

13.601 METROLOGY AND INSTRUMENTATION (MP)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

The main objectives of this course are

- *To understand the basic principles of measurements.*
- *To learn the various linear and angular measuring equipments, their principle of operation and applications.*
- *To learn about various methods of measuring Mechanical parameters.*

Module – I

General principles of measurement: Precision, accuracy and the influencing factors.

Calibration. Methods of measurements - Features of Line standard and End standards – Slip gauges.

Angular measurements: Bevel protractor, spirit level, clino-meter, angle gauges, sine bar, Sine centre.

Module – II

Tolerance- Allowance- Limits and Fits:- Systems of limits and fits. Deviation as per BIS. Designation of Holes, Shafts and Fits - Problems for limits and fits. Interchangeability, selective assembly. Limit gauges: Design Considerations - Taylor's principles - Classification and features of Limit gauge - Plug, Ring, Taper, Gap, Snap, Position gauges -Features. Gauge tolerance and allowance. Gauges materials.

Geometric forms and measurements: Straightness, Flatness, Squareness, Circularity. Geometric tolerances: Types, Representation.

Module – III

Comparator:- Mechanical, Optical, Pneumatic, Electrical and Electronic comparators. Optical flat: Features, applications. Optical Measuring Instruments - Principle of Interferometry – Interferometers – Autocollimator - Angle dekkor.

Surface Texture – Surface roughness: Parameters, Evaluation - Simple problems. Surface roughness measuring instruments.

Module – IV

Co-ordinate measuring machine – Types, features, measurement process.

Transducers: Classification - Static and Dynamic characteristics.

Dynamometers – Types: Mechanical, hydraulic, electrical. Strain Measurement: Strain gauges – Types: Resistance based and mechanical strain gauges.

Errors in measurements – Static, dynamic, systematic, random, loading, absolute and relative errors. Analysis of experimental errors- Gaussian and normal error distribution- Methods of Least Squares- Simple problems.

References:

1. Doebelin E. O., *Measurement System (Application and Design*), McGraw-Hill, 2008.
2. Jain R. K., *Mechanical and Industrial Measurements,* Khanna Publishers, 2010.
3. Jain R. K., *Engineering Metrology*, Khanna Publishers, New Delhi, 1997.
4. Bewoor A. K., V. A. Kulkarni, *Metrology and Measurements*, Tata McGraw-Hill, 2009.
5. I. C. Gupta, *A Text Book of Engineering of Metrology*, Dhanapath Rai Publications, 2012.
6. ASME*, Hand book of Industrial Metrology,* ASME.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able,

- *To know about quality control and quality assurances.*
- *To design a sensors and transducers used for measurements.*
- *To understand the importance of quality in engineering products.*

13.602 DYNAMICS OF MACHINERY (MP)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

This course aims to equip the students with fundamental knowledge of dynamics of machines so that they can appreciate problems of force analysis, balancing of systems & vibrations.

Module – I

Force analysis: Static force analysis: Graphical and vector method- Free body diagrams- Conditions for equilibrium- two and three force members, four force members, Analysis of mechanisms without considering friction, analysis with sliding and pin friction- Method of virtual work- Principle of super position. Dynamic force analysis: Inertia force and inertia torque. D'Alembert's principle, Analysis of mechanisms, Equivalent dynamical systems. Shaking forces and moments.

Module – II

Governors: Types of governors – Watt ,Porter, Proell and Hartnell governors – Sensitiveness – Hunting – Isocronism – Stability – Effort and power of governor – Controlling force.

Gyroscopes **:** Principle, -analysis of 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.

Module – III

Balancing **:**Static and Dynamic balancing - Balancing of revolving masses in different planes – Balancing of reciprocating mass – single cylinder engine – multi cylinder engine – V engines - Balancing machines. Fly wheel- Turning moment diagrams,- fly wheel in different applications like IC engines, Punching press.

Module – IV

Types of vibrations – Basic elements of a vibrating system - Undamped force vibrations, different methods of analysis, Free vibrations with viscous damping, logarithmic decrement, forced vibrations, vibration isolation and transmissibility. Force due to unbalance - Force due to support motion – Vibration measuring instruments - vibrometers – accelerometers.

Transverse vibration – string, beam. Natural frequency - Dunkerley's method – Whirling of shafts – critical speed.

Torsional vibrations Free torsional vibrations – Single rotor - Two rotor, three rotor systems – Torsionally equivalent shaft - geared systems.

References

1. Rattan S. S., *Theory of Machines*, McGraw Hill, 2009.
2. Thomson W. T., *Theory of Vibration with Application*, Prentice Hall, 1997.
3. Holowenko, *Dynamics of Machinery*, John Wiley, 1955.
4. Shigley J. E. and J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill, 1995.
5. Wilson C. E. and J. P. Sadler*, Kinematics and Dynamics of Machinery*, Pearson, 2003.
6. Ballaney P. L., *Theory of Machines and Mechanisms*, Khanna Publishers, 2005.
7. Ramamoorthi V., *Mechanics of Machinery*, Narosa publishers, 2010.
8. Singh V. P., *Theory of Machines*, Dhanpat Rai, 2013.
9. Rao J.S. and R. V. Dukkipati, *Mechanisms and Machine Theory*, John Wiley, 1989.
10. Gosh A. and A. K. Mallick, *Theory of Machines and Mechanisms*, Affiliated East West Press, 1988.
11. Lasithan, *Elementary Mechanical Vibration and Noise Control*, Prentice-Hall, 2014.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

After successful completion of this course, the students will be able,

- *To develop sufficient background in the application of knowledge in force analysis of mechanisms*
- *To understand the fundamentals of free and forced response of single degree of freedom vibration.*
- *To understand the dynamic balancing of revolving and reciprocating masses. Understand the fundamentals of gyroscopes and its applications and governors.*

13.603 COMPUTER AIDED DESIGN (MPU)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

To equip students with fundamentals of computer aided design and to provide elementary algorithms in computer graphics and finite element analysis for basic engineering problems

Module – I

Computer Aided Design – Definition, Necessity for CAD, Benefits of CAD, Design process, Application of computers in Design- Geometric modeling, Engineering analysis, design review & evaluation, Automated drafting. Types of models- wire frame - surface and solid models - CSG and B-rep techniques.

Module – II

Introduction to Computer graphics, Functions of computer graphics software. Line generation algorithm- Bresenhams algorithm. Circle generation algorithm - Midpoint algorithm and Bresenhams algorithm. Coordinate Transformations – 2D and 3D - translation, scaling, rotation, mirroring, concatenation of transformations, homogeneous transformations.

Module – III

Clipping operations – introduction to point and line clipping - Cohen Sutherland point and line clipping algorithm. Hidden surface removal algorithms – z-buffer algorithm, scan line algorithm. Projections - Perspective geometry – Orthographic and Oblique projections – perspective transformations.

Module – IV

Introduction to finite element analysis-steps involved in FEM- Preprocessing, discretisation, types of elements, interpolation functions- Formulation of stiffness matrix - formulation of load vector- Transformation of coordinates-assembly of global equations-solution procedure, post processing phase. Simple problems with Axial element - beam element, CST element. Isoparametric formulation. Solution of 1D and 2D structural - linear static analysis.

References:

1. D.F. Rogers and J.A. Adams, *Mathematical Elements in Computer Graphics* , McGraw-Hill Book Company, New York,2007.

2. Hearn and Baker, *Computer Graphics*, Prentice Hall.
3. Ibrahim Zeid, *CAD - CAM Theory and Practice*, TMH, 2009.
4. Radhakrishnan P. and S. Subramanyan, *CAD / CAM / CIM*, New Age Int. Ltd, 2009.
5. Sadhu Singh, *Computer Aided Design and Manufacturing*, Khanna Publishers, New Delhi, 2010.
6. Mikell P. Groover, *CAD/CAM*, Prentice Hall, 1997.
7. Zienkiewicz O. C., R. L. Taylor and J. Z. Zhu, *The Finite Element Method, Its Basis & Fundamentals,* Dover Publishers, New York, 2013.
8. Daryl Logan, *A First course in Finite Element Method*, Thomson Learning, 2012.
9. Saeed Moaveni, *Finite Element Analysis-3rd edition*, Pearson Education, 2007.
10. Chandrupatla T. R. and A. D. Belagundu, *Introduction to Finite Elements in Engineering*, Pearson Education, 2012.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Students successfully completing this course are expected to have basic knowledge in computer aided design, capability to prepare fundamental graphics algorithms and solve basic structural problems using finite element method.

13.604 HEAT AND MASS TRANSFER (MSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems,*
- *To apply analytical and numerical methods to solve conduction problems.*
- *To combine thermodynamics and fluid mechanics principles to analyze heat convection processes.*
- *To provide useful information concerning the performance and design complex heat transfer applications, such as heat exchangers and fins*
- *To integrate radiation aspects into real-world global heat transfer problems.*

Module – I

Modes of Heat Transfer: Conduction: Fourier law of heat conduction-Thermal conductivity of solids, liquids and gases-Factors affecting thermal conductivity- Most general heat conduction equation in Cartesian, cylindrical and spherical coordinates One dimensional steady state conduction with and without heat generation conduction through plane walls, cylinders and spheres-variable thermal conductivity conduction shape factor- heat transfer through corners and edges. Transient heat conduction-lumped heat capacity method. Critical radius of insulation.

Module – II

Elementary ideas of hydrodynamics and thermal boundary layers-Thickness of Boundary layer-Displacement, Momentum and Energy thickness (description only).

Convection heat transfer: Newton's law of cooling- Laminar and Turbulent flow, Reynold's Number, Critical Reynold's Number, Prandtl Number, Nusselt Number, Grashoff's Number and Rayleigh's Number. Dimensional analysis Buckingham's Pi theorem- Application of dimensional analysis to free and forced convection- empirical relations- problems using empirical relations.

Module – III

Combined conduction and convection heat transfer-Overall heat transfer coefficient - Heat exchangers: Types of heat exchangers, AMTD, Fouling factor, Analysis of Heat exchangers-LMTD method, Correction factor, Effectiveness- NTU method, Special type of heat exchangers (condenser and evaporator, simple problems only)

Fins: Types of fins - Heat transfer from fins of uniform cross sectional area- Fin efficiency and effectiveness. Boiling and condensation heat transfer (elementary ideas only).

Introduction to heat pipe.

Module – IV

Radiation- Nature of thermal radiation-definitions and concepts- monochromatic and total emissive power-Intensity of radiation- solid angle- absorptivity, reflectivity and transmissivity-Concept of black body- Planck' law- Kirchoff's law- Wein's displacement law- Stefan Boltzmann's law- black, gray and real surfaces-Configuration factor (derivation for simple geometries only)- Electrical analogy- Heat exchange between black/gray surfaces- infinite parallel plates, equal and parallel opposite plates-perpendicular rectangles having common edge- parallel discs (simple problems using charts and tables). Radiation shields (no derivation).

Mass Transfer :Mass transfer by molecular diffusion- Fick's law of diffusion- diffusion coefficient Steady state diffusion of gases and liquids through solid- equimolar diffusion, Isothermal evaporation of water through air- simple problems.

Convective mass transfer- Evaluation of mass transfer coefficient- empirical relations- simple problems- analogy between heat and mass transfer.

Data book: *Heat and Mass Transfer Data Book*: Kothandaraman C.P. and S. Subramanya, New age International Publishers.

References:

1. Yunus A Cengel, *Heat Transfer: A Practical Approach*, Tata McGraw Hill Inc., 2003.
2. Holman J P, *Heat Transfer*, McGraw Hill Inc., New York, 2007.
3. Incropera F. P. and D. P. Dewitt, *Heat and Mass Transfer*. John Wiley and sons, 2006.
4. Rajput R.K., *Heat and Mass Transfer*, S.Chand & Co, 2014.
5. Kothandaraman C P, *Fundamentals of Heat and Mass Transfer*, Second Edition, New Age International Publishers, 2010.
6. Sachdeva R C, *Fundamentals of Engineering Heat and Mass Transfer*, New Age Science Limited, 2009.
7. Nag P K., *Heat and Mass Transfer*, Tata McGraw Hill Publishing Company, 2002.
8. Venketashan S.P., *Heat Transfer*, Ane books, 2011.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved data book is permitted in the examination hall.*

Course Outcome:

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

- *understand the basic laws of heat transfer.*
- *apply principles of heat and mass transfer to basic engineering systems*
- *demonstrate general knowledge of heat transfer [conduction, convection, radiation], and general knowledge of mass transfer [molecular diffusion, convection].*
- *analyse the performance and design of heat exchangers.*
- *design heat and mass transfer processes and equipment.*

13.605 DESIGN OF MACHINE ELEMENTS – I (M)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits:** 4

Course Objectives:

To provide basic knowledge on the design considerations and methodology of various machine elements.

Module – I

Design principles – different phases in design cycle; common engineering materials, properties and selection. Stresses in machine parts -Tension, compression and shear; factor of safety; stress concentration. Theories of failure –Guest's theory – Rankine's theory – St. Venant's theory – Haigh's theory – Von Mises & Hencky theory. Design for fatigue loading – endurance limit stress- Factors affecting endurance limit –fatigue stress concentration factor, notch sensitivity; Combined steady and variable stress- Gerber, Goodman & Soderberg method and Modified Goodman method.

Module – II

Shafts design- stresses in shafts- causes of failure in shafts - design based on strength and rigidity, design for static and fatigue loads- repeated loading- reversed bending and steady torsion. Bolted joints, preloading of bolts. Design of couplings- rigid and flexible couplings- design of keys, pins and cotters.

Module – III

Riveted joints – types of rivets- stresses in riveted joints - strength analysis - boiler joints - structural joints-eccentric loading. Welded joints- types of joints- strength of welds -fillet welds- stress concentration in welded joints- eccentric loading.

Module – IV

Springs- classification, stresses and deflection of helical springs with axial loading – curvature effect – resilience – Design of springs for static and fatigue loading- surging- stress analysis and design of leaf springs- nipping.

Design Data hand book

1. Design data Book -K. Mahadevan – C.B.S Pub.
2. P.S.G., Tech., *Machine Design Data Handbook*

References:

1. Shigley J. E., *Mechanical Engineering Design*, McGraw Hill Book Company, 2014.
2. Bhandari V. B., *Design of Machine Elements,* Tata McGraw Hill, 2010.
3. Gope P. C., *Machine Design- Fundamentals and Applications,* Prentice Hall, 2012.

4. Spotts M. F. And T. E. Shoup, *Design of Machine Elements*, Pearson Education, 2006.
5. Siegel, Maleev and Hartman, *Mechanical Design of Machines*, International Book Company, 1965.
6. Phelan R. M., *Fundamentals of Mechanical Design,* Tata McGraw Hill, 1975.
7. Doughtie V. L., and A.V. Vallance, *Design of Machine Elements*, McGraw Hill, 1964.
8. Juvinall R. C. and K.M. Marshek, *Fundamentals of Machine Component Design,* John Wiley, 2011.
9. Robert L Norton. *Machine Design*, Prentice Hall India, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved data book is permitted in the examination hall.*

Course Outcome:

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

- *demonstrate the fundamentals of stress analysis and theories of failure in the design of machine components.*
- *make proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components.*

13.606.1 ARTIFICIAL INTELLIGENCE SYSTEMS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the importance of artificial intelligence in the current scenario*
- *To provide brief idea about various languages, logical ideas in LISP and streams*
- *To implement the technology of AIS in planning and production systems*

Module – I

Definition - history and applications - propositional calculus – predicate calculus - inference rules - structures and strategies for state space search - heuristic search algorithms - heuristics in games - complexity issues – control and implementation of state space search - production systems - planning - the blackboard architecture.

Module – II

Knowledge intensive problem solving - expert system technology - rule-based expert systems - model based reasoning - case based reasoning – knowledge representation problem - reasoning with uncertain or incomplete information - statistical approach - non-monotonic systems - fuzzy sets – knowledge representation.

Module – III

Languages - issues - network representation – conceptual graphs - structured representation Languages and programming techniques for AI - overview of LISP - search - higher order functions and procedural abstractions - search strategies - pattern matching - recursion - interpreters.

Module – IV

Logic programming in LISP - streams and delayed evaluation - expert system shell in LISP – network representations and inheritance – CLOS Introduction to understanding natural language - introduction to automated reasoning - introduction to machine learning.

References

1. Luger G.F. and W.A. Stubblefield, *Artificial Intelligence*, Addison Wesley, 1998.
2. Nilsson N. J., *Artificial Intelligence - A New Synthesis*, Harcourt Asia Pvt. Ltd., 2008.
3. Rich E. and K. Knight, *Artificial Intelligence*, Tata McGraw Hill, 2000.
4. Tanimotto S. L., *The Elements of Artificial Intelligence*, Computer Science Press, 1987.
5. Winston P.H., *LISP*, Addison Wesley, 1989.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able:

- *To know about the uses and applications of AIS.*
- *To understand the issues and solutions about AI languages.*
- *To understand the fuzzy sets, reasoning techniques and pattern matching.*

13.606.2 MECHANICAL WORKING METHODS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To impart an idea about various mechanical working methods, their design, uses and problems encountered*
- *To create a skill in selecting appropriate working methods as per design requirement.*
- *To identify the relative advantages, disadvantages in selecting a machining process.*

Module – I

Introduction : Elements of mechanical processing systems – Definition of mechanical working – Hot and cold working – Comparison with other processing systems .Elastic and plastic behaviour – Yielding and yield stress – Conventional stress– Strain curve and true stress-strain curve – Ductile and brittle behaviour –The flow curve. Energy and power requirements in plastic deformation –Factors affecting plastic deformation.– Deformation temperature – Rate of deformation – Friction and Lubrication. Need for preheating- Need for heat treatments after mechanical working –Heat treatment methods – Furnaces for pre heating and heat treatment.

Module – II

Materials for mechanical working - A brief survey of the characteristics and composition of the common ferrous and nonferrous alloys and nonmetallic materials used for mechanical working.

Rolling Metals – Fundamental principles of metal rolling classification of rolled products, types and sizes –Basic principles of draughting schedule design and roll pass design (simple examples) Roll load and power required in rolling – Problems encountered and defects in rolling practice.

Module – III

Forging, Extrusion and Wire drawing – Principles of product design and die design in forging – Calculation of forging loads and selection of hammers and process for forging – Design of extrusion and wire – drawing dies –Computation of power requirements problems encountered and defects in the above processes.

Module – IV

Press working of metals – Description and classification of the processes –Product and die design for shearing, blanking drawing and bending –Compound and progressive dies – Computation of capacities and tonnage requirements for blanking, piercing and drawing operations – Process selection and selection of process problems and defects in press working.

References

1. Campbell, *Principles of Manufacturing Materials and Processing*, McGraw Hill, 1984.
2. Alexander Brower, *Manufacturing properties of Materials*.
3. Cole C. B., *Tool Design*.
4. ASTME, *Fundamentals of Tool Design*, Fifth edition, 2010.
5. Richard Little, Metal Working Technology, McGraw-hills, 1977.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the features of different mechanical working methods*
- *To get sufficient knowledge in hot and cold working, rolling, forging, extrusion and wire drawing and press working*
- *To design and develop elements of mechanical processing systems.*

13.606.3 SYSTEM MODELING & SIMULATION (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce different system modelling and simulation techniques.*
- *To illustrate about analytical models, random number generations, validation of models and simulation software.*
- *To provide a brief idea about simulation languages, alternative modelling and simulators.*

Module – I

System concepts - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling - types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation – examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views.

Module – II

Random number generation - techniques for generating random numbers - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chisquare test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - Input modelling for simulation - data collection -identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity.

Module – III

Validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis, .Measures of performance and their estimation - output analysis for terminating simulations - confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - output analysis for steady-state simulations - initialization bias - replication method - sample size determination for a specified precision - batch means method.

Module – IV

Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems – simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS)

and simulation language for alternative modelling (SLAM) - salient features of simulators such as WITNESS and ARENA.

References

1. Banks J., J.S. Carson and B.L. Nelson, *Discrete-Event System Simulation*, Prentice Hall of India Private Limited, Fifth edition, 2009.
2. Askin R.G. and C.R. Standridge, *Modelling and Analysis of Manufacturing Systems*, John Wiley, 1993
3. Deo N., *System Simulation with Digital Computer*, Prentice-Hall of India, 1978.
4. Gordon G., *System Simulation*, Prentice Hall of India, 2/e, 1989.
5. Law A.W. and W.D. Kelton, *Simulation Modelling and Analysis*, 3/e, McGraw Hill International Editions, 2014.
6. Kelton W. D., R. P. Sadowski and D. A. Sadowski, *Simulation with ARENA*, WCB/McGraw Hill International Editions, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the principles, uses and applications of modeling and simulations.*
- *To get an overall idea about GPSS, SLAM, WITNESS and ARENA.*
- *To develop simulation software for manufacturing applications.*

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13.606.4 MATERIALS HANDLING (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To aware about the significance of material handling in production industry*
- *To learn the basics of material handling techniques and how they can be effectively and efficiently used to support facility objectives.*
- *To understand the underlying mechanisms to design, and develop material handling devices.*

Module – I

Importance of Materials Handling- Principles of Materials Handling – Principal groups of Materials handling equipment – General characteristics and applications of materials handling equipment – Modern trends in Materials handling.

Lifting equipment – hoist –Components of hoist – Load handling attachments – hooks , grabs and clamps – Grabbing attachments for bulk materials – Wire ropes – and chains.

Module – II

Lifting tackle pulleys for gain of force and speed – Tension in drop parts –Drums , shears and sprockets - Arresting gear and brakes – block brakes , band brakes , thrust brakes – Safety and hand cranks .Principle operation of EOT , Gantry and jib cranes – Hoisting Mechanisms , travelling mechanisms , lifting mechanisms – slewing mechanisms – Elevators and lifts.

Module – III

Conveying Machines - Belt conveyers – Types , principal components of a conveyor and their purpose – Conveyor belts – tractive elements – take up devices – Special types of belt conveyors - Metal belt conveyors – Apron conveyors – Elevators , Passenger conveyors – Flight conveyors , Principal types and applications – Bucket flight conveyors – Cradle conveyors – Conveyor elevators.

Module – IV

Overhead Conveyors – Principal types and applications – Overhead pusher conveyor Overhead load towing truck conveyors – Load carrying car conveyors – Load towing and walking beam conveyors – Bucket elevators – Cradle conveyors – Screw conveyors - Oscillating conveyors – Roller conveyors – Hydraulic and pneumatic conveyors – Chutes – bins.

References

1. Rudanko, *Material Handling Equipment*. Mir Publishers, 1969.
2. Alexandr V, *Material Handling Equipment*, Mir Publishers 1989.
3. Spivakvsky A. and V. Dyachkov, *Conveying Machines,* Peace Publishers, 1989.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To effectively design and analyze material handling devices.*
- *To describe the safe work practices utilizing various types of hoisting and conveying equipment.*
- *To identify industry regulations necessary for material handling operations*

13.606.5 TOTAL QUALITY MANAGEMENT (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in various business organizations.*
- *To introduce about TQM principles, customer orientation and management tools.*
- *To provide an idea about quality standards.*

Module – I

Introduction to the concept of quality - Small 'q' & Big 'Q'- Total quality mode– internal and external customer -TQM axioms Quality management philosophies: Major contributions of Deming, Juran and Cross by to quality management- Juran Trilogy, PDCA Cycle, 5S, Kaizen – Cost of quality, quality and cost-Characteristics of quality cost - Barriers to TQM Implementation.

Module – II

TQM Principles-Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation. Quality planning: SWOT analysis-Strategic planning-strategic grid-organizational culture.

Module – III

Customer orientation: Customer focus-customer satisfaction model-customer retention model-Quality Function Deployment, Problem solving process: Steps involved in problem solving-Quality control tools: Brain storming-Histograms-Check sheets- Pareto diagram-Ishikawa diagram-Control charts-Scatter diagram.

Module – IV

Introduction to seven new management tools. Continuous improvement strategies: Deming wheel- Zero defect concept- Six sigma approach – application of six sigma approach to various industrial situations. Quality circles- Benchmarking- Quality standards – Need of standardization - ISO 9000 series – ISO 14000 series – Other contemporary standards.

References

1. Dale H. Besterfiled, *et al*., *Total Quality Management*, Pearson Education, Inc., 2003, (Indian reprint 2004).

2. Suganthi L. and A. A. Samuel, *Total Quality Management*, Third edition, Prentice Hall of India New Delhi.
3. Sridhara Bhat K., *Total Quality Management -Text and Cases*, Himalaya Publishing House, 2010.
4. James R. Evans and William M. Lidsay, *The Management and Control of Quality*, (5th Edition), South-Western (Thomson Learning), 2002.
5. Feigenbaum A. V., *Total Quality Management*, McGraw-Hill, 1991.
6. Oakland.J.S., *Total Quality Management*, Butterworth Heinemann Ltd., Oxford, 1989.
7. Narayana V. and Sreenivasan, *N.S. Quality Management – Concepts and Tasks*, New Age International, 1996.
8. M Zairi., *Total Quality Management for Engineers*, Wood Head Publishers,1991.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To know the principles of total quality management and peculiarities of their implementation.*
- *To be able to use quality management methods analyzing and solving problems of organization.*
- *To know business excellence models and be able to assess organization's performance making reference to their criteria.*

13.606.6 ADVANCED MANUFACTURING PROCESSES (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide an idea about the advanced machining theory and practice techniques used in industry.*
- *To develop an ability to look for the unconventional manufacturing process to machine the objects*
- *To understand appreciate the latest manufacturing process in fabrication.*

Module – I

Advances in casting: Newer casting processes - plaster mould and ceramic mould casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming-Rapid solidification for Amorphous alloys. Powder metallurgy processes: Methods of Powder production – Blending of metal powders- Compaction of metal powders- Sintering – hot pressing – Isostatic pressing – hot and cold (HIP and CIP), selective laser Sintering.

Module – II

Other shaping processes – Metal Injection moulding, pressure less compaction, ceramic moulds – spray deposition - Finishing of sintered parts. Manufacturing processes for plastics: Extrusion, Injection, Blow and rotational moulding of plastics-Thermoforming-Compression moulding – Transfer moulding – Foam moulding.

Module – III

Processing of reinforced plastics and composite –Moulding – compression, vacuum bag – contact – resin transfer – transfer / injection. Filament winding. Rapid prototyping and rapid tooling: Introduction – Stereo lithography – Fused deposition moulding – selective laser machining – Laminated object manufacturing – solid base curing – Direct manufacturing and rapid tooling.

Module – IV

Manufacturing processes for MEMS: Introduction to MEMS – semiconductors and silicon – crystal growing and wafer preparation –Films and film deposition – Oxidation- Lithography-diffusion and Ion implementation – Etching – wet etching – dry etching – wire bonding and packaging – printed circuit boards – Micro machining – Bulk micro machining – surface micro machining- Single crystal silicon reactive etching (SCREAM) - silicon micro machining by single step plasma etching (SIMPLE) – Etching combined with fusion bonding – LIGA micro fabrication process – Solid free form fabrication.

References

1. Serope Kalpakjian, Steven R. Schemid, *Manufacturing processes for Engineering Materials*, Fourth edition, Pearson Education, 2003.
2. Serope Kalpakjian, *Manufacturing Engineering and Technology*, Third Edition-Addison-Wesley Publication Co., 1995.
3. Brahem.T.Smith, *Advanced machining*, I.F.S., U.K., 1989.
4. Amstead B. H., Ostwald Phylips and R.L. Bageman, *Manufacturing Processes*, John Wileys Sons, 1987.
5. Muccic E. A., *Plastic Processing Technology*, Materials Park, OHIO, ASM Int., 1994.
6. Jaeger R. C., *Introduction to microelectronic Fabrication*, Addison-Wesley, 1988.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To learn the art of manufacturing new products due to the development of new materials and process.*
- *To select suitable process while fabricating new machine parts.*
- *To get information in SCREAM, SIMPLE, LIGA process*.

13.606.7 MATERIAL CHARACTERISATION (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide basic descriptions of a range of common characterization methods for the determination of the structure and composition of solids.*
- *To introduce the Scope of optical metallographic studies.*
- *To understand the major components of material characterization essential to the understanding of the physical properties of solids.*

Module – I

Scope of metallographic studies in materials science. Understanding image formation, resolution of a microscope, numerical aperture, magnification, depth of field and depth of focus. Important lens defects and their correction, principles of phase contrast. Bright field and dark field contrast, sample preparation. Optical microscopy, interference and polarized light microscopy, quantitative analysis using optical microscopy (inclusion analysis, grain size determination volume fraction of phases etc.).

Module – II

Production and properties of X-rays, X-ray diffraction, Bragg's law of diffraction, Scattering of an electron by an atom, by a unit cell, structure factor and intensity calculations. Stereographic projection, Effect of texture, particle size, micro and macro strain on diffraction lines. Indexing of powder photographs. Chemical analysis by X-rays, Stress measurement, Particle size determination.

Module – III

Construction and working principles of transmission electron microscopes. Image formation, resolving power, magnification, depth of focus, elementary treatment of image contrast. Bright field and dark field images, sample preparation techniques. Selected area diffraction, reciprocal lattice and Ewald sphere construction, indexing of selected area diffraction patterns.

Module – IV

Scanning electron microscopy: construction; interaction of electrons with matter, modes of operation, image formation, resolution and magnification. Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy.

References

1. Gifkins R.C., *Optical Microscopy of Metals*, Sir Isaac Pitman and Sons LTD, 1970.
2. Cullity B.D., *Elements of X-Ray Diffraction,* Addison Wesley, 1978.

3. Williams D.B. and C. Barry Carter, *Transmission Electron Microscopy,* Planum Press New York, 1996.
4. Goodhew P.J., J. Humphreys and R. Beanland, *Electron Microscopy and Analysis*, Taylor and Francis, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand microstructure investigations using optical microscopes.*
- *To explain construction of working principles of electron microscopes.*
- *To gain knowledge on different types of analyses using XRD.*

13.606.8 MICROMACHINING METHODS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get an overview of various techniques used for machining in the micro scale.*
- *To understand the theory of micromachining.*
- *To give an introduction about various applications of MEMS.*

Module – I

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport –feedback systems. Micromechanics: Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials.

Module – II

Micro-fabrication: Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining- Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer devices.

Module – III

Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining- microturning, micromilling, microdrilling - Micromachining tool design. Precision Grinding-Partial ductile mode grinding- Ultraprecision grinding- Binderless wheel – Free form optics.

Module – IV

Micro electro mechanical system fabrication: Introduction – Advance in Microelectronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

References

1. Sámi Franssila, *Introduction to Micro Fabrication*, John Wiley and Sons, UK, 2004.

2. Madore J., *Fundamental of Micro Fabrication*, CRC Press, 2002.
3. Mark J. Jackson, *Micro fabrication and Nanomanufacturing*, CRC Press, 2006.
4. Peter Van Zant, *Microchip fabrication*, McGraw Hill, 2004.
5. Mohamed Gad-el-Hak, *The MEMS Handbook,* CRC Press, 2006

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To gain knowledge on the structure of materials in the micro scale.*
- *To explain various micro machining processes and to differentiate its uses.*
- *To do micro machining tool design.*

13.606.9 NEW ENERGY SYSTEMS (MP) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide an overview of various energy sources and its applications.*
- *To aware about the need of newer energy sources to meet the extending demands.*
- *To understand the theories and principles behind various energy systems.*

Module – I

Direct Energy Conversion Systems: Basic principles of thermoelectric and thermionic generations- Thermoelectric effects- Design and selection of materials. Principle of MHD Generators – Choice of generator parameters –Applications. Fuel cells- Thermodynamics of fuel cells- Selection of fuel and operating conditions- Practical fuel cells – The Redox cell- Merits and demerits. Photoelectric conversion – Conceptual Description of photovoltaic effect – Solar cell – Materials and prospects.

Module – II

Nuclear fusion- Fusion fuels and reactions- Sustained fusion reaction- Production and containment of plasma – Fusion – breeder concept. Solar energy – Terms and definitions- Applications- Solar collectors and Concentrations- performance analysis of flat plate collectors- Solar thermal devices – Solar power generation- Thermal storage.

Module – III

Ocean Power-Resources- Principle of OTEC systems- Ocean wave energy conversion systems- Tidal power Wind Energy- Fundamentals and Applications- Wind turbine-generator systems- Wind forms- Solar – wind hybrid.

Module – IV

Geothermal Energy- Energy resources – Geothermal electrical power plants –Non-electric applications- Biogas energy- Principle of biogas production-Biogas plants- Design and construction- socio- economic relevance. Hydrogen- Introduction and Applications- Production, Storage and Transportation – production and application of methanol.

References

1. Coobme R. A., *An Introduction to Direct Energy Conversion,* Isaac Pitman & Son Ltd., 1968.
2. Sheldon S. L. Chang, *Energy Conversion*, Prentice Hall Inc., 1964.
3. Rao and Parulekar, *Energy Technology*, Khanna Publishers, 2009.

4. Rai G. D., *Non- Conventional Energy Sources*, Khanna Publishers, 2005.
5. Duff Ice and Beckman, *Solar Energy Thermal Processes*, John Wiley & Sons, New York, 1974.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To explain the use of newer energy sources and their applications.*
- *To design and develop various bio-gas plants.*
- *To understand the various practical fuel cells.*

13.606.10 OBJECT ORIENTED PROGRAMMING (MP) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To develop an understanding of the principles underpinning object oriented programming.*
- *To apply object-based approaches for programming.*
- *To understand the essential features of an object oriented programming language.*

Module – I

OOPS and Java basics - Java virtual machine - Java platform API – extended security model - applet classes - exceptions and abstract classes – Java applet writing basics - GUI building with canvas - applet security – creating window applications - writing console applications - utility and math packages.

Module – II

Swing programming - working with swing components - using the clipboard - input/output streams - printing - working with 2D and 3D Graphics – using audio and video - creating animations Java beans development kit - developing beans - notable beans.

Module – III

Network programming - client and server Programs - naming and directory services - working with Java management APIS Distributed application architecture - CORBA - RMI and distributed applications.

Module – IV

Working with remote objects - object serialization and Java spaces - Java IDL and ORBs, connecting to database - using JDBC - integrating database - support into web applications - Java servlets - JSDK - JAR files - Java native interface.

References

1. Campione, Walrath and Huml Tutorial team, *The Java Tutorial Continued: The Rest of the JDK*, Addison Wesley, 1998
2. Jamie Jaworski, *Java 2 Platform Unleashed: The Comprehensive, Solution*, SAMS Teachmedia,1999
3. Holzner S., *Java 2, Swings, Servlets, JDBC & Java Beans Programming*, IDG Books, 1998.

4. Campione M. and K. Walrath, *The Java Tutorial: Object-Oriented Programming for the Internet*, Addison Wesley,1998
5. Naughton Patrick and Herbert Schildt, Java 2:1998.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To produce class diagrams, object interaction diagrams and object state transition diagrams for a given problem.*
- *To produce and/or debug code fragments that illustrate principles of object oriented software development.*
- *To evaluate the quality of programs according to object oriented principles.*

13.606.11 NUCLEAR ENGINEERING (MP) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To explore the engineering design of nuclear power plants using the basic principles of reactor physics, thermodynamics, fluid flow and heat transfer.*
- *To provide an overview on reactor principles, nuclear safety, and reactor dynamic behaviour.*
- *To explain the standards of radiation protection and need for nuclear waste disposal.*

Module – I

Review of Elementary nuclear physics: Atomic structure – nuclear energy and nuclear forces – Nuclear fission. Nuclear reactions and radiations – Principles of radioactive decay interactions of an ray with matter – Neutron cross sections and reactions –The fission process – Chain reactions – Basic principles of controlled fusion .Nuclear reactor principles – Reactor classification – Critical size.

Module – II

Basic diffusion theory - Slowing down of neutrons – Neutrons – Neutron flux and power – Four factor formula – Criticality condition – Basic features of reactor control. Boiling water reactor. Description of reactor system – Main components –Control and safety features .Materials of reactor construction – Fuel, moderator, coolant.

Module – III

Structural materials – Cladding –Radiation damage, Nuclear fuels: Metallurgy of Uranium – General principles of solvent extraction – Reprocessing of irradiated fuel – Separation process fuel enrichment.

Module – IV

Reactor heat removal / equations of heat transfer as applied to reactor cooling– Reactor heat transfer systems – Heat removed in fast reactors.

Radiation safety: Reactor shielding – Radiation dozes – Standards of radiation protection – Nuclear waste disposal.

References

1. Glasstone S. and A. Sesonske, *Nuclear Reactor Engineering*, Van Nostrand Co., 1967.
2. Glasstono S., *Source Book on Atomic Energy*, Van Nostrand Co., 1967.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the theories and principles behind the nuclear engineering.*
- *To understand the heat removal techniques applied to reactor heat transfer systems.*
- *To acquire knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.*

13.606.12 INSTRUMENTATION AND CONTROL (MP) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide an overview of different types of measurement systems.*
- *To introduce various measuring devices for temperature, pressure and flow and the transducers used.*
- *To explain the need, design techniques and importance of control systems.*

Module – I

Measurement: Aims- Fundamental methods- Measurement systems-Functions of Instrument- Static and dynamic Measurements, Terminology, Time element, Errors in measuring Instruments, Sources of error, Error distribution- Sensing element: Types- Sensors for motion- Angular motion, Speed, Force, Electrical transformation, Simple transducer elements- Types of transducers- Voltage and current generating Analog type, Variable parameter Analog type, Frequency and pulse generating transducers- Specification for transducers.

Module – II

Measurement of Temperature- Temperature scales, Basic fixed point, ITS scale - Measuring devices and their ranges- Electrical type and mechanical type- Measuring system for resistance thermometers and Thermocouples- Bridge circuits- Calibration- Filled system thermometers- Ambient temperature compensation-Measurement of pressure- Force balance principles- Deformation of elastic members- Ring balance – Impulse line layout- Calibration Low pressure measuring devices. Measurement of flow.

Module – III

Head flow meters- Primary elements – Secondary elements- Float manometers- squire root extraction- Flow transducers- Area flow meters- Rotameter- Measurements of liquid level- Direct methods- Inferential methods- Boiler drum- Level indicator. Introduction to Data Acquisition System- Concept of virtual instrumentation.

Module – IV

Control system- Classification of control system- Block diagram- Rule of Block diagram algebra- Transfer functions, Set point- Identification of plat, Characteristics- First order proportional and second order proportional elements- Dynamic response – Analogues circuits stability of control systems- Routh – Hurwitz criterion- Nyquist criterion.

References

1. Jain R.K., *Mechanical and Industrial Measurements*, Khanna Publishers, 1988.
2. Considine D. M., *Process Instrument and Control Hand Book*, McGraw Hill, 1999.
3. Doeblin E. O., *Measurements System*, *Application and Design*, 5/e, McGraw Hill, 2004.
4. Pribanco A.E., *Industrial Instrumentation*.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the functions of instrumentations and its various types.*
- *To select suitable measuring devices depending upon the nature of measurement.*
- *To draw the control system block diagrams and able to check the stability of the control systems.*

13.606.13 PRECISION ENGINEERING (MP) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide an overview of micro manufacturing process and lithography.*
- *To introduce principles applied to precision engineering systems, including: accuracy, errors ,spindle accuracy and advanced CNC systems.*
- *To introduce various micro systems.*

Module – I

Concept of accuracy and of machine tools: Part accuracy–errors, accuracy of machine tools-spindle accuracy- displacement accuracy-errors due to numerical interpolation-definition of accuracy of NC system-errors in the NC machines-feed stiffness-zero stability.

Module – II

Static stiffness and its influence and inaccuracy due to thermal effects in the machine tools: Overall stiffness of a lathe-compliance of work piece-errors caused by cutting forces deformation in turning-boring-milling-heat sources thermal effects-rate of thermal expansion. Dimensioning accuracy and surface finish: Definition of terms – dimensional chains – dimensional stepped shaft-assigning tolerances in the constituent dimensions-dimensional chains – concepts of precision machining-finish turning-boring-grinding.

Module – III

Micro manufacturing process: Micro machining-photo resist process lithography- optical. Processing of materials-electron beam machining-iron beam machining-micro forming, diamond turning-micro positioning devices.

Module – IV

Smart structures, materials 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.

References

1. Murthy R.L. *Precision Engineering in Manufacturing*, New Age International, 2005
2. Norio Tanigughi, *Nano Technology*, Oxford University Press, 1996.
3. Stephen A. Campbell, *The Science and Engineering of Micro Electronic Fabrication*, Oxford University Press, 1996.

4. Randy Frank, *Understanding Smart Sensors*, Artech House, Boston, 1996.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the accuracy-errors in NC systems.*
- *To use and understand the various micro manufacturing process.*
- *To know the different and micro systems and their applications.*

13.606.14 TOOL ENGINEERING (M) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To build the fundamental knowledge and skills for tool design especially Jigs and Fixtures, cutting tools and Press Tools.*
- *To analyse the use of CAD/CAM in tool engineering applications.*

Module – I

Significance and purpose of jigs and fixtures and their functions in manufacturing processes. Classifications of jigs and fixtures. Designs features of main elements of Jigs and fixtures such as locating, Clamping and guiding elements and their integrations. Indexing, locking and auxiliary elements. Swarf disposal methods. Bodies and bases or frames of Jigs and fixtures. Economics of Jigs and fixtures, Pneumatics & Hydraulics for jigs & fixtures.

Module – II

Work holding devices for flat, round and irregular surface, - Design of drill jigs, bush specifications. Fixture for lathe operations, milling, broaching and welding fixtures, Fixtures for CNC machines, Analysis of number of clamping forces required & their magnitude, concept of modular fixtures & tool presetting fixtures.

Module – III

Press work tools, blanking and piercing tools, load variation during blanking-Calculation of press tonnage for blanking and piercing. Types of dies, simple, compound, combination and progressive dies. Design of compound and progressive dies. Bending and drawing dies: Bending allowances, bending methods. Bending pressure-calculation of blank size and press tonnage for drawing, metal flow during drawing operations. Fine blanking, Embossing and Coining.

Module – IV

Tool for forging, Design of drop forging dies- Rolling, strip rolling theory, stress distribution in rolling, Roll separation force and torque. Forces acting on single point and multiple point cutting tools. CAD for tooling: Turret press FMS-Computer applications (CAD / CAM) in short metal press work – Quick die change method – Single minute exchange of dies- group tooling –Design of single point tools – Plastic as a tooling materials – Fluidized bed fixturing.

References

1. Donaldson C., *Tool Design*, Tata McGraw Hill, 2012.
2. Cole G.B., *Tool Design,* 1985.

3. ASTME, *Die Design Hand Book,* Third Edition.
4. Jigs and Fixtures – Calving-Hoose,2004
5. William and Boyles, *Jig and Fixture Design Hand Book,* 1989.
6. ASTME and Edward G. Hoffman, *Fundamentals of Tool Design,* Society of Manufacturing Engineers, 2003.
7. Koraskove V., *Fundamentals of Fixture Design* Mir, 2008.
3. *Metal Hand Book*- ASM, 1993.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To select proper tool for a given manufacturing operation.*
- *To select and design jig and fixture and to select a die for a given simple component.*
- *To classify and explain various press tools and press tools operations.*

13.607 COMPUTER AIDED MODELING AND ANALYSIS LAB. (MPU)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective:

- *To train the students in Solid Modelling and Assembly of machine parts.*
- *To practice finite element approach in the design of engineering systems.*

PART: A – MODELLING & ASSEMBLY

Introduction to various modelling and assembly tools in CAD software. Exercise on the creation of solid models. Exercise on the creation of assembled models of riveted joints, cotter joints, shaft couplings and machine parts

PART: B - FINITE ELEMENT ANALYSIS

Introduction to pre-processing and post processing tools in finite element software. Exercise on the application of Finite Element Method to Engineering systems:-

(1) Structural Analysis

(2) Thermal Analysis

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

The question paper shall consist of 2 parts.

PART- I : 50 Marks from Part-A

PART -II : 30 Marks from Part-B

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, students shall be able to understand various phases in engineering design process through modelling, assembly and finite element analysis.

13 .608 MACHINE TOOLS LAB (M)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective :

- *To acquaint with milling machines, grinding machines and drilling machines and to impart training on these machines.*
- *To acquaint with CNC machines and to impart training on these machines.*
- *To introduce the students to various welding techniques.*

List of Experiments:

1. Study of Milling Machines (Universal Milling Machine & Vertical Milling Machine, parts and accessories)
2. Study of different types of Milling Cutters
3. Study of Grinding machines (Surface and Cylindrical grinding machines) & grinding wheel nomenclature
4. Study of radial drilling machine.
5. Study of CNC machines, important CNC codes, programming & simulation.
6. Exercises on Milling machines (face milling, end milling, spur and helical gear cutting, milling of keyways).
7. Exercise on Surface Grinding Machine & Cylindrical Grinding Machine
8. Exercise on drilling machine.
9. Exercises on CNC Lathe: Turning, Taper turning, Thread cutting, Ball and cup turning.
10. Exercises on CNC Milling machine: Surface milling, Pocket milling, Contour milling and Drilling.
11. Study & practice on different welding techniques - Arc welding, Gas welding, TIG welding, MIG welding. (Demonstration only and no University examination)

Note: *Students should do all the exercises mentioned above except serial no.11*

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed.

80% - Procedure, calculations if any, working/machining, accuracy.

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, the students will be familiar with the various operations using milling machines, grinding machines, drilling machines and CNC machines.