SCHEME & SYLLABI

OF

M.TECH.
MANUFACTURING TECHNOLOGY & AUTOMATION

w.e.f. 2016 -2017

DEPARTMENT OF MECHANICAL ENGINEERING

Y.M.C.A. UNIVERSITY OF SCIENCE AND TECHNOLOGY FARIDABAD-121006

VISION

"YMCA University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building."

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Mechanical Engineering

VISION

To be a centre of excellence by producing high calibre, competent and self-reliant mechanical engineers, who possess scientific temperament and would engage in activities relevant to industries with ethical values and flair to research.

MISSION

- To provide efficient engineers for global requirements by imparting quality education.
- To explore, create and develop innovations in various aspects of engineering through industries and institutions.
- To emphasize on practical skills and socially relevant technology.

About the Program of Mechanical Engineering Department

YMCA University of Science & Technology, Faridabad established in 2009, formerly known as YMCA Institute of Engineering, Faridabad, established in year 1969 as a Joint Venture of Govt. of Haryana and National Council of YMCA of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized field of engineering to meet specific technical manpower requirement of industries. Mechanical Engineering Department started in 1969 and has been conducting B.Tech. Course in Mechanical Engineering of 4-Years duration since 1997. Students are admitted through centralized counseling nominated by state govt. in 1st Year and 2nd year through lateral entry entrance test. Besides under graduate degree courses, it is also running M.Tech. Mech. Engg. Course (in specialization of Manufacturing Technology and Automation) and Ph.D. All courses are duly approved by AICTE/ UGC. The Mechanical Engineering Department has been well known for its track record of employment of the pass out students since its inception.

The Department has four storey building with 08 class rooms , 14 laboratory, 03 Workshop , 12 Offices, Seminar Hall and Conference Hall. It has established Centre of Excellence with Danfoss Industries (P) Ltd in the area of Climate and Energy. It has excellent faculty with 10 Professors, 04 Associate Professors and 16 Assistant Professor. At present, 21 faculty members are PhD in various specializations. The various syllabi of UG/PG courses in Mechanical Engineering Department, has been prepared with active participation from Industry. The Department is organizing number of expert lectures from industry experts for students in every semester. Seven month training is mandatory for every B.Tech. student. Emphasis has been given on project work and workshop for skill enhancement of students. Choice based credit system allows students to study the subjects of his/her choice from a number of elective courses /audit courses.

With regards,

Dr M.L.Aggarwal

Chairman (ME)

Programme Educational Objectives (PEOs) (Mechanical Engineering: Manufacturing Technology and Automation):

PEO-1:
Post Graduates will have fundamental technical knowledge and develop analytical skills required for mechanical engineering (manufacturing technology and automation).

PEO-2:
Post Graduates to focus on practical skills and capable of using software and developing program related to core and applied areas of their discipline to expand their knowledge horizon beyond books and to equip them with experimental and industrial practices.

PEO-3:
Post Graduates will have improved team building, team working and leadership skills with high regard for ethical values and social responsivities.

PEO-4:
Post Graduates will create and develop innovations in various aspects of mechanical engineering.

PROGRAMME OUTCOMES (PO) Mechanical Engg.(Mfg. Tech. & Automation)

Engineering programs have been designed to prepare M.Tech. Students for attaining the following program outcomes (PO):

1. an ability to apply knowledge of manufacturing technology and automation in practice for solving complex engineering problems
2. an ability to identify, critically analyze, formulate and solve manufacturing technology and automation problems
3 use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in mechanical engineering
4 an ability to automate a mechanical system and process to meet desired needs within realistic constraints such as health, safety, security and manufacturability
5 an ability to do innovation and incorporation of new research with usage of the techniques, IT skills, and modern engineering tools for various changes in manufacturing engineering practice
6 apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities
7 an ability to understand the impact of mechanical engineering solutions in a contemporary, global, economic, environmental and societal context for sustainable development
8 apply ethical principles and commit to professional ethics and responsibilities and norms of the mechanical engineering practice
9 function affectively as an individual, and as a member or leader in diverse teams
10 an ability to communicate effectively as an individual or as a team leader in manufacturing activities.
11 ability to engage in independent research and lifelong learning in the broadest contest of technological changes in manufacturing technology and automation.
12 an ability to appreciate the importance of goal setting and to recognize the need for life-long reflective learning in mechanical engineering.

PROGRAM SPECIFICOUTCOMES (PSO):

[1] an ability to apply knowledge and skill of various approaches in manufacturing technology and automation, for solving complex engineering problems.
[2] use research based knowledge and research methods including design of experiments, analysis and interpretation of data and IT tools.
[3] an ability to automate a mechanical system or a process to meet desired needs within realistic constraints such as health, safety and manufacturability.

M. Tech (Manufacturing Technology & Automation)
Scheme w.e.f. 2016- 2017

The credit requirements of the course are — Max. Marks: 2400

Total Credits	**:**	**78**	Labs	:	07
Discipline Core Courses (DCC)	:	11	Seminar	:	01
Discipline Elective Courses (DEC)	:	02	Project/ Dissertation (SEC)	:	02
Mandatory Audit Course (AUD)	:	01	Open Elective Course(OEC)	:	01

First Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Category Code
				Internal	External	
M-601-A	Foundry Technology	4-0-0	4	40	60	DCC
M-603-A	Welding & Allied Process	4-0-0	4	40	60	DCC
M-605-A	Mechatronics Product Design	4-0-0	4	40	60	DCC
M-607-A	Design Planning & Control of Production Systems	4-0-0	4	40	60	DCC
M-609-A	Cyber Security	2-0-0	2	20	30	DCC
M-611-A	Welding lab	0-0-2	1	30	20	DCC
M-613-A	Mechatronics Lab	0-0-2	1	30	20	DCC
	Total	**18-0-4**	**20**	**240**	**310**	

Second Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Category Code
				Internal	External	
M-602-A	Metal Cutting Technology	4-0-0	4	40	60	DCC
M-604-A	Automation in Manufacturing	4-0-0	4	40	60	DCC

M-606-A	CAD/CAM	4-0-0	4	40	60	DCC
M-608-A	Discipline Elective Course*	4-0-0	4	40	60	DEC
M-610-A	Mfg./ Metal cutting Lab	0-0-2	1	30	20	DCC
M-612-A	Automation Lab	0-0-2	1	30	20	DCC
M-614-A	CAD/CAM Lab	0-0-2	1	30	20	DCC
M-616-A(AUD)	Mandatory Audit Course*	2-0-0	-			AUD
	Total	**18-0-6**	**19**	**250**	**300**	

Third Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Category Code
				Internal	External	
M-701-A	Computer Integrated Mfg.	4-0-0	4	40	60	DCC
M-703-A	Material Management	4-0-0	4	40	60	DCC
M-705-A	Discipline Elective Course –II*	4-0-0	4	40	60	DEC
M-707-A	Project Management	4-0-0	4	40	60	DCC
M-709-A	Presentation Skill Development	0-0-2	1	30	20	SEC
M-711-A	Project	0-0-12	6	120	80	SEC
M-713-A	CIM Lab	0-0-2	1	30	20	DCC
M-715-A	Open Elective Course*	3-0-0	3	40	60	OEC
	Total	**19-0-16**	**27**	**380**	**420**	

Fourth Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Category Code
				Internal	External	
M-702-A	Dissertation	0-0-24	12	300	200	SEC
	Total	**0-0-24**	**12**	**300**	**200**	

*The student will have to select one subject from list of Discipline Elective Courses, open elective courses and mandatory audit courses.

List of Electives:

Discipline Elective Course -I

M-608-A-1 Industrial Inspection
M-608-A-2 Quality control techniques
M-608-A-3 Design & Metallurgy of welded joints

M-608-A-4 Robotics Engg.
M-608-A-5 Machine Tool Dynamics
M-608-A-6 Finite Element Methods
M-608-A-7 Principle of Management
M 608 -A-8 Supply Chain Management

Discipline Elective Course – II

M-705-A-1 Artificial Intelligence
M-705-A-2 Value Engg.
M-705-A-3 Advanced Theory of Vibrations
M-705-A-4 Total Quality Mgmt.
M-705-A-5 Metal Forming Analysis
M-705-A-6 Mechanical Behavior of Materials

M715 A : Open Elective Course

Courses offered by Computer Engg. Dept

S.No	Code	Name of Subject
1	OEC-1	Intelligent Systems
2	OEC-4	Web Technology and Information Retrieval
3	OEC-5	Intellectual Property and Rights

- Courses offered by Electronics Engg. Deptt.

S.No	Code	Name of Subject
4	OEC-15	Microprocessor and Interfacing
5	OEC-17	Instrumentation and Control

- Courses offered by MBA Dept

S.No	Code	Name of Subject
6	OEC-22	Financial Management
7	OEC-24	Entrepreneur Development

M- 616A(AUD): Mandatory Audit Course

Subject	**Code**
• German -1	AUD-01
• German-2 (with German-1 as prerequisite)	AUD-02
• French -1	AUD-03
• French-2 (with French-1 as prerequisite)	AUD-04
• Sanskrit -1	AUD-05
• Sanskrit-2 (with Sanskrit-1 as prerequisite)	AUD-06

- Personality Development AUD-07
- Interview and Group Discussion Skills AUD-08
- Yoga and Meditation AUD-09
- Art of Living/ Life Skills AUD-10
- Contribution of NSS towards Nation/Role of NSS AUD-11
- Physical Education AUD-12

NOTE FOR THEORY PAPERS:

Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

Grading Scheme(w.e.f. July 2016 onwards)

Marks %	Grade	Grade points	Category
90-100	O	10	Outstanding
80≤marks<90	A+	9	Excellent
70≤marks< 80	A	8	Very good
60≤marks< 70	B+	7	Good
50≤marks< 60	B	6	Above average
45≤marks< 50	C	5	Average
40≤marks< 45	P	4	Pass
<40	F	0	Fail
……	Ab	0	Absent

Percentage calculation= CGPA * 9.5

M-601-A: FOUNDRY TECHNOLOGY

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study the basic concepts regarding design and manufacture of a component by various casting methods. To provide knowledge to the students, on the principles that guides production of sound engineering castings.

Syllabus:

UNIT 1. Introduction to Foundry Technology, Items (Domestic and Engg.) made by foundry technology, Advantage and limitations of foundry technology over the other manufacturing processes

UNIT 2. Castability and factors affecting castability.Ferrous and Non-ferrous casting metals & their alloys and items made of them.Melting furnaces for cast iron, cast steels, aluminium and its alloys, brass and bronze.Pattern: Pattern material, Types of patterns, Pattern allowances, Colour coding system for patterns, Numerical on pattern allowances.

UNIT 3. Moulding: Mould material, properties of moulding sand, Main constituents of moulding sand, Classification of moulding sand, Preparation of moulding sand, Testing of moulding sand, Methods of moulding.

UNIT 4. Core: Introduction, Characteristics of core, Types of core, Core making, Core chaplets, Core print, Core boxes.

UNIT 5. Gating system: Requirements of gating system, elements of gating system, Types of gates, Types of risers, Design and positioning of risers, Calculation of pouring time and solidification time, Casting design considerations, Chills.Solidification of castings.

UNIT 6. Special casting methods: Gravity die casting, Cold chamber die casting, Hot chamber die casting, Investment casting, Centrifugal casting, Shell mould casting, Continuous casting

UNIT 7. Casting defects, their causes and remedies, Fettling of castings,Casting inspection, repair and salvage of castings.Heat treatment of castings, Quality control of castings, Pollution control in foundry, modernisation of foundry.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Design of pattern for a particular component to be manufactured
- Understand the basic composition of various ferrous and non-ferrous metals and their application in casting process
- Choose the appropriate furnace for the production of a particular material

- Design of gating system for a particular component
- Analyse adequate casting method based on quantity, application, mechanical properties and tolerances
- Identify casting defects, understand reasons and recommend remedial measures

Reference Books:

1. Principles of Metal Casting - Richard W. Heine , Carl R. Hoper, Philip C. Rosenthal, Tata McGraw Hill Education
2. Principles of Foundry Technology - P. L. Jain, Tata McGraw-Hill Education
3. Foundry practice - W.H. Salmon and E.N. Simons, Pitman
4. Principles of manufacturing materials and processes - J. S. Campbell, McGraw Hill
5. Materials and processes in manufacturing - E. Paul DeGarmo, J. T. Black, Ronald A. Kohser, John Wiley & Sons
6. A Textbook of Production Technology: Manufacturing Processes - P. C. Sharma, S. Chand publications
NPTEL Video Lecture , Metal Casting ,Web: http://nptel.ac.in/

M-603-A: WELDING PROCESSES AND TECHNOLOGY

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study essential concepts for welding parameters and welding processes. To study various techniques for metal spraying and thermal cutting processes. To study various techniques of welding automation.

Syllabus:

***Unit 1*: Introduction:** Review of welding processes like gas, arc and resistance welding. Weld bead geometry and shape factors, Weld dilution.

***Unit 2*: Welding Power Sources:** Types of power sources, External V-I characteristics for constant current and constant voltage power sources, Rectifiers, Solid-state Rectifiers, Inverter systems, Duty cycle.

***Unit 3*: Arc Welding Consumables and Metal Transfer:** Types of electrodes, AWS and Indian system of classification and coding of covered electrode for mild steel, Shielding gases and associated mixtures. Types of metal transfer, Short circuit/ dip transfer, Free flight, Globular type, Spray type, Forces affecting metal transfer.

***Unit 4*: Arc welding processes:** Electric arc welding principle, MIG: welding equipment and processes, shielding gas, types of metal transfer. Tungsten inert gas arc welding (GTAW): welding equipment, electrodes, inert gases and torches. Submerged arc welding (SAW): principle of processes, applications, fluxes and welding electrodes used. CO_2 welding: Difference from MIG welding, Principle of operation, equipment, welding parameters and applications.

***Unit 5*: Other advanced welding processes:** Introduction, main features and applications of Ultrasonic welding, Friction welding, Explosive welding and Friction Stir welding, Introduction, methods and applications of Underwater Welding.

***Unit 6*: Weldability of specific Materials:** Welding of plastics: Difficulties in welding of Plastics, Processes for welding of Plastics. Welding of Stainless Steel, Aluminum and Cast Iron.

***Unit 7*: Welding Allied Processes:** Surfacing and metal spraying: Surfacing methods such as SMAW, MIG, TIG, SAW. Thermal spraying: Introduction, Procedures, Applications, Advantages and Disadvantages. Thermal cutting of metals: Introduction, types, principle and operation of flame and plasma cutting.

***Unit 8*: Automation in Welding:** Introduction, Semiautomatic welding, Automatic welding, Welding mechanization, Flexible Automated Welding, Robotic welding, Types of Welding Robots, Robot Selection Mechanics, Joint tracking system.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand principles of various traditional and newer welding processes
- Develop concept of welding specific materials such as plastics, stainless steel.
- Develop concept and techniques of welding automation.
- Analyze methods of advanced welding processes like underwater welding.
- Analyze arc welding parameter section and types of metal transfer.
- Understand concept of thermal spraying and thermal cutting of metals.

Reference books:

1. Modern Welding Technology: by Howard B. Cary and Scott C. Helzer, (Pearson Education)
2. Welding and Welding Technology: by R. Little (TMH)
3. Welding Processes and Technology: by R. S. Parmar (Khanna Publishers)
4. AWS- Welding Handbook.

NPTEL Video Lecture ,Web: http://nptel.ac.in, Welding Distortion

M-605-A : MECHATRONICS PRODUCT DESIGN

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study essential concepts of a system model in a mechanical system. To study interfacing of various hardware in mechatronics product design. To incorporate application of electronics and computer engineering in mechanical engineering for enhancing product design values.

Syllabus:

UNIT 1. Introduction to Mechatronics systems and components, Principles of basic electronics – Digital logic, number system logic gates, Sequence logic flip flop system, JK flip flop, D-flip flop.

UNIT 2. Microprocessors and their applications – Microcomputer computer structure/microcontrollers, Integrated circuits – signal conditioning processes. Various types of amplifiers . Low pass and high pass filters.

UNIT 3. Sensors –sensors and transducers. Displacement, position proximity sensors , velocity, force sensors. Fluid presence Temperature, Liquid level and Llight sensors. Selection of sensors, Actuators: Pneumatic and hydraulic systems, Mechanical actuation system, Electrical actuation system. Other Electrical/Electronic hardware in Mechatronics system.

UNIT 4. Principles of Electronic system communication, Signal conditioning, Interfacing, A.D. and D.A. convertors, Software and hardware principles and tools to build mechatronic systems, Basic system models, Mathematical models, Mechanical and other system building blocks.

UNIT 5. System models – Engg. Systems, Rotational-translation, Electro- mechanical, Hydraulic- mechanical system, System Transfer functions, First-second order system in series.

UNIT 6. Design and selection of Mechatronics components namely sensors line encoders and resolvers, stepper and servomotors, ball screws, solenoids, line actuators and controllers with application to CNC system. PLC and Ladder programming, Robots, Consumer electronics products, etc. Design of a Mechatronic Products using available software CAD packages MATLAB and SIMULINK.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand conceptual design for mechatronics products based on potential custom requirements.
- Analyze appropriate sensors and transducers and devise an instrumentation system
- Understand design of a control system for effective functioning of mechatronics systems using digit electronics, microprocessors, microcontrollers and PLC.
- Develop system model for mechanical system.
- Calculate transfer function for first order and second order system.
- Understand analogue to digital conversion and digital to analogue conversion.

Reference books:

1. Mechatronics by W.Bolton, published by Pearson Education, 4th Ed.

2. Automation Production System and CIMS by Mikel P Groover, Prentice Hall of India New Delhi.

NPTEL Video Lecture , Web: http://nptel.ac.in, Mechatronics Engineering

Software available: Control-X supplied by Cyber Tech.

M-607-A: DESIGN, PLANNING AND CONTROL OF PRODUCTION SYSTEMS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

COURSE OBJECTIVE:

To study life cycle approach both for production system and new product development & compare production system with service system. Clarify various MRP models in production planning & sequencing and scheduling of the job on the machines. To study the concept of forecasting in production system.

Syllabus:

Unit 1. Introduction to production systems: Aim of production system, generalized model of Production systems, Types and characteristics of production and service systems, Life cycle approach to production management. Case studies of production and service systems.

Unit 2. Product development and design: Product life cycle, New product development and process selection, stages in new product development, use of decision tree, Breakeven Analysis, Make/buy decision, Problems for Break even Analysis Non-linearity in B.E. Analysis, selection of location among alternatives –A case study, systematic layout planning, objectives, types, comparison and application of different types of layouts. Assembly line balancing concept and problems for maximum line efficiency.

Unit 3. Planning for production: Importance, objectives and types of forecasting methods, Analysis and comparison standard error of estimate, Material Requirement Planning (MRP) objective, dependent demand, inputs to MRP, MRP-II, MRP model, ERP.

Unit 4. Sequencing and scheduling: Criteria for sequencing, priority sequencing and rules, n job 2 machine, n job 3 machine, n job m machine problems. Scheduling of flow shops and job shops. Gantt chart.

Unit 5. Element of monitoring and follow up.

COURSE OUTCOMES: Towards the end of the course, the students should be able to:

- Develop life cycle approach to new product development and production system.

• Develop the concept of break-even analysis, line balancing and relate it with practical industrial work.

• Understand and generate MRP-I, MRP-II and ERP models for production and enterprise resource planning.

• Estimating production requirement using various forecasting techniques.

• Understand the criteria for sequencing & accordingly schedule the job on machines.

Reference Books:

1. Modern Production / operations management 8th ed. - Buffa, Elwood and Sarin, Rakesh (Wiley)
2. Elements of Production, planning and control - Eilon Samuel (Macmillan)
3. Production control: A quantitative approach - Biegel. J (Prentice Hall)
4. Industrial Engineering and production management – Martand Telsang (S. Chand)
5. Operations Management – Theory and Problems – Joseph Monks (Mcgraw Hill))
6. Production and Operations Management – Kanishka Bedi. (Oxford University Press)
7. Operations Management 2nd ed. – B. Mahadevan. (Pearson)

M – 609A CYBER SECURITY

No. of Credits: 2	Sessional: 20 Marks
L | T | P |Total	Theory: 30 Marks
2 | 0 | 0 | 2	Total: 50 Marks
	Duration of Exam: 2 Hours

Course Objectives:

To study essential concepts for cyber security , cyber security applications, cyber crimes unauthorized crimes and hacking. To study prohibited action on cyber policies , evaluation of crime scene, evidence collection, Cyber security law and policies.

Syllabus:

Unit 1 **Introduction**: What is security? Need of security, Why is security so hard? Various goals of security, Introduction to Cyber Security, Difference between Computer security, Information security, Network security and Cyber security, Cyber security Applications and Principles.

Unit 2 **Introduction to Cyber Crimes:** Category of Cyber Crimes, Technical Aspects of Cyber Crimes: unauthorized access & Hacking, Trojan, Virus and worm attacks, E-mail & IRC related crimes: Email spoofing and spamming, Email bombing: Sending threatening emails, Defamatory emails, Email frauds, IRC related, Denial of service (DoS) attacks, Distributed Denial of Service (DDoS) attacks, Cyber criminals and objectives.

Unit 3 **Prohibited Actions on Cyber:** IPR Violations, Cyber Squatting, Cyber Terrorism, Cyber Pornography, Forgery and fraud, Banking/Credit card related crimes, Sales and Investment frauds, Defamation (Cyber smearing), Cyber Stacking.

Unit 4 **Cyber Forensics and Cyber Security:** Introduction to forensic tools, Evaluation of crime scene and evidence collection, Cyber security law and policies, Policy foundation for cyber security.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand cyber security applications and principles.
- Analyse about cyber-crimes and Email frauds.
- Understand prohibited action on IPR violations, prevention of forgery and card related crimes.
- Understanding cyber-crime criminals and cyber objectives.
- Understanding the forensic tool and evidence collection.
- Understand policy foundation for cyber security.

Reference Books

1. William Stalling, "Cryptography and Network Security", 5th Edition. PHI New Delhi
2. William Stalling, "Network Security Essentials: Applications and Standards", 4th Edition. PHI New Delhi
3. Stuart McClure, "Hacking Exposed: Network Security Secrets & Solutions", McGraw-Hill
4. Albert Marcella, Doug Menendez, "Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Second Edition, AUERBACH PUBLICATIONS, A CRC Press Company

611-A : WELDING LAB

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 30 Marks
Theory : 20 Marks
Total : 50 Marks

Course Objectives:
To develop domain knowledge in the field of welding and study of bead geometry , hardness microstructure of welding bead for various types of welding processes.

List of Experiments in Welding

1. To study Heat flow in Welding
   (Equipment for use-Gas Welding equipment)

2. To study Bead Geometry, Hardness of Bead, Microstructure of welding Bead in case of:

   i) MIG Welding

   ii) SAW Welding

   iii) FCAW Welding

(By changing electrode diameter & carriage speed)

3. To conduct under water welding (to study bead shape & microstructure)

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand heat flow in gas welding.
- Analyse about bead geometry, hardness and microstructure of MIG,SAW and FCAW welding.
- Understand underwater welding procedure .

M-613-A : MECHATRONICS LAB

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 30 Marks
Theory : 20 Marks
Total : 50 Marks

Course Objectives:

To develop domain knowledge in the field of mechatronics product design and select various equipments for mechatronics applications. To run a variety of mechanical equipments with the help of computer.

List of experiments:

1. To verify truth table of various gates such as AND, OR, NOR, NOT, etc.
2 To realize a logic equation Y=AB+CD.
3 Selection of sensor for a particular application from Catalogue/Internet.
4 Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values
5 To study the hardwares and softwares of mechatronics kit.
6 To move a table in X-direction and Y-direction within the range of proximity sensors using Control-X software.
7 To rotate a table using DAC system.
8 To run a motor with PLC.
9. To run a conveyor with computer.
10. To study the movement of actuating cylinders and sensors.
11 To study mechatronics and their interfacing in a CNC machine.
12. Life prediction from computer programme based on mathematical model.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the various practical demonstrations of mechatronics.
- To utilize the theories for designing digital system.
- Selection of equipments and practical demonstration.
- Prepare computer programme based on mathematical model.

M-602-A : METAL CUTTING TECHNOLOGY

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study essential concepts of metal cutting using single point and multipoint cutting tools.To study concept and application of modern machining processes. To study milling, broaching, gear cutting, grinding, thread cutting tools and tools for making holes.

Syllabus:

Tool Geometry, Tool & work piece material: Common work and Tool materials, Tool inserts, Specifications of inserts and tool holders, Physical principle in metal cutting: Chip formation and types of chips, work done in cutting, BUE on metal cutting, curling & contraction of chip , work hardening, quality of machines surfaces, Effect of cutting fluid on cutting process, vibration in metal cutting. Machining economics, cutting power, Tool wear, lubrication and surface finish, cutting fluids.

Turning, Boring and threading tools: Operation, signature of single point tools, Design of single point turning tool, ISO tool shapes, design of flat and circular form tools, threading tools chip breaking methods.

Milling, Broaching, Gear cutting tools: Milling cutter design, design of broach, Gear shaping and gear shaving operations, design of Gear hobs.

Tools for holes: Hole making operations-drilling, Reaming and boring, Designs of Drill, Reamer and Boring tools.

Grinding: Features of grinding process, characteristics, shapes, mounting, wear, turning, Dress of Abrasive tools, center type cylindrical grinding, centreless grinding, internal grinding, surface grinding, grinding fluid

Modern machining Processes: USM, Abrasive Jet Machining, water jet machining, electrochemical machining, grinding, deburring, Honing, EDM, plasma arc machining, Laser Beam machining, Electro Beam machining Process detail, Metal cutting mechanics, application.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the effect of chip on quality of machine surface.
- Understand the design of broaching tools and gear hobs.
- Understand the design of single point and multipoint cutting tools.
- Analyze hole making processes such as reaming and drilling.
- Understand concept various grinding processes and applications.

- Understand concept of metal cutting mechanics.

Reference books:

1. Metal Cutting theory and cutting tool design:-v Arshinov Mir Publishers, Moscow, Allekseev Mir Publishers, Moscow
2. Cutting tools: P.H. Joshi, Wheeler Publishing
3. Theory of Metal cutting: E.M. Trent
4. Tool design: Donaldson
5. Production Technology: HMT, Tata Mcgraw Hill, New Delhi
6. Modern Machining Processes: P.C. Pandey, H.S.Shah, Tata Mcgraw-Hill, New Delhi

M-604-A : AUTOMATION IN MANUFACTURING

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study various techniques of automatic material handling in a manufacturing organization. To study concept and interfacing of various pneumatic, hydraulic and software for automation of mechanical products /system. To study control strategies, modeling and simulation in a manufacturing system.

Syllabus:

Introduction:

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, Introduction to automation productivity.

Material Handling Systems:

Overview of Material Handling Systems- rotary feeders, oscillating force feeder, vibratory feeder, elevator type and centrifugal type feeders, Principles and design consideration, Material transport systems, Storage systems.

Automated Manufacturing Systems:

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, Product design for automatic assembly.

Control Technologies in Automation:

Industrial Control Systems, Components,Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete ,Open and close loop control, PID Controller, Controller tuning: Process reaction method and ultimate cycle method.

Evaluation of Automatic Production:

Product manufacturability, Orientation devices- active and passive devices, Parts orientation and Escapement devices.

Pneumatic and Hydraulic Components and Circuits:

Boolean algebra, Pneumatic sensors and amplifiers, Jet destruction devices, Logic devices, Schimit triggering devices, Developing pneumatic circuits for automatic die casting machine.

Modeling and Simulation for Manufacturing Plant Automation:

Introduction, need for system modeling, Building mathematical model of a manufacturing plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, Robots and application of robots for automation.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the effect of manufacturing automation strategies.
- Analyze automated flow lines and assembly systems, and balancing the line.
- Develop automated material handling and feeders for a typical production system.
- Design a flexible manufacturing system and control strategies.
- Understand various types of part orientation devices and escapement devices.
- Develop pneumatic systems and simulation for a manufacturing plant automation.

Reference Books:

1. Handbook of Design, Manufacturing & Automation : R.C. Dorf, John Wiley and Sons.
2. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, PHI.
3. Industrial Automation, W.P. David, John Wiley and Sons.
4. Computer Based Industrial Control, Krishna Kant, PHI
5. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
6. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI

NPTEL Video Lecture , Web: http://nptel.ac.in, Automation and control

Software available: Pneumatic and hydraulic simulation , CyberTech

M-606-A: CAD/CAM

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

Explain principles of various theories of computer aided designing involved along with their industrial applications. Study the design process of any product or operation and how CAD improvises it by increasing the efficiency and accuracy of the process. Study the manual & Computer aided part programming and the various methods for CAPP.

Syllabus:

CAD/CAM SYLLABUS

UNIT-1

Introduction of CAD/CAM,Co-ordinate system in CAD, 2D & 3D Transformation:-Scaling, Rotation, Shearing, Translations & Reflection, introduction of Part family and Group Technology.

UNIT-2

Representation of parametric and non-parametric curves, Types of curves (analytic & synthetic curves), Geometric modeling, representation and types of surfaces.

UNIT-3

Introduction to FEM and FEA, Basic Concepts of FEM, Meshing, Element Selection, Types of Analysis

UNIT-4

Introduction of CAPP & its type (variant, generative and hybrid CAPP), NC part programming, APT programming, advances in CAD/CAM (Agile & Lean manufacturing, concurrent Engineering and reverse engineering)

UNIT-5

Fundamentals of Rapid Prototyping, Benefits and Application, STL file Generation,Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling vs. RT, Need for RT

RAPID PROTOTYPING MACHINES: Classification, Description of RP Machines: Stereo lithography, Selective Laser Sintering, Fused deposition modeling, laminated object manufacturing, Laser powder forming.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand 2-D and 3-D transformations of different object based on coordinate system and design the 2D and 3D surfaces and solids.
- Understand the various types of curves
- Develop a part program using CNC Part Programming.
- Analyze a part program using APT language.
- Understand the applications of various CAPP techniques /methods.

References Books:

1. CAD/CAM by Groover and Zimmer
2. CAD/CAM Theory and Practice, Ibrahim-Zeid, TATA McGraw Hill
3. CAD/CAM/CIM – P. Radhakrishnan, New age international.
4. Mathematical Elements of Computer graphics- Rogers and Adams
5. Computer Aided Design – Besant and Lui, PHI

NPTEL Video , Web: http://nptel.ac.in, Computer aided design and manufacturing

Software available: AutoCAD of Microsoft

Elective-I

M-608-A-1 : INDUSTRIAL INSPECTION

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study industrial process of inspection ,design consideration for gauges and measuring instruments. To study Indian and international standards for limits ,fits, tolerances. To identify geometrical and physical limitations in measuring devices. To study surface texture of components.

Syllabus:

UNIT-1: Design consideration for Gauges and measuring instruments: material selection for gauges, Nas per Indian and international standards, design of plug gauge, snap gauge, center distance gauge.

UNIT 2:Inspection of threads and gears : thread gauge design, thread size measurement by two wire and three wire methods, vernier gear tooth gauge design.

UNIT 3: Surface textures: components of machined surface texture, specification of surface texture, surface roughness measuring device and techniques, design of pneumatic gauges in process gauging methods.

UNIT 4:Geometrical and positional tolerances
UNIT 5: Geometrical and physical limitations in measuring devices.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand about the types Gauges.
- Complete understanding about measurement standards.
- Understanding about the gears and threads.
- Understanding surface textures with processes
- Understand tolerances and their positioning with geometry.

References:

1. Metrology:- I .C. Gupta (Dhanpat Rai Pub.)
2. Engg. Metrology :- R. K. Rajput (S. K. Kataria and sons)
3. Metrology :- R. K. Jain
4. PSG design data book for Gauge design

M-608-A- 2 : QUALITY CONTROL TECHNIQUES

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
To study about statistical concepts in quality control, quality control techniques, various control charts. Study about variables inspection and attributes inspection, relative merits and demerits. To study about special control charts for variables, group control chart total quality control.

Syllabus:
UNIT 1:Statistical concepts in Quality Control, Graphical Representation of Grouped Data, Continuous and Discrete Probability Distributions, control limit Theorem,

UNIT2: Introduction to Quality Control, process Control and Product Control, Chance and Assignable causes of Quality variation, Advantages of shewhart control charts, Process Control charts for variables, X, R and σ charts, fixation of control limits, Type I and Type II Errors, Theory of runs, Interpretation of Out of Control points, Probability limits, Initiation of control charts, Trial control limits, Determination of aimed at value of Process Setting, Rational method of sub grouping, control chart parameters, control limits and specification limits, Natural tolerance limits, Relationship of a process in Control to upper and lower specification limits, process capability studies.

UNIT3:Special control charts for variables, group control chart, arithmetic moving $\bar{X}$ and R charts, Geometric moving chart, control chart with reject limits, steady trend in Process average with constant dispersion, trend chart with sloping limits, variable subgroup size.

UNIT4: Variables inspection and Attributes inspection, Relative merits and demerits, Control charts for Attributes, p chart and np chart, varying control limits, high defectives and low defectives, special severe test limits, C chart, U chart, Dodge demerit chart, Quality rating, CUSUM or Cumulative sum control chart, Average run length (ARL) Relative efficiency or sensitivity of control chart.

UNIT5: Probability theory, binomial and Poisson distribution, Acceptance Inspection, 100% Inspection, No Inspection and sampling Inspection, operating characteristic curve (O.C. curve). Effect of sample size and Acceptance number, type A and type B O.C. curves, Single, Double and Multiple sampling Plans, SS Plan. Acceptance/Rejection and Acceptance/Rectification Plans, Producers Risk and Consumer's Risk, Indifference Quality level, Average Outgoing quality (AOQ) curve, AOQL, quality protection offered by a sampling Plan, Average sample Number (ASN) curve, Average Total Inspection (ATI) curve.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand about the Concept of Quality control system and process capability study.
- Analyze about process control charts and Errors.
- Understand about the Inspection control methods.
- Understanding about the probability theory, binomial and Poisson distribution .
- Analyze product control, chance and assignable causes of Quality variation .

Reference Books

1. Statistical Quality control by E.L. Grant
2. Quality control and Industrial Statistics, by A.J. Duncan
3. Quality control by Dale H. Bestefield
4. Total Quality Control by A.Y. Feigenboum
5. Elementary S.O.L. by I.W.Burr, M. Dekkar

M-608-A-3 : DESIGN AND METALLURGY OF WELDED JOINTS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study welding defects , control and design of welded joints. Study metallurgy and cost estimation of welded joints. To study destructive and non destructive testing of welds, residual stresses and control of residual stresses.

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Syllabus:

UNIT 1. Weld defects: common weld defects like weld cracks, LOP, LOF, porosity, blow holes etc., remedies and control, welding symbols.

UNIT 2. Cost analysis of welded joints: costing factors of welding jobs- fabrication cost, material cost, preparation cost, finishing cost, overhead cost etc., economy in preparation and welding a job, labour accomplishment factor, cost calculation of welded jobs.

UNIT 3. Prediction and control of distortion: calculation of longitudinal contraction, transverse contraction, angular contraction due to single weld pass, control of welded distortion, and calculation of shrinkage.

UNIT 4. Residual stresses: introduction, types, effect of thermal stresses, control of residual welding stresses.

UNIT 5. Destructive tests: equipment required and test piece geometry for tensile test, bend test, impact test, hardness test, brittle and fatigue failure tests, non destructive tests for welds:-dye penetrate inspection, magnetic particle inspection etc.

UNIT 6. Weldability tests: definition and concept of weldability, purpose and types of weldability tests such as hot cracking test, root cracking tests, hydrogen induced cracking test, cruciform test.

UNIT 7. Weldability of metals: welding techniques, preparation of joints and electrode types for gray cast iron welding, aluminium welding, austenitic steels, titanium and its alloys.

UNIT 8. Welding metallurgy: thermal effect of welding on parent metal, structure of fusion welds, effect of cooling rate, weld metal solidification and heat affected zone.

UNIT 9. Automation in welding: introduction and concept, classification of welding automation, economics of welding automation.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand to predict and control of distortion in welded joints.
- Calculate cost estimation of welded joints.
- Understanding the effect of residual stress in welded joints.
- Understanding weld metallurgy: thermal effect of welding on parent metal
- Develop the application of welding automation for enhancing productivity.

Reference books:

1. Modern welding technology:- carry H. B. (PH).
2. Welding technology: - A. C. Devis
3. Welding and welding Technology: - Little (TMH)
4. Welding technology: - R. S. Parmar
5. AWS- welding handbook (IV – VI) Edition
6. Elements of machine design: - Pandya and shah

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M-608-A-4 : ROBOTIC ENGINEERING

No. of Credits: 4 Sessional: 40 Marks
L T P Total Theory : 60 Marks
Total : 100 Marks

4 0 0 4 Duration of Exam: 3 Hours

Course Objectives:

To study various techniques for robotic automation. To study kinematics of robot manipulation.To study vision and sensing characteristics of robot. Various robot teaching methods, task programming, robot level programming languages.

Syllabus:

UNIT 1:Introduction:

Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, Types of Drive Systems and their Relative Merits, the Wrist & Gripper Subassemblies. Concepts and Model about Basic Control System, Transformation and Block Diagram of Spring Mass System, Control Loops of Robotic Systems, PTP and CP Trajectory Planning, Different Types of Controllers, Control Approaches of Robots

UNIT2:Kinematics of Robot Manipulator:

Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics' Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation.

UNIT3:Robotic Workspace & Motion Trajectory:

Introduction, General Structures of Robotic Workspaces, Manipulations with n Revolute Joints, Robotic Workspace Performance Index, Extreme Reaches of Robotic Hands, Robotic Task Description.

UNIT 4:Robotic Motion Trajectory Design: –

Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories:- 4-3-4 & 3-5-3 Trajectories, Admissible Motion Trajectories.

UNIT5:Robot Teaching:

Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc,

UNIT 6:Robot Sensing & Vision:

Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

UNIT 7: Industrial Applications:

Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the robotic automation strategies.
- Analyze dynamics of robot manipulator.
- Task programming of robots.
- Understand vision and sensing characteristics of robots.
- General design consideration on trajectories motion of robots.

Text Books/ Reference Books:

A Robot Engineering Textbook – Mohsen Shahinpoor – Harper & Row publishers, New York.
Robotics, control vision and intelligence, Fu, Lee and Gonzalez. McGraw Hill International.
Introduction to Robotics, John J. Craig, Addison Wesley Publishing.
Robotics for Engineers , Yoram Koren, McGraw Hill International.
Industrial Robotics, Groover, Weiss, Nagel, McGraw Hill International.
Robot Technology Fundaments, Keramas, Thomson Vikas Publication House.
Company Fundamentals of Robotics Analysis and Control, Schilling, PHI.
Introduction to Robotics, Niku, Pearson Education, Asia.

NPTEL Video , Web: http://nptel.ac.in, Advanced Robotics

M-608-A-5 : MACHINE TOOL DYNAMICS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
To study various theories of chatter in machine tools. To study damping character ship of machine tools, dynamic characteristic of the cutting process and dynamic acceptance tests. To study single and multidegree freedom system of machine tools.

Syllabus:
UNIT 1: Chatter in machine Tools_ sources of chatter, primary chatter, regenerative chatter, chatter frequency, forced vibration for machine tools, forced vibration due to perturbance of the cutting process, forced vibration due to perturbance of equivalent elastic system, theories of machine tool chatter: Tlusty's, Kudinovs, Toblas theories.

UNIT 2: Machine tool stability: dynamic characteristic of the cutting process, general procedure for assessing the dynamic characteristic of machine tool in single degree and many degree of freedom system, methods of reducing the instability in machine tool, dynamic acceptance tests

UNIT 3: Damping in machine tools: requirements of damping system,. Viscous dampers, active dampers,

UNIT 4: Static and dynamic analysis of machine tools: lumped parameter method, finite element method,

UNIT 5: Chatter in grinding machine.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the theories of chatter in machine tools.
- Analyze damping characteristics of machine tools.
- Analyze static and dynamic analysis of machine tools.
- Understand single and multidegree freedom system of machine tools.
- Understand chatter in machine tools.

Reference Books:

1. Principles of machine Tools:- G.C.Sen and Amitabh Bhattacharya(New central book agency Calcutta)
2. Machine Tool Design: - S.K. Mehta (TMH)

M-608-A-6: FINITE ELEMENT METHODS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study concepts of FEM, concepts of structural modeling, mathematical analysis of finite element method ,computer implementation of finite element method, linear analysis and various non-linearity analysis.

Syllabus:

UNIT 1: Review of basic FEM concepts ,FEM Discretization and the Direct Stiffness Method: Basic concepts of structural modeling, Review of the stiffness method of structural analysis, Modeling stiffness, loads and displacement boundary conditions

UNIT 2: Formulation of Finite Elements: Mathematical interpretation of finite elements, variational formulation, Development of continuum elements, shape functions, consistent loads, Isoparametric elements for plane stress, Numerical integration, Convergence requirements.

UNIT 1. UNIT 3: Computer Implementation of the Finite Element Method: Pre processing: model definition, Element level calculations, Equation assembly, Equation solver, Post processing: strain and stress recovery.

1. Advanced topics in linear problems : Static condensation and sub-structuring , Patch test and incompatible element , p-formulation
2. Advanced Beam, Plate and Shell elements :
    a. Timoshenko beam theory (shear locking)
    b. Plate and shell theory
        i. Thin plate and Mindlin plate (shear and membrane locking)
        ii. Mixed formulation for plate and shell
        iii. Degenerated shell formulation
3. Dynamic analysis using FEM
    a. Consistent mass and lumped mass, mass lumping technique
    b. Time integration methods: explicit, implicit, explicit-implicit methods.
    c. Stability, convergence and consistency
    d. Hyperbolic systems: structural dynamics and wave propagation
    e. Parabolic system: transient heat transfer
    f. Modal solution for natural frequencies and mode shapes
    g. Modal Superposition method for structural dynamics
4. Nonlinear analysis
    a. Nonlinear solution procedures
    b. Newton-Raphson, modified Newton-Raphson, and secant methods
    c. Line search algorithm

    d. Automatic time step control
5. Material nonlinearity
    a. Rate independent elastoplasticity with return-mapping algorithm
    b. Isotropic and kinematic hardening with Baushinger effect
    c. Consistent tangent operator
    d. Objective rate and finite rotation elastoplasticity
    e. Multiplicative decomposition and finite deformation elastoplasticity
6. Geometric nonlinearity
    a. Generalized strain and stress
    b. Total and Updated Lagrangian formulation
    c. Kirchhoff stress and Cauchy stress
7. Boundary nonlinearity
    a. Frictionless contact problems
    b. Penalty, Lagrange multiplier, augmented Lagrange multiplier, and perturbed Lagrange multiplier methods
    c. Frictional contact problems including frictional return-mapping algorithm
    d. Rigid-flexible contact and flexible-flexible contact
    e. Multiplicative decomposition and finite deformation elastoplasticity
8. Geometric nonlinearity
    a. Generalized strain and stress
    b. Total and Updated Lagrangian formulation
    c. Kirchhoff stress and Cauchy stress
9. Boundary nonlinearity
    a. Frictionless contact problems
    b. Penalty, Lagrange multiplier, augmented Lagrange multiplier, and perturbed Lagrange multiplier methods
    c. Frictional contact problems including frictional return-mapping algorithm
    d. Rigid-flexible contact and flexible-flexible contact

Assignments and Tutorials are essential part of this course. Various programming and formulation problems will be assigned through the course of study.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the theories of linear system for finite element analysis.
- Understand the theories of non-linear system for finite element analysis.
- Develop the formulation of problem for analysis.
- Analyse non-linear problem solution procedure.
- Understand modeling of system with load, displacement and boundary conditions.

Text Book: Finite element analysis by P.Seshu, PHI, 2003.

NPTEL Video , Web: http://nptel.ac.in, Finite Element Method

M-608-A-7 PPINCIPLES OF MANAGEMENT

No. of Credits: 4

L T P Total

4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks

Duration of Exam: 3 Hr

Course Objectives:

To study about Management ,management functions, management model and theories of management. To Study about organization system, managerial decision making, QFD and MIS .

Syllabus:

UNIT 1. Introduction: Definition, Management thoughts, Nature & purpose of management, Management- an art or science, Management vs. administration, Levels of management and skills required, Management functions, Branches of management, Management model.

UNIT 2. Theories of management: Traditional Management theory: Taylor's Theory, Scientific Management, Henry Fayol's management Theory, Behavioural Theory: comparison of traditional and behavioural theory, Maslow's need hierarchy theory, Herzberg's Two factor theory, Theory X and Theory Y, Contingency approach to management.

UNIT 3. Organisation as a system: Interaction with external environment. Managerial decision making and MIS. Planning approach to organizational analysis, design of organization structure: job design and enrichment; job evaluation and merit rating, Motivation and productivity. Leadership styles and managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control.

UNIT 4. Management techniques: Conventional management tools, applications of cause & effect diagram, Pareto analysis, Force field analysis, QFD.

UNIT 5. Introduction to Japanese techniques- 5S, Kaizen, JIT, SCM, ERP, Six Sigma, TPM, TQM.

UNIT 6. Case studies.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand management functions .
- Understanding about theories of management.
- Understand about the organization as a system.
- Understanding about the techniques of management ,5S,Kaizen,JIT,SCM,ERP,Six Sigma,TPM,TQM.
- Understand usage of management techniques with applica

Reference books:

1. " Management" by James A.F. Stoner, R.Edward Freeman, Daniel R. Gilbert.(Prentice-Hall of India)
2. "Management for Business and Industry" by Claude S. George. (PHI Private Ltd.)
3. "Management Information Systems" by W. S. Jawadekar. (Tata McGraw-Hill Publishing Co.)
4. "Principles & Practice of Management" by T.N.CHHABRA. (Dhanpat Rai &Co. (P) Ltd.
5. "Motivation and Productivity" by Saul W. Gellerman. (D.B. Taraporevala sons & Co.)

M 608 A-8: SUPPLY CHAIN MANAGEMENT

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study the concept of supply chain management, supply chain dynamics, supply chain performance measurement, key issues in supply chain, application of internet in SCM and various quantitative tools in SCM.

Syllabus:

Unit 1 Overview of supply chain management: Introduction, Definitions of SCM, types of SCM, process for implementation of SCM, Parties involve in SC, Flows in supply chain, Goals of SCM, Obstacles to process integration in SC, Key issues in SC.

Unit 2 Supply chain dynamics: Introduction**,** Bullwhip effect, Impact of Lead time, offshoring and outsourcing on SC dynamic and cost.

Unit 3 Performance measurement: Introduction, Purpose, Measuring the supply chain performance, Evolving SC matrices, Performance Monitoring, Key supply chain performance indicators, various issues related to SC performance, world class performance measurement system.

Unit 4 Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling.

Unit 5 IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

Unit 6 Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the process for implementation of SCM.
- Analyse the effect of various parameters on the Supply chain dynamics.
- Analyse various issues related to SC performance.
- Understand application of internet in SCM.
- Implementation of various Quantitative tools for SCM.

Text Books:

1. Designing and Managing the Supply Chain concepts, Strategies and Case studies by D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, and Ravi Shankar, Tata McGraw Hill.
2. Supply Chain Management, Strategy planning and operation by Chopra and Mendel, Prentice Hall.

Review and train in CAD modeling. • use parametric CAD software for geometric modeling of mechanical designs.• Translate production drawings to 3D CAD models.• Evaluate a mechanical design and optimize it using CAD, CAE software.• use 2D / 3D CAD and CAE for use in other courses and research thesis work

M-610-A : METAL CUTTING LAB

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 30 Marks
Theory : 20 Marks
Total : 50 Marks
Duration of Exam: 2 Hours

Course Objectives:

- To impart knowledge about the cutting tools through live experiments
- To develop domain knowledge in the field of metal cutting, conventional as well as non-conventional machining operations.

List of Experiments:

1. To identify various angles and parameters of various single point cutting tools
2. To identify various angles and parameters of various multipoint cutting tools
3. To grind various angles on a single point cutting tool.
4. To identify chips produced in turning of Aluminium, mild steel work piece at different speeds and feeds
5. To perform some hole making operations on Electro- Discharge Machine (EDM).
6. To study wear of cutting tool in turning.
7. To study surface finish by varying cutting parameters on surface grinding machine.
8. To cut a spur gear on gear shaping machine
9. To braze a carbide tip on a carbon steel tool shank.
10. To study effect of cutting fluid on machining.
11. To produce and inspect a splined/round hole on horizontal Broaching Machine.

Course Outcomes (CO): At the end of the course, the students will be able to:

1. Understand various angles and parameters of single as well as multipoint tools.
2. Differentiate the kinds of chips produced in the machining of Aluminium and Mild Steel
3. Understand the basic operation of EDM and Broaching machines through hole making operations
4. Understand the gear production method through Gear shaping machine
5. Understand the effects of cutting fluid in machining operations

M-612-A : AUTOMATION LAB

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 30 Marks
Theory : 20 Marks
Total : 50 Marks

Course Objectives:

To develop domain knowledge in the field of automation of mechanical equipments and select equipments for automation. To design various types of feeders . Study a variety of softwares for automation of mechanical equipments .

List of Experiments:

1. To study the hardware of a retrofit and CNC machine tools.
2. Selection of various equipments required with the specifications from Internet/Catalogue: To convert a manual machine tool/system into an automatic machine tool/system.
3. To write programme with G code and M code for a component.
4. To simulate machining of component using machining software.
5. Study and applications of Hydraulic software.
6. Study and applications of Pneumatic software.
7. Study and applications of Robotic software.
8. Study and applications of PLC software.
9. To design an automated part feeder.
10. Developing pneumatic circuits for casting.
11. To simulate gear hobbing process and to calculate gear hobbing time.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the various practical demonstrations of automation of mechanical equipments.
- To utilize the theories for designing feeder system.
- Selection of equipments and practical demonstration.
- Operation of variety of software .
- Computer programming on CNC machine.

M-614-A: CAD/CAM LAB

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 30 Marks
Theory : 20 Marks
Total : 50 Marks

Course Objectives:
To develop domain knowledge in the field of CAD /CAM. Exposure to CAD tools for use in mechanical engineering design conceptualization, geometric modelling, communication, analysis and optimization, further use in CAD, CAM, related courses and research work. Impart knowledge related to principles, methods and techniques of 3D modelling in parametric CAD software. Undertake project works in use of CAD geometric modeling software for design analysis, evaluation and optimization using a professional software.

List of Experiments:

1. Introduction to CAD, CAM & CIM
2. Development of orthographic models in AUTOCAD /PRO-E/CATIA
3. Introduction & Development of 3-d models in AUTOCAD /PRO-E/CATIA
4. Introduction to surface modeling
5. Introduction to part assembly
6. Introduction & comparison in b/w different 3-D software of design
7. Introduction of part programming (g& m codes)
8. Simulation of design's in CNC machine shop
9. Introduction to FEM packages
10. Introduction to rapid prototyping
11. Create the geometric model using any of the modeling package
12. Generate the sequence employed to generate solid model

Course Outcomes (CO's): At the end of the course, the student shall be able to:
Review and train in CAD modeling. • use parametric CAD software for geometric modeling of mechanical designs.• Translate production drawings to 3D CAD models.• Evaluate a mechanical design and optimize it using CAD, CAE software.• use 2D / 3D CAD and CAE for use in other courses and research thesis work

M-701-A : COMPUTER INTEGRATED MANUFACTURING

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

Study the basic concepts of computer integrated manufacturing, NC,CNC and DNC system. Illustrate the numerical control and part programming. Study the concept of computer aided quality control and material handling.

Syllabus:

UNIT 1. **Introduction:** CAD/ CAM defined, computer technology: introduction, central processing unit, types of memory, input/ output, the binary number system, computer programming languages. Role of CAD/CAM in improving the product cycle. Introduction to CIM. Applications of computers in CIM.

UNIT 2. **Conventional Numerical Control:** basic components of NC system, NC motion control, system, applications of NC, advantages and disadvantages of NC, problems with conventional NC, NC controller technology, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC.

UNIT 3. **NC part programming:** introduction, punched tapes in NC, tape coding and format, NC words, manual part programming, computer assisted part programming, The part programmer's job, the computer's job, NC part programming languages, APT language, geometry statements, motion statements, post processor statements, auxiliary statements.

UNIT 4. **Robotics technology:** joints and links, common robot configuration, work volume, drive systems, types of robot control, accuracy and repeatability, end effectors, sensors in robotics, applications of robots.

UNIT 5. **Automated material Handling and FMS.:** material handling function, types of material handling equipments, conveyor systems, types of conveyors, automated guided vehicle system, applications, FMS, components of a FMS, types of systems, where to apply FMS technology, FMS workstation, planning the FMS.

UNIT 6. **Computer aided quality control:** Introduction, the computer in QC, contact and non contact Inspection methods- optical and non optical, computer aided testing. Coordinate measuring machine(CMM)- its construction, drive systems, programming methods, softwares used in CMM,applications and benefits of CMM. Machine Vision System- its basic functions, Image acquisition and digitization, Image processing and analysis, Interpretation, applications of machine vision system.

UNIT 7. **Computer Integrated Manufacturing systems:** Introduction, Technologies used in CIM, Difference between CIM and FMS, CIM hierarchy system, Implementation process of CIM, applications and benefits of CIM.

Course Outcomes: Towards the end of the course, the students should be able to:

- Apply robotic control and sensors for quality improvement.

- Understand the role of CAD/CAM in improving product life cycle.
- Understand different concepts of FMS .
- Prepare and analyse numerical control programming.
- Understand computer aided testing to various equipment.

Reference books:

1. CNC Technology and Programming—Tilak Raj
2. Automation, Production systems and Computer Integrated Manufacturing :- Groover M. P. (PHI)
3. CAD/CAM : - Zimmers and Groover (PHI)
4. Approach to computer integrated design and manufacturing :- Nanua Singh (John Wiley and sons)

M-703-A : MATERIAL MANAGEMENT

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
Study the basic concepts of materials management like productivity, techniques of materials management ,purchasing in production process and cost reduction techniques.Illustrate the material requirement planning process like JIT, production planning, economic analysis and break even analysis .

Syllabus:
UNIT 1: Introduction: introduction to material management and productivity, functions of material management, organization structures in material management, role of material management techniques in improved material productivity.

UNIT 2:Material planning: objectives, material requirement planning, manufacturing resource planning, JIT production planning, strategic material planning, material control: acceptance, sampling, inspection, make or buy decision, simple cost analysis, economic analysis, break even analysis, break even point theory, whether to add or drop a product line store management and warehousing, product explosion.

UNIT 3: Purchasing: importance of good purchasing system, organization of purchasing functions, purchase policy and procedures, responsibility and limitations, purchasing decisions, purchasing role in new product development, role of purchasing in cost reduction, negotiations and purchase, purchasing research: identification of right sources of supply, vendor rating, standardization, vendor certification plans, vendor and supply reliability, developing new source of supply.

UNIT4:Cost reduction: cost control v/s cost reduction, price analysis, material cost reduction techniques, variety reduction, cost reduction and value improvement, techniques of cost control, standard costing, cost effectiveness, cost analysis for material management, material flow cost control.

UNIT 5: Inventory management: inventory v/s stores, types of inventory, inventory control, inventory build –up, EOQ, various inventory models, inventory models with quantity discount, exchange curve concept, coverage analysis, optimal stocking and issuing policies, inventory management of perishable commodities, ABC – VED analysis, design of inventory distribution systems, surplus management, information system for inventory management, case studies.

Course Outcomes: Towards the end of the course, the students should be able to:

- Understand materials management techniques for productivity improvement.
- Analyse the concept of materials planning with the theoretical concepts like break even analysis, JIT etc.

- Apply different concepts of Purchasing while purchasing a material for the company.
- Understand mathematical model the cost reduction techniques for reducing the cost & enhancing the profits of an organization.
- Analyse inventory management techniques like EOQ for the efficient Inventory management of production plant.

Reference books:

1. Material management :- W. R. Stelzer Jr. (PHI)
2. Material management :- D. S. Ammer & Richard Erwin Inc.
3. Material management :- A. K. Dutta (PHI)
4. Material management- An integrated approach :- P. Gopal;akrishnan,& M. Sundersen (PHI)

Elective-II

M-705-A -1: ARTIFICIAL INTELLIGENCE

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
Study concept of artificial intelligence,overview of expert systems, the concepts AI in manufacturing problems. AI theory problems, problem spaces and search, Heuristic search technique and knowledge acquisition.

Syllabus:

UNIT 1. Definition, basic concepts of artificial Intelligence, scope, role and potential of artificial intelligence in manufacturing, Expert systems, Popular AI application.

UNIT 2. Overview of Expert systems, architecture, comparison with procedural programming, developing Expert system for typical manufacturing domains, implementation and maintenance, state- of- art Expert system application, case study.

UNIT 3. AI theory problems, problem spaces and search, Heuristic search technique, Knowledge acquisition and knowledge representation, predicate logic, procedurals Declarative knowledge, forward V/s backward reasoning AI architecture, overview of advanced features, planning, learning, natural language processing, neural nets, fuzzy logic, object oriented programs.

UNIT 4. Case studies, examples of AI, theoretical concepts to manufacturing problems, CAD, CAPP, scheduling GT, CIM system.Domains welding, casting, forming, metal cutting, maintenance.

Course Outcomes: Towards the end of the course, the students should be able to:

- Understand knowledge acquisition and knowledge representation.
- Apply artificial intelligence in manufacturing.
- Understand expert system application.
- Analyze state-of art expert system application.
- Apply theoretical concepts to manufacturing problems.

M-705-A- 2 : VALUE ENGINEERING

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
To enhance value of a component either by reducing cost or by increasing its function. To study how to improve resource efficiency. To reduce operational, maintenance cost and help industries in competing more successfully in market.

Syllabus:

UNIT 1. Introduction, Life cycle of a Product, Definition, objectives and methodology of value Engineering, Comparison with other cost reduction techniques, unnecessary cost.

UNIT 2. Quantitative definition of values, alternatives to increase value, Type of value, estimation of Product Quality/performance.

UNIT 3. Functions: definition, types and relationship between different functions in design of a Product, functional cost, functional worth, test for poor value, aim of value engineering. Systematic approach, Phases of value engineering Job plan: General phase, information phase, function phase creation/speculation phase, evaluation phase, investigation phase, recommendation and implementation phase.

UNIT 4. Decision /evaluation Matrix: Quantitative comparison of alternatives, estimation of weight factors and efficiency.

UNIT 5. FAST diagramming: Critical path of function, How, why and when logic, supporting and all time functions, Ground rule for FAST diagram.

UNIT 6. Case studies.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand about the life cycle of the product.
- Complete understanding about methodologies of value engineering.
- Understand about the different functions of product design & their relationship.
- Understand the phases of value engineering.
- Understand the cost reduction techniques.

1. Value Engineering – A systematic Approach
-A.E. Mudge
2 Techniques of value analysis and value engineering
-L.D. Miles
3 Value engineering for cost reduction and product improvement
-H S Mittal

M-705-A-3 : ADVANCED THEORY OF VIBRATIONS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study essential concepts for Mechanical Vibrations induced in various equipment. To study and analyze effects of vibrations in equipment. To study experimental methods in vibration analysis, vibration exciters, transducers and measurement devices.

Syllabus:

UNIT 1. Single degree of freedom systems, two degree of freedom systems: spring coupled, mass coupled, vibration absorbers, and vibration isolation.

UNIT 2. Multi degree of freedom systems: Lagrange's equation, close couples and far coupled systems, dunker ley's approximation method, rayleigh method, matrix method, matrix iteration, orthogonality principle, orthogonality, expansion theorem and modal analysis, stodola method, holzer method, galerkin method, rayleigh- ritz method, myklested – prohl method for far coupled systems, transfer matrix method

UNIT 3. Experimental methods in vibration analysis: vibration instruments, vibration exciters, transducers and measurement devices, analyzers, vibration tests:- free and forced vibration tests.

UNIT 4. Vibration of continuous systems: Transverse, flexural, torsional vibration of beams, timoshenko beam, Hamilton principle, vibration of plates, collocation method, myklested – prohl method.

UNIT 5. Transient vibrations: duhamel's integral, method of step input, phase plane method, method of laplace transformation, drop test spectra by laplace transformations.

UNIT 6. Non linear vibrations: non linear vibrations and superposition principle, examples of non linear vibrations, method of dealing with non linear vibrations, phase plane trajectories, method of direct integration, perturbation method, iteration method, Fourier series.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand the fundamentals of mechanical vibrations leading to analysis of first degree of freedom
- To understand the concept of two degree of vibration and vibration isolation and transmissibility
- Analyse experimental methods for vibration analysis.

- Understanding the influence and stiffness coefficients.
- Analyse the concept of the non-linearity in vibrations.

Reference books:

1. Theory of vibration with applications:- W. T. Thomson (PHI)
2. Theory and practice of mechanical vibrations:- J. S. Rao & K. Gupta (Wiley eastern)
3. Mechanical vibration :- S. S. Rao (Addison Wesley)
4. Vibration and noise for Engineers :- Kewal Pujara (Dhanpat Rai and Co.)
5. Mechanical vibrations :- G. K. Grover and Nigam (Nem chand and sons)
6. An introduction to mechanical vibrations :- Steidel (John Wiley)
7. Elements of vibration analysis :- Meirovitch (TMH)

M-705-A-4 : TOTAL QUALITY MANAGEMENT

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

Understand the definition of quality given by different qualities Gurus
Have an insight into the concepts & dimensions of quality.
Analyze the enablers for TQM Environment and their impact thereof
Understand the hard options and soft options TQM
Develop Knowledge of tools & techniques, quality awards.

Syllabus:

Introduction

Quality – Basic concepts, dimensions, economics of quality, quality Gurus.
TQM: Definition, evolution, journey from inspection to TQM, comparison at different stages, dimensions of TQM, TQM viewpoints, reasons for adopting TQM.

Introspection to TQM environment

Sphere of TQM, components of TQM, TQM – Managing Total Quality, Factors affecting TQM environment, Classification and interaction among factors, Researchers' viewpoint, TQM as a system, steps in TQM implementation, Roadblocks in TQM implementation, Reasons for TQM failure.

Role of soft options in TQM

Hard vs. Soft factors, Role and expectation of employer, employee, customer and supplier from organization and vice versa. Human factors in TQM, Role of top management commitment, work culture, motivation, coordination, attitude, innovation.

Quality initiatives in organizations

Role of tools and techniques in TQM, Classification of tools and techniques – Problem identification, Data analysis, Graphical, Creativity, Company wide.
Brief description of Quality awards – MBNQA, Deming award, European quality award, Australian quality award.

TQM Effectiveness

Impact of TQM, Need and difficulty in measuring TQM effect, Parameters governing effect of TQM and the attributes thereof.

Course Outcomes (CO's): At the end of the course, the student shall be able to:

- Understand the concepts & dimensions of quality.

- Understand the definition of quality given by different quality gurus.
- Understand the quality at different stages.
- Understand the hard, soft & human factors of quality.
- Develop knowledge of tools & techniques, quality awards.

Reference books:

1) "Total Quality Management" by Oakland (Butterworth – Heinamann Ltd.)
2) "Managing for total quality from Deming to Taguchi and SPC" by Logothetis N. (PHI)
3) "Total Quality Control" by Feigenbaum A.V. (MGH)
4) "Total Quality Management" by Besterfield Dale H (Pearson Education)
5) "A slice by slice guide to TQM" by John Gilbert (Affiliated East West Press)
6) "The TQM toolkit – a guide to practical techniques for TQM" by Waller Jenny, Allen Derek and Burna Andrew (Kogan Page)

Useful weblinks:

1. **http://nptel.ac.in/courses/122106032/pdf/4.1.pdf**
2. **http://nptel.ac.in/courses/110101010/**
3. **http://nptel.ac.in/courses/110105039/10**
4. **http://freevideolectures.com/course/2688/human-Resource-Managment/13**
5. **http://textofvideo.nptel.iitm.ac.in/110105039/lec1.pdf**

Note: Each student will review a research paper on TQM as a part of assignment which will carry due weightage.

M-705-A-5 : METAL FORMING ANALYSIS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study effects of temperature and strain rate in metal working and application of finite element methods to metal forming processes. To study plastic deformation problems for metal forming analysis and analysis of important metal forming processes.

Syllabus:

UNIT 1. Stress- Strain relations in Elastic and plastic Deformations, Yield Criteria for Ductile Metals, Work hardening and Anisotropy in Yielding, Flow Curves.

UNIT 2. Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, Upper and lower Bound methods, Slip line field theory

UNIT 3. Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working.Technology and analysis of important metal forming processes- Forging, Rolling, Extrusion. Wire drawing, Sheet Metal forming processes like Deep drawing, Stretch forming, Bending

UNIT 4. Application of Finite Element Methods to Metal Forming Processes- special Discretization, Shape function, Stiffness matrices and their assembly, Implicit and explicit formulations, Elasto-plastic approximations, Lagrangian Vs Eularian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation, steady state solutions for Drawing, Forging, rolling and extrusion problems

UNIT 5. Case Studies- analysis and validation of metal forming processes problems by standard softwares.

UNIT 6. Forming defects in products and their critical effects, remedies.

UNIT 7. An introduction to use of International standards in Metal Forming Problem solutions and system Design

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand application of finite element methods to metal forming processes.

- Understand the formulations of plastic deformation problems for metal forming analysis.
- Understand technology and analysis of important metal forming processes- forging, rolling, extrusion, wire drawing, sheet metal forming processes.
- Understand the thermos-mechanical problem formulation.
- Analyse the effect of friction and lubrication in hot and cold working of materials.

Reference Books :

1. Metal Forming Analysis- R. H. Wagoner, Cambridge University Press.
2. Theory of Elasticity- Dally and Riley
3. Physical Metallurgy- Dieter, McGraw Hill Inc.
4. Metal Forming Handbook by H Frontzek, M Kasparbauer , Springer Verleg

M-705-A-6 : MECHANICAL BEHAVIOR OF MATERIALS

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study plastics, composites, smart materials and non-material. To study improvement in design parameters using non-common metal and analysis of various properties for plastic components, manufacturing techniques of plastics materials.

Syllabus:

INTRODUCTION

Modern materials in design- plastics, composites, smart materials and nanomaterials, Weight reduction using plastics and composites, Properties and uses of plastics, composites, smart materials and nanomaterials in the design of mechanical equipments. Estimation of factor of safety in design.

DESIGN OF PLASTIC COMPONENTS

Analysis of various properties for plastic components, manufacturing techniques of plastics, Various design considerations for plastic components, Applications of plastics in design of mechanical equipments, Mechanical properties of glass filled –polyphenylene, glass filled -polyethylene and glass filled-polyurethane.

DESIGN OF COMPOSITE STRUCTURE

Structure and specific properties of composites, polymer-composite properties and application in aircraft industry, Prediction of service life, Main stages in composite structure design, Technological concept and production structure, Application of composites in passengers aircraft structures, Types of composite joints and their applications, Mechanical –joint design, Stress concentration and hole geometry.

Characteristics of particulate composite materials, Metal-matrix composites, Fatigue failure in particulate composite material, Design and manufacturing of particulate composites, Shot peening for improving fatigue and mechanical properties of particulate composite materials, Mechanical properties of Aluminium-silicon carbide, Aluminium-alumina, Aluminium-boron fibre particulate composites .

SMART MATERIALS

Design and various characteristics of smart materials, Application of smart materials for design of intelligent structures, Smart paint, Modeling analysis and design of simple mechanical systems using smart materials.

NANOMATERIALS

Nanotechnology, Nanoscale, Design applicaions, Nanotubes, Nano-sized particles in composites, Fabrication of nano-sized particles, nanodevices.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand the improvement in design parameters using plastics.
- Understand the improvement in design parameters using composites.
- Understand the improvement in design parameters using smart materials.
- Understand the improvement in design parameters using nano-materials.
- Understand the improvement in design parameters using composites in aircraft structure.

Reference books:

1. Composite manufacturing technology by A.G. Bratukhin and V.S. Bogolyubov, Chapman &Hall publication.

2. Smart Materials and Structures, M.V. Gandhi and B.S. Thomson, Chapman &Hall.

3. Machine Design by R.L. Norton, Pearson Asia publication.

4. Introduction to Nanotechnology, Charles P Poole and Frank J.Owens, Wiley-Inderscience,2003

M-707-A : PROJECT MANAGEMENT

No. of Credits: 4
L T P Total
4 0 0 4

Sessional: 40 Marks
Theory : 60 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To develop project within time, resource & budget,types of projects, project life cycle and decisions.. To align project execution with strategies. To identify project issues clearly and come up with new solutions.

Syllabus:

UNIT 1. Introduction & Overview: Definitions, Types of projects, Project life cycle (Project phases) and decisions.

UNIT 2. Go/ No go decisions based on: a) Project Identification and Screening, b) Project Appraisal: Market, Technical, social, Ecological & Financial, c) Project Selection: Pragmatic, pair wise, MADM approach.

UNIT 3. Development of Project Network: Project description, Work break down structure, Nomenclature, Rules for drawing and representation, consistency and Redundancy in Project Networks, Matrix representation.

UNIT 4. Basic Scheduling with Networks (Forward & Backward Pass)

UNIT 5. CPM & PERT: Activity times, Completion, Floats, Probability (ND usage), Examples, and Problems.

UNIT 6. Project Monitoring & Control: Project adjustments, Crashing: Direct & Indirect cost, Normal & Crash: duration & cost, Resource leveling: Types, usage, leveling, Problems, Managing Risk.

UNIT 7. Role of Human Factors: Dealing with people Team Building and Leadership in Projects, commitment, work culture, motivation, coordination, attitude, innovation.

UNIT 8. Project Completion, Review and Future Directions

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand about the types of projects & project life cycle.
- Complete understanding about development of project network.
- Understand about the crashing of a project.
- Understand Project evaluation & review technique (PERT) & Critical path

method (CPM).

- Understand , how to control & monitor a project.

Reference books:

1. Project Management by Clifford Gray and Erik Larson. (Tata McGraw Hill Edition)
2. Management Guide to PERT/ CPM by Wiest, JD and Levy F.K. (PHI)
3. Industrial Engg. & Mgmt. by Dr Ravi Shankar. Galgotia Publications.

M-709-A : PRESENTATION SKILL DEVELOPEMENT

No. of Credits: 1

L	T	P	Total
0	0	2	2

Course Objectives:

To discuss clearly your idea/topic. To explain process of work in a sequence in clean manner. To have a questionnaire with audience at last. Audience to make understand your topic and to coordinate with the audience.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

- Understand about the ethics of presentation.
- Understand, how to co-ordinate with others.
- Analyze and answer the questions in better manner.
- Understand the ideas of others on same topic.
- Understand, how to keep your presentation simple and effective.

M-711-A: CIM LAB

No. of Credits: 1 Sessional: 30 Marks
L T P Total Theory : 20 Marks
0 0 2 2 Total : 50 Marks

Course Objectives:

- To impart knowledge about the computerized machining and inspection methods in advanced manufacturing systems
- To develop domain knowledge in the field of Computer Integrated Manufacturing (CIM)

List of Experiments:

1. To study general features different parts and specifications of a CNC Machining Centre.
2. To prepare part program and machine a steel/cast iron/aluminium component on CNC Machining Centre.
3. To study general features, different parts and specifications of a CNC Turning Centre.
4. To prepare part program and machine a steel/cast iron/aluminium component on CNC Turning Centre.
5. To study Robot anatomy and related attributes (i.e. different types of joints, links, configurations, drive and control systems, end effectors and sensors used in robots).
6. Demonstration of some small activity of an industrial robot.
7. To study some general features guidance technologies and traffic management system of Automated Guided Vehicles (AGVs).
8. To study different configurations, drive systems and software used in Coordinate Measuring Machine (CMM).
9. To study the basic concept of Machine Vision System

Course Outcomes (CO): At the end of the course, the students will be able to:

1. Understand the basic features of CNC Machining Centres and CNC Turning Centres
2. Understand the part programming of CNC Machining Centres and CNC Turning Centres through live demonstrations of machining examples
3. Learn the basics of Automatic Guided Vehicles (AGVs) and Robotics
4. Learn about the basic knowledge about Coordinate Measuring Machine (CMM) and Machine Vision System

M-713-A: PROJECT

L	T	P
0	0	12

Every student of this programme would work on a project as per guidelines from the department. The project is essentially to be an innovative project in the area of manufacturing technology and automation.

The project report must consist of following chapters:

Chapter 1- Introduction

Chapter 2- Literature Review

Chapter 3- Problem Formulation

(It can span in two to three sub chapters depending on the type and volume of the work)

Chapter 4- Result and Discussion

Chapter 5-Conclusions and future scope

References

Appendix (if any)

Annexure-I,II,III

M-702-A : DISSERTATION

L	T	P
0	0	24

Every student of this programme would work for the completion of his/her dissertation as per guidelines from the department.

INSTRUCTIONS FOR M.TECH. DISSERTATION/ THESIS

1. The thesis shall be computer typed (English- British, Font -Times Roman, Size-12 point) and printed on A4 size paper.
2. The thesis shall be hard bound with cover page in light **green** colour. The name of the candidate, degree (specifying the specialization) ,year of submission, name of the University including school name shall be printed in black on the cover [Refer sample sheet (outer cover)]
3. The thesis shall be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
4. In the thesis, the title page [Refer sample sheet (inner cover)] should be given first then the Certificate by the candidate and the supervisor(s) in sequence, followed by an abstract of the thesis (not exceeding 1500 words). This should be followed by the acknowledgment, list of figures/list of tables, notations/nomenclature, and then contents with page numbers.
5. In the body of the text, a reference should be indicated giving author's name and year of publication in parenthesis such as (Malhotra and Singh, 2016).
6. The reference should be given at the end of the Thesis in alphabetical order indicating:

   i). The authors name and his initials and if more than two co-authors are there then you can give first author details followed by et.al.

   ii). The title of the paper and name of the journal

   iii). The name of the book and the publisher

   iv) The number of the volume, page numbers, and the year of publication

   (v) standard abbreviation may be used in the names of the journals

For Example:

A. Singh, S. and Shan, H. S. (2002) *"Development of Magneto Abrasive Flow Machining Process",* International Journal of Machine Tools & Manufacturing, vol. 42, 2, pp. 953-959.

B. Laroiya, S.C. and Adithan, M. (1994), *"Precision Machining of Advanced Ceremics"* Proceeding of the International Conference on Advanced Manufacturing Technology (ICMAT - 94), University Teknoloi Malaysia, Johor Bahru ,Malaysia, pp 203-210.

C. Adithan, M. and Gupta, A.B. (1996), *"Manufacturing Technology",* New Age, International Publishers, New Delhi.

7. The diagrams should be printed on a light/white back ground, Tabular matter should be clearly arranged. Decimal point may be indicated by full stop(.)The caption for Figure must be given at the BOTTOM of the Fig. and Caption for the Table must be given at the TOP of the Table only.

8. The graphs should be combined for the same parameters for proper comparison. Single graph should be avoided as far as possible.

9. Conclusions must not exceed more than two pages.

10. The thesis must consist of following chapters

Chapter 1- Introduction

Chapter 2- Literature Review

Chapter 3- Problem Formulation

(It can span in two to three sub chapters depending on the type and volume of the work)

Chapter 4- Result and Discussion

Chapter 5-Conclusions and future scope

References

Appendix (if any)

Annexure-I,II,III

The Syllabus for Open Elective Subjects

Intelligent Systems (OEC-1)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1: Fundamental Issues In IS : Defi of AI , History ,Domains AI ,AI problems & State space ,Some examples problems representations like Travelling Salespersons ,Syntax analysis Problem .Basic issues to solve AI problems ,Underlying assumptions ,AI techniques ,Level of model ,Criteria for success ,Control strategies ,DFS,BFS

UNIT 2:Heuristic Search Techniques :Generate & Test ,HillClimbing(simple & stipest),Best first search ,A*, AO*, Constraint satisfaction.

UNIT 3:Knowledge Representation Issues :Systax & Semantic for Propositional logic ,Syntax & Semantic for FOPL, Properties for WFF's, Resolution Basics :conversion to clausal form ,Resolution of proposition logic ,Resolution algorithms for predicates ,Problems with FOPL ,Semantic nets ,Frames ,Scripts

UNIT 4:Reasoning Under Uncertainity :An introduction ,Default reasoning & Closed world assumptions ,Model & Temporal logic ,Fuzzy logic ,Basian Probabilstic inference Dempster Shafer theory ,Heuristic reasoning methods

UNIT 5:Planning & Learning :Planning ,Planning in Situational calculus ,Representation for planning ,Partial order palnning, Partial order palnning algorithm ,Learning by Examples ,Learning by Analogy ,Explanation based learning ,Neurals nets ,Genetics algorithms

Unit 6: Minimax: Game playing strategy ,Natural language processing ,Overview of linguistics , Grammer & Language ,Transformation Grammer ,Basic Parsing Techniques, Expert System ,Architecture of Rule based Expert system ,Non Rule based Expert system.

REFERENCES

1. Artificial Intelligence by Elain Rich & Kevin Knight, Tata McGraw Hills Pub.
2. Principals of AI by Nills .J.Nilsson, Pearson Education Pub.
3. Artificial Intelligence by DAN. W.Petterson. Printice Hall of India
4. Artificial Intelligence by Petrick Henry Winston,
5. Artificial Intelligence by Russel and Norvig, Pearson Education Pub.

Web Technology & Information Retrieval(OEC-4)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1. Web Server Technology: Web's Robot global access to information, HTML, HTTP, Accessing a web server, publishing on web server, secure HTTP, Secure Sockets Layer, WWW Proxies, IIS, Case study of apache web server.

UNIT 2 .Web search basics:Background and history,Anatomy of WWW, Web characteristics, Spam, The web graph, The Web Search Users, search engines, architecture of search engines, search tools, DNS resolution, The URL frontier, Link analysis, PageRank,

UNIT 3. Web Crawlers: Basics of Web crawling, Various crawling techniques , incremental crawler, parallel crawler, distributed crawlers, focused crawler, agent based crawler, Hidden web Crawler

UNIT 4. Introduction to Information Retrieval: Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

UNIT 5. Index construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes Index compression: Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression.

Intellectual Property Rights(OEC-5)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1: Introduction to Intellectual Property: Concept of Intellectual Property, Kinds of Intellectual Property, Economic Importance of Intellectual Property, Indian Theory on Private Property: Constitutional Aspects of Property, Constitutional Protection of Property and Intellectual Property, Economic Development and Intellectual Property Rights Protection

UNIT II: Introduction to Patents: Overview, Historical Development, Concepts: Novelty, Utility, Patentable Subject-matter: Patent Act, 1970- Amendments of 1999, 2000, 2002 and 2005, Pharmaceutical Products and Process and Patent , Protection, Software Patents, Business Method, Protection of Plant Varieties and Farmers' Rights Act, 2001, Patenting of Micro-organism

UNIT III: Procedure of Obtaining of Patents: Concepts of a Patent Application,, Specification: Provisional, Complete, Disclosure Aspects, Claims: Principal, Dependant, Omnibus, Examination of Application, Opposition of Application, Sealing of Patents

UNIT IV: Working of Patents – Compulsory License: Commercialization of Inventions: License- Terms of License Agreement, Assignments of Patents, Revocation of Patents

UNIT V: Infringement: What is Infringement?, How is Infringement determined? Who is an Infringer?, Direct, Contributory and Induced, Defences of Infringement:
5.2.1 Research Exemption, Invalidity, Misuse, Failure to mark, Laches and Estoppel and first sale doctrine

References Books:

1. W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000)
2. P. Narayana, Patent Law, Wadhwa Publication
3. Merges, Patent Law and Policy: Cases and Materials, 1996
4. Brian C. Reid, A Practical Guide to Patent Law, 2nd Edition, 1993
5. Brinkhof (Edited), Patent Cases, Wolters Kluwer.
6. Prof. Willem Hoyng & Frank Eijsvogels, Global Patent Litigation, Strategy and Practice, Wolters Kluwer.
7. Gregory Stobbs, Software Patents Worldwide, Wolters Kluwer.
8. Feroz Ali Khader, The Law of Patents- With a special focus on Pharmaceuticals in India, Lexis Nexis Butterworths Wadhwa, Nagpur.
9. Sookman, Computer Law, 1996
10. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009). Eastern Book Company, Lucknow.

Microprocessor and Interfacing(OEC-15)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT1. Architecture of 8085: Functional block diagram—Registers, ALU, Bus systems. Pin configuration, Timing and control signals, Machine cycle and timing diagrams. Interrupts—Types of interrupt, interrupt structure.

UNIT2. Programming of 8085: Instruction format, Addressing modes, Instruction set. Development of assembly language programs.

UNIT3. Interfacing Devices:(a).The 8255 PPI chip: Architecture, pin configuration, control words, modes and Interfacing with 8085. (b). The 8254 PIC chip: Architecture, pin configuration, control words, modes and Interfacing with 8085.

UNIT4. Interrupt and DMA controller: The 8259 Interrupt controller chip: Architecture, pin configuration, control words, modes

UNIT5. Architecture of 8086: Functional block diagram of 8086, details of sub-blocks such as EU, BIU,memory segmentation, physical address computations, pin configuration, program relocation, Minimum and Maximum modes of 8086— Block diagrams and machine cycles.

UNIT6. Programming of 8086: Instruction format, Addressing modes, Instruction set and programs.

TEXT BOOKS:

1. Microprocessor Architecture, Programming & Applications with 8085: Ramesh S Gaonkar; Wiley Eastern Ltd.
2. Microprocessor and applications – A.K.Ray. , TMH

REFERENCE BOOKS:

1. Microprocessors and interfacing : Hall; TMH
2. The 8088 & 8086 Microprocessors-Programming, interfacing,Hardware& Applications :Triebel& Singh; PHI
3. Microcomputer systems: the 8086/8088 Family: architecture, Programming &Design : Yu-Chang Liu & Glenn A Gibson; PHI.
4. Advanced Microprocessors and Interfacing :Badri Ram; TMH

Instrumentation and Control(OEC-17)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1. OSCILLOSCOPE: Block diagram, study of various stages in brief, high frequency CRO considerations. Sampling and storage oscilloscope.

UNIT 2. ELECTRONIC INSTRUMENTS: Instruments for measurement of voltage, current & other circuit parameters, introduction to digital meters.

UNIT 3. GENERATION & ANALYSIS OF WAVEFORMS: Block diagram of pulse generators, signal generators, function generators wave analysers, distortion analysers, spectrum analyser, Harmonic analyser, introduction to power analyser.

UNIT 4. FREQUENCY & TIME MEASUREMENT: Study of decade counting Assembly(DCA), frequency measurements, period measurements, universal counter, introduction to digital meters.

UNIT 5. TRANSDUCERS: Classification, Transducers of types: RLC photocell, thermocouples etc. basic schemes of measurement of displacement, velocity, acceleration, strain, pressure, liquid level & temperature.

UNIT 6.CONTROL SYSTEM : Concept of transfer function, relationship between transfer function and impulse response, order of a system, block diagram algebra, signal flow graphs : Mason's gain formula & its application, characteristic equation, derivation of transfer functions of electrical and electromechanical systems. Transfer functions of cascaded and non-loading cascaded elements.

TEXT BOOK:

1. A course in Electrical & Electronics Measurements &Instrumentation :A.K.Sawhney; DhanpatRai& Sons.
2. Control System Engineering : I.J.Nagrath&M.Gopal; New Age
3. Modern Control Engg : K.Ogata; PHI.

REFERENCE BOOKS.

1. Electronics Instrumentation & Measurement Techniques : Cooper; PHI.

Financial Management(OEC-22)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT-I :Financial management-scope finance functions and its organisation, objectives of financial management; time value of money; sources of long term finance.

UNIT-II Investment decisions: importance, difficulties, determining cash flows, methods of capital budgeting; cost of different sources of raising capital; weighted average cost of capital.

UNIT-III:Capital structure: Meaning, importance, determinants and Theories. Financial and operating leverage; EBIT/EPS Analysis, determinants of dividend policy and dividend models -Walter, Gordon & M.M. models.

UNIT-IV:Working Capital- meaning, need, determinants; estimation of working capital need; management of cash, inventory and receivables.

Suggested Readings:

1. Pandey, I.M., Financial Management, Vikas Publishing House, New Delhi 10th edition 2010
2. Khan M.Y, and Jain P.K., Financial Management, Tata McGraw Hill, New Delhi
3. Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, FinancialManagement, Pearson Education
4. Chandra, Prasanna, Financial Management, TMH, New Delhi
5. Van Horne, James C., Financial Management and Policy, Prentice Hall of India
6. Brigham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
7. Kishore, R., Financial Management, Taxman's Publishing House, New Delhi

Entrepreneur Development(OEC-24)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT I : Concept of Entrepreneur, Characteristics, qualities and pre-requisites of entrepreneur, entrepreneurship and intrapreneur, Entrepreneur vs. Manager; Economic, social and psychological need for entrepreneurship;

UNIT II :Environmental Factors affecting success of a new business, Formulation of business plan, Contents and significance of business plan

UNIT III: Feasibility Study -Preparation of Feasibility Reports: Economic, Technical, Financial and Managerial Feasibility of Project, Methods and procedures to start and expand one's own business

UNIT IV: Role of Government and Promotional agencies in entrepreneurship development, Entrepreneurship Development Programmes

Reference Books:

- Khanka S.S., “Entrepreneurship Development”. S.Chand.
- Desai, A N. "Entrepreneur & Environment". 1990. Ashish, New Delhi.
- Drucker, Peter. "Innovation and Entrepreneurship". 1985. Heinemann, London.
- Jain Rajiv. "Planning a Small Scale Industry: A Guide to Entrepreneurs". 1984. S.S. Books, Delhi.
- Kumar, S A. "Entrepreneurship in Small Industry". 1990, Discovery, New Delhi.
- McClelland, D C and Winter, W G. "Motivating Economic Achievement". 1969. Free Press, New York.
- Pareek, Udai and VenkateswaraRao, T. "Developing Entrepreneurship -A Handbook on Learning Systems". 1978, Learning Systems, Delhi.

Open Electives of ME Department for other PG students of other Departments
(Not for ME Department Students)

Industrial Engineering(OEC-9)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1. Basic Concepts of Industrial Engineering: Definition, Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement - various methods, Time Study - PMTS, determining time, Work sampling, Numerical Problems.

UNIT 2. Productivity, Workforce & Information Management: Productivity Definition, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity, Various methods of Job evaluation & merit rating, Various incentive payment schemes, Organizational & information system structure,

UNIT 3. Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Numerical Problems.

UNIT 4. Materials Management : Strategic importance of materials in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Inventory control systems - P,Q,Ss Systems,determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED,SCM , Numerical Problems.

UNIT 5. Sales Forecasting: Importance, Objectives, Forecasting and Prediction, Types, Classification of Forecasting Methods, Forecast Errors, Costs and Accuracy of Forecasts, Numerical Problems.

UNIT 6. Entrepreneurship : Planning a New Business Venture, Small-scale Industries, Government Policies for Small-scale Industries, Project Identification and Project Formulation, Project Appraisal, Laws Concerning Entrepreneurs, Role of Various National and State Agencies that Render Assistance to Small-scale Industries.

Text Books

1. Production & Operations Management – Chary, TMH, New Delhi.
2. Management Information Systems - Sadagopan, PHI New Delhi.

Reference Books

1. Modern Production Management – S.S. Buffa, Pub.- John Wiley.

2. Operations Management - Schroeder, McGraw Hill ISE.

1. Operation Management - Monks, McGraw Hill ISE.
2. 4. Production & Operations Management - Martinich, John Wiely SE.
3. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall Pub.
4. 1. Industrial Engineering & Operations Management – SK Sharma, Pub-S. K. Kataria
2. 7. Industrial Engineering – Ravi Shankar, Galgotia Pub.

Total Quality Management (OEC-10)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1: Introduction : Quality – Basic concepts, dimensions, economics of quality, quality Gurus.TQM: Definition, evolution, journey from inspection to TQM, comparison at different stages, dimensions of TQM, TQM viewpoints, reasons for adopting TQM.

UNIT 2: Introspection to TQM environment: Sphere of TQM, components of TQM, TQM Managing Total Quality, Factors affecting TQM environment, Classification and interaction among factors, Researchers' viewpoint, TQM as a system, steps in TQM implementation, Roadblocks in TQM implementation, Reasons for TQM failure.

UNIT 3:Role of soft options in TQM :Hard vs. Soft factors, Role and expectation of employer, employee, customer and supplier from organization and vice versa. Human factors in TQM, Role of top management commitment, work culture, motivation, coordination, attitude, innovation.

UNIT 4:Quality initiatives in organizations :Role of tools and techniques in TQM, Classification of tools and techniques – Problem identification, Data analysis, Graphical, Creativity, Company wide. Brief description of Quality awards – MBNQA, Deming award, European quality award, Australian quality award.

UNIT 5: TQM Effectiveness : Impact of TQM, Need and difficulty in measuring TQM effect, Parameters governing effect of TQM .

Reference books:

7) "Total Quality Management" by Oakland (Butterworth – Heinamann Ltd.)
8) "Managing for total quality from Deming to Taguchi and SPC" by Logothetis N. (PHI)
9) "Total Quality Control" by Feigenbaum A.V. (MGH)
10) "Total Quality Management" by Besterfield Dale H (Pearson Education)
11) "A slice by slice guide to TQM" by John Gilbert (Affiliated East West Press)
12) "The TQM toolkit – a guide to practical techniques for TQM" by Waller Jenny, Allen Derek and Burna Andrew (Kogan Page)

Solid Waste(OEC-11)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT I : Sources And Types Of Municipal Solid Wastes :Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes – public health effects. Principle of solid waste management – social & economic aspects; Public awareness; Role of NGOs; Legislation.

UNIT II : On-Site Storage & Processing :On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options

UNIT III : Collection And Transfer :Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

UNIT IV : Off-Site Processing :Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.

UNIT V : DISPOSAL :Dumping of solid waste; sanitary land fills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Text Books/Reference Books:

1. George Tchobanoglous et.al., “Integrated Solid Waste Management”, McGraw-Hill Publishers, 1993.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, “Waste Management”, Springer, 1994
3. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
4. R.E.Landreth and P.A.Rebers, “Municipal Solid Wastes – problems and Solutions”, Lewis Publishers, 1997.
5. Bhide A.D. and Sundaresan, B.B., “Solid Waste Management in Developing Countries”, INSDOC, 1993

Product Design and Development(OEC-12)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1. Introduction: Design theory, design materials, human factors in design, man-machine system, applied ergonomics, characteristics of successful product development, challenges to product development.

UNIT 2.Development process and product planning: Generic development process, Concept development, product development process flows, product planning process, identify customer needs.

UNIT 3. Product specifications and concept generation: Product specification, steps to establish the target specifications, Concept generation, five step concept generation method, concept selection, concept screening, concept testing, product architecture

UNIT 4. Product design methods: Creative and rational, clarifying objectives - the objective tree method, establishing functions- the function analysis method, setting requirements – the performance specification method, determining characteristics – the QFD method, generating alternatives – morphological chart method, evaluating alternatives – the weighted objective method, improving details – the value engineering method and design strategies.

UNIT 5. Design for manufacture: Estimating manufacturing cost, reducing component, assembly and support costs, design for assembly, design for disassembly, design for environment, design for graphics and packaging, effective prototyping – principle and planning

UNIT 6. Industrial design: Its need, impact and quality, industrial design process and its management, legal issues in product design, design resources, economics and management of product development projects.

UNIT 7. Prototyping: Basics and principles of prototyping, prototyping technologies, planning for prototypes

Text Books

1. K.T. Ulrich and S.D. Eppinger, “Product design and development”, Tata McGraw Hill
2. Chitale & Gupta, “Product Development”, Tata McGraw Hill
3. Monks, J. G., “Operations Management”, McGraw Hill, 1997.
4. George Dietor, A material and Processing approach, McGraw Hill

Power Plant Engineering (OEC-13)	
No. of Credits: 3 L T P Total 3 0 0 3	Sessional: 40 Marks Theory :60 Marks Total :100 Duration of Exams: 3 Hours

UNIT 1. Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

UNIT 2. Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

UNIT 3. Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

UNIT 4. Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

UNIT 5. Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

UNIT 6. Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing, Problems.

UNIT 7. Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

UNIT 8. Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Text Books

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Campany Ltd., New Delhi
2. Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition 2001.