

# DAV UNIVERSITY, JALANDHAR



## Course Scheme & Syllabus

### Master of Technology

### In

## *Industrial and Production Engineering*

For Session 2019 onwards

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)**

1. PG students will have a thorough grounding in the key principles and practices of Industrial & Production Engineering, and will apply their engineering skills and knowledge of fundamental principles to the design and implementation of practical systems to meet customer requirements.
2. PG students will be ready for successful employment in design and research in the engineering profession and will be actively engaged in learning, understanding, and applying new ideas and technologies as the field evolves.
3. To develop the capabilities among students so that they have the ability to participate in creative, activities related to Industrial & Production Engineering.
4. To develop communication skills so that the students are able to express ideas clearly and persuasively, in written and oral forms.
5. To develop ability to design and perform experiments in the industrial & production engineering and to acquire the ability to interpret and evaluate experimental results.
6. To develop the ability to work with others as a team, in professional and social environment.
7. To aware students about work ethics.

### **PROGRAMME OUTCOMES (PO's)**

1. The students have proficiency in the area of Industrial & Production Engineering and have the ability to distinguish, estimate, scrutinize and create solutions for various mechanical engineering problems.
2. The students have ability to apply the fundamental knowledge to generate solutions for complex engineering problems. The student has capability to apply the basic research principles to conduct research in wider spectrum of theoretical and practical aspects of the problem.
3. The students have ability to conceptualize the problem and present a broad spectrum of solutions and finally arrive at a feasible and optimal solution.
4. The students have ability to apply research methodologies, tools and techniques to unfamiliar problems. The student has the ability to conduct the experiments, logically analyze and interpret the experimental or theoretical outcome.
5. The students have ability to create or apply modern IT tools and techniques to find out fundamental solutions of problems.
6. The students have ability to communicate efficiently with the society at large related to complex engineering activities. They also have ability to write effective reports and design documentation by adhering to suitable standards.

**SEMESTER-I**

S. No	Subject Code	Name of Subject	L	T	P	Credits	Course Type
1.	MEC752	Advanced Manufacturing Processes	4	0	0	4	Core
2.	MEC753	Metal Cutting and Machine tool design	4	0	0	4	Core
3.	MEC754	Production Planning and Control	4	0	0	4	Core
4.		Elective – 1*	4	0	0	4	PE
5.		Elective – 2*	4	0	0	4	PE
6.	MEC756	Advanced Manufacturing Technology Lab	0	0	4	2	Core
7.		Audit course-1	2	0	0	0	AC
<b>Total</b>			<b>20</b>	<b>0</b>	<b>6</b>	<b>22</b>	

**SEMESTER-II**

S. No	Subject Code	Name of Subject	L	T	P	Credits	Course Type
1.	MEC715A	Research Methodology and IPR	4	0	0	4	Core
2.	MEC755	Product Design and Development	4	0	0	4	Core
3.	MEC763	Methods Engineering and Ergonomics	4	0	0	4	Core
4.		Elective – 3*	4	0	0	4	PE
5.		Elective – 4*	4	0	0	4	PE
6.	MEC764	Industrial Engineering Lab	0	0	4	2	Core
7.	MEC765	Seminar and Dissertation Writing	0	0	4	2	MP
8.		Audit course-2	2	0	0	0	AC
<b>Total</b>			<b>20</b>	<b>0</b>	<b>0</b>	<b>24</b>	

**SEMESTER-III**

S. No	Subject Code	Name of Subject	L	T	P	Credits	Course Type
1.		Elective – 5*	4	0	0	4	PE
2.		Open Elective*	3	0	0	3	OE
3.	MEC795	Dissertation Phase – I	0	0	12	6	Dissertation
<b>Total</b>			<b>8</b>	<b>0</b>	<b>16</b>	<b>13</b>	

**SEMESTER-IV**

S. No	Subject Code	Name of Subject	L	T	P	Credits	Course Type
1.	MEC796	Dissertation Phase – II	0	0	24	<b>12</b>	Dissertation

PE- Program Elective, MP – Mini Project, AC- Audit Course

\*-ref page no. 5

**Program Elective (PE) Baskets****ELECTIVE-1**

<b>S. No</b>	<b>Subject Code</b>	<b>Name of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	MEC711	Computer Control of Machine Tools	4	0	0	4
2.	MEC775	Advanced Materials	4	0	0	4
3.	MEC789	Business Policy and Strategies	4	0	0	4
4.	MEC790	Instrumentation and Control	4	0	0	4

**ELECTIVE-2**

<b>S. No</b>	<b>Subject Code</b>	<b>Name of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	MEC702	Advanced Mechatronics	4	0	0	4
2.	MEC703	Computer Integrated Manufacturing System	4	0	0	4
3.	MEC721	Industrial Automation	4	0	0	4
4.	MEC751	Casting and Welding Technology	4	0	0	4

**ELECTIVE-3**

<b>S. No</b>	<b>Subject Code</b>	<b>Name of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	MEC705	Robotics	4	0	0	4
2.	MEC761	Metrology and Computer Aided Inspection	4	0	0	4
3.	MEC762	Total Quality Management	4	0	0	4
4.	MEC783	Entrepreneurship	4	0	0	4

**ELECTIVE-4**

<b>S. No</b>	<b>Subject Code</b>	<b>Name of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	MEC777A	Casting & Welding Metallurgy	4	0	0	4
2.	MEC781	Organization Theory and Behaviour	4	0	0	4
3.	MEC782	Material Management	4	0	0	4
4.	MEC784	Management Information System	4	0	0	4

**ELECTIVE-5**

<b>S. No</b>	<b>Subject Code</b>	<b>Name of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	MEC725	Non-Destructive Testing	4	0	0	4
2.	MEC785	Industrial Psychology	4	0	0	4
3.	MEC786	Tribology	4	0	0	4
4.	MEC787	Maintenance and Reliability	4	0	0	4

**OPEN ELECTIVE**

S. No	Subject Code	Name of Subject	L	T	P	Credits
1.	MGT701	Business Analytics	3	0	0	3
2.	MEC707	Industrial Safety	3	0	0	3
3.	MEC788A	Operations Research	3	0	0	3
4.	CIV903	Cost Management of Engineering Projects	3	0	0	3
5.	CIV904	Composite Materials	3	0	0	3
6.	CIV905	Waste to Energy	3	0	0	3

**AUDIT COURSES**

S. No	Subject Code	Name of Subject	L	T	P	Credits
1.	ENG755	English for Research Paper Writing	2	0	0	0
2.	CIV906	Disaster Management	2	0	0	0
3.	SGS708	Value Education	2	0	0	0
4.	SGS709	Constitution of India	2	0	0	0
5.	EDU701	Pedagogy Studies	2	0	0	0
6.	PHE721	Stress Management by Yoga	2	0	0	0
7.	SGS710	Personality Development through Life Enlightenment Skills	2	0	0	0

\* - MOOC courses

Students can also pursue MOOC courses of equivalent credits floated by NPTEL, SWAYAM in place of Elective courses provided content of such MOOC courses should not match with regular subjects. MOOC chosen against departmental elective has to be a technical course related to mechanical/ industrial and production engineering and for open elective course has to be from any other domain except mechanical engineering/ industrial and production.

# **DETAILED SYLLABUS**

**Course Title: Advanced Manufacturing Processes**

**Paper Code: MEC 752**

L	T	P	Credits
4	-	-	4

**Objective:** Students will learn about

- Non-conventional machining processes, its construction features, Comparison of its aspects.
- Principles, analysis, control parameters and its effect on the response parameters.

**UNIT-A**

**Introduction:** Need of non- conventional machining processes, classification of modern machining processes, process selection, the benefits, and limitations over conventional machining processes.

**Mechanical Energy Based Processes:** Working principles, elements of the process, process parameters, analysis of machining, response characteristics, Applications of the Abrasive Jet Machining, Water Jet Machining, Abrasive water Jet Machining, Ultra sonic machining.

**UNIT –B**

**Electro Chemical and Chemical Based Processes:** Working principles, elements of the process, process parameters, analysis of machining, response characteristics, Applications of the electro chemical and chemical processes, Electro chemical grinding, Electro Chemical Deburring, Electro Chemical Honing, Numericals.

**UNIT –C**

**Electrical Energy Based Processes:** Working principles, elements of the process, process parameters, analysis of machining, response characteristics, Applications of the Electro-discharge machining, laser beam machining, plasma arc machining.

**UNIT –D**

**Rapid Prototyping:** Introduction, steps in RPT, Major RP technologies, Rapid manufacturing, Applications of RPT, future developments, limitations and challenges.

**Learning Outcomes**

Students will be able

1. To classify the various non-conventional manufacturing process based on sources of energy and mechanism employed.
2. To select the best suitable advanced manufacturing process for processing of hard to cut and non-electric Materials employed in current manufacturing industries
3. To study the parametric influences during processing of materials using developed models

**References:**

- 1) Pandey P.C and Shan H.S, *Modern Machining Processes*, Tata McGraw Hill education Pvt. Ltd.,1980.
- 2) Jain V.K., *Advanced Machining Processes*, Allied Publishers Pvt. Ltd. New Delhi, 2007.
- 3) Kalpakjian S., *Manufacturing Engineering & Technology*, Pearson Education Asia, 7<sup>th</sup> edition, 2014.
- 4) Ghosh & Mallick., *Manufacturing Science*, New Age Publishers Pvt. Ltd. New Delhi, 4<sup>th</sup> edition 2011.
- 5) Mishra, P.K., *Non -Conventional Machining*, Narosa Publishing House, Delhi,1997
- 6) <https://nptel.ac.in/courses/112104028/>



**Course Title: Metal Cutting and Machine Tool Design**

**Paper Code: MEC 753**

L	T	P	Credits
4	-	-	4

**Objective:** To impart the fundamental notions of

- The metal cutting and machine tools including mechanics of machining, different parameters, the different types of machine tool.
- Construction, applications and their technological capabilities.
- To provide exposure to the systematic methods for solving the problems of designing machine tools.

**UNIT-A**

**Introduction:** System of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram, Factors affecting cutting temperature, Tool wear and Tool Life.

**Oblique Cutting:** Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting.

**UNIT –B**

**Dynamometry:** Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature.

**UNIT –C**

**Cutting Tool Materials and Cutting Fluids:** Introduction, Types of Cutting tool materials, Cutting Fluids, Properties of Cutting Fluids, Types of Cutting Fluids, Requirement of good cutting fluid, and Selection of a cutting fluid & Effect of fluids on cutting variables.

**Cutting Tool Failure Analysis:** Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank, and crater wear analysis, optimum tool life.

**UNIT –D**

**Machine Tool Design:** Design requirements of machine tools, A design approach for machine tools, Identification and quantification of objectives and constraints in machine tool design, Estimation of power requirements and selection of motor for metal cutting machine tool spindles, Design of gearbox, spindle and guide ways, Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and over arms to achieve desired static and fatigue strength, stiffness, dynamic characteristics and other requirements.

### Learning Outcomes

Students will be able to

1. Analyze various forces involved in the machining operations.
2. Design various single and multi-point cutting tools.
3. Analyze heat generation in machining & coolant operations.
4. Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining applications.
5. Demonstrate the inter-relationship between cutting parameters and machining performance measures like power requirement, cutting time, tool life and surface finish and analyze economics of machining operations

### References:

- 1) Brown., *Machining of Metals*. Prentice hall. Print, 1969.
- 2) Shaw., *Principles of Metal cutting*. Oxford I.B.H. Print, 2014.
- 3) Arshimov & Alekree., *Metal cutting theory & Cutting tool design*. MIR Publications. Print, 1970.
- 4) Shan, H. S., *Modern Machining Processes*. New Delhi: Tata McGraw Hill Publishing Co., 2002. Print.
- 5) Jain, Serope, Kalpak., *Manufacturing engineering and Technology*. Addison Wesley Publishing Co., 1995. Print.
- 6) Ghosh, Amitabh., *Manufacturing Processes*. New Delhi: Tata McGraw Hill Publishing Co., 2001. Print.
- 7) N Acherkan., *"Machine Tool Design"*, Volume- 1-4, MIR Publishers, Moscow, 1969.

**Course Title: Production Planning and Control**

**Paper Code: MEC 754**

L	T	P	Credits
4	0	0	4

**Objective:**

- Measure the effectiveness, identify likely areas for improvement, develop and implement improved planning and control methods for production systems.
- Identify different strategies employed in manufacturing and service industries to plan production and control inventory.

### **UNIT-A**

**Concepts of Production Planning & Control:** Concept of Production System, Types of production systems (Job Order Production, Batch Production, and Continuous Production), Concepts of PPC, Definitions, Objectives and Functions of PPC, Organization of PPC Department, Production Planning, Production Control, Principles of sound production control system.

**Sales Forecasting and Market Analysis:** Introduction, Types of forecasting, Objectives and importance of sales forecasting, Process of sales forecasting, Advantages and disadvantages of sales forecasting, Factors affecting forecasting, Methods of sales forecasting, Market analysis.

### **UNIT –B**

**Process Planning, Operation Planning and Capacity Planning:** Process planning, Pre requisites of process planning, Steps in process planning, Factors affecting process planning, Make or Buy decision, Operation Planning, Capacity Planning.

**Aggregate Planning: MRP and MPS:** Aggregate planning, Cost relevant with aggregate planning, Concept of MRP, Inputs to MRP (MPS, Bill of materials, Inventory status file), Working of MRP, MRP Outputs, Computerized system of MRP, Benefits and limitations of MRP.

**Selection of Materials, Methods, Machines and Manpower:** Selection of materials, Process selection, Machine selection, Recruitment and selection of manpower.

### **UNIT-C**

**Routing, Scheduling and Dispatching:** Routing (Routing procedure, Route Sheet, Routing in different production system), Scheduling (Factor affecting scheduling, Master schedule, production schedule and Machine loading), Dispatching (Work order documents, Dispatching rules, Centralized and Decentralized dispatching)

**Line Balancing:** Introduction, Terminology, Methods

**Progress Control:** Progress control through records and charts, Functions of progress control

## UNIT -D

**Factory Location, Plant Layout and Material Handling:** Nature of location decisions, Importance of plant location, Choice of site for location, State regulations on location, Comparison of locations, Suburban area, Economic survey of site selection, Plant layout, Situations, in which plant layout problem may arise, Factors influencing plant layout, Principles of plant layout, Techniques used in plant layout, Types, Symptom of bad plant layout, Storage space requirement, Flow pattern, Material Handling, Factors to be considered in material handling problems, Principles of material handling, Material handling devices.

### Learning Outcomes

Students will be able to

1. Recognize the objectives, functions, applications of PPC and forecasting techniques.
2. Solve routing and scheduling problems and summarize various aggregate production planning techniques.
3. Able to make the economic analysis of the suitable site for plant and choose the suitable material handling equipment's etc.
4. Students will develop an integrated framework for strategic thinking and decision making to analyze the enterprise as a whole with a specific focus on the wealth creation processes

### References

- 1) Mahajan M., *Production Planning & Control*. New Delhi: Dhanpat Rai & Co. Print.
- 2) Buffa., *Production and Operations Management*. Wiley. Print-8ed,2007.
- 3) Jain and Agarwal, *Production Planning & Control*. New Delhi: Khanna Publishers, 2004.
- 4) Bhatt Shridara, k., *Production and Operation Management*. New Delhi: Himalaya Publication, 2011.
- 5) Dalela S, Ali Mansoor., *Industrial Engineering and Management Systems*. Standard Publishing Distributors, 2000.
- 6) Philip E Hicks., *Industrial Engineering & Management –A new perspective*. Tata Mcgraw Hill.
- 7) <https://nptel.ac.in/courses/112107238/26>

**Course Title: Advanced Manufacturing Technology lab**

**Paper Code: MEC 756**

**Objective:** Students will learn the practical learning objectives in the lab related to advance manufacturing technology.

L	T	P	Credits
-	-	4	2

**List of Experiments:**

- 1) To perform the various lathe operations on the given job.
- 2) To perform the welding on TIG welding set-up.
- 3) To perform the welding on MIG welding set-up.
- 4) To develop the part programme of a given job to be machined on CNC lathe.
- 5) To develop the part programme of a given job to be machined on CNC machining centre.
- 6) To study the construction and working of CNC turning centre.
- 7) To study the construction and working of CNC machining centre.
- 8) To study the construction and working of CNC EDM machine.
- 9) To study the construction and working of CNC Wire EDM machine.
- 10) To study the construction details of ECM set-up and its working principal.
- 11) To study the construction and working of selective layer rapid prototyping technique.

**Note: Students required to perform any eight experiments from the above mentioned list.**

**Course Title: Research Methodology and IPR**

**Paper Code: MEC 715A**

L	T	P	Credits
4	-	-	4

**Course Objective:** The course is designed

- To introduce the students to research methodology and application of research techniques and procedures.
- The primary goal of this course is to develop a sound understanding of research methods.

**UNIT – A**

**Introduction to Research:** Objectives and Types of Research, Research Approaches, Significance and process, Criteria of Good Research, Selecting the Problem, Necessity of Defining the Problem and Technique Involved in Defining a Problem.

**Research Design:** Research Design and its need, Features of a Good Design, Different Research Designs, Basic Principles of Experimental Designs, Factors affecting RDs, Relation among RDs, Developing a Research Plan.

**UNIT – B**

**Sampling Design:** Census and Sample Survey, Steps in Sampling Design, Sampling Procedure, Characteristics and Different Types of Sample Designs, Selection of a Random Sample, Complex Random Sampling Designs.

**Measurement and Scaling Techniques:** Measurement in Research, Measurement Scales, Sources of Error in Measurement, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques.

**UNIT – C**

**Methods of Data Collection:** Collection of Primary Data, Observation Method, Interview Method, Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

**Processing and Analysis of Data:** Measures of Central Tendency, Dispersion, Asymmetry (Skewness), Measures of Relationship Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes, Other Measures.

**Sampling Fundamentals:** Need for Sampling, Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, and Estimation, Estimating the Population Mean, Estimating Population Proportion, Sample Size and its Determination.

**UNIT – D**

**Testing of Hypotheses (Parametric or Standard Tests of Hypotheses):** Basic Concepts and Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means,

Hypothesis Testing for Differences between Means, Hypothesis Testing for Comparing Two Related Samples, Hypothesis Testing of Proportions, Hypothesis Testing for Difference between Proportions, Hypothesis Testing of Correlation Coefficients.

**Design of Experiments and Analysis of Variance and Covariance:** Taguchi and RSM, Analysis of Variance (ANOVA), The Basic Principle of ANOVA, ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA, ANOVA in Latin-Square Design, Analysis of Co-variance (ANOCOVA), ANOCOVA Technique, Assumptions in ANOCOVA.

**IPR:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

### Learning Outcomes

Students will be able to

1. Formulate a preliminary research design for projects in their subject matter areas
2. Precisely collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings
5. Apply the statistical approach to find the significant factors which influence the processes

### References:

- 1) Kothari, C.R. *Research Methods and Techniques*, New Age Publishers. 3<sup>rd</sup> Edition 2014 Print.
- 2) Srivastava, T.N. *Business Research Methods*, TMH. Print-2010.
- 3) Bajpai Naval, *Business Research Methods*, Pearson Publications. Print-2011.
- 4) Malhotra, Naresh K. *Marketing Research: An Applied Orientation*, 5th Edition. Pearson/ Prentice-Hall, 2007. Print.
- 5) Proctor Tony, *Essentials of Marketing Research*, Prentice Hall, 4th Edition 2005, Print.
- 6) <https://nptel.ac.in/courses/107108011/>

**Course Title: Product Design and Development**

**Paper Code: MEC755**

L	T	P	Credits
4	-	-	4

**Objective:**

- To introduce the Objectives of product design and the Requirements of a Good Product Design.
- To expose the students to different Design Principles like Designing for function, Production, Installation and Handling, Maintenance, Packaging etc.

**UNIT-A**

**The Process of Product Design:** Design by evolution, Limitations of evolutionary method in modern design situation, Structure of design process, Morphology of design, Specifications and Standards of performance, Environmental factors, Creativity techniques in design problem.

**UNIT –B**

**Strategies for Search of Design Concepts:** Physical reliability, Economic and Financial Feasibility, Designing for Function, Designing for Production, Tolerance Analysis, Use, Maintenance, Designing for handling and installing, Economics of Design, Human factors in design, Optimization of design, Reverse Engineering of Ergonomic Shape Designs and Visual Design.

**UNIT –C**

**Use of CAD / CAM /CAE:** Software for Concurrent Engineering Design. Case studies in design of products for Manufacture, Aesthetics, Surface styling and shaping tools in CAD software, Exercises in Design, Reverse Engineering and Surface Design and Review Software.

**UNIT –D**

**Elements of testing:** Qualitative and Quantitative Methods including survey, measurement of customers' response, Intellectual Property: Elements and outline, patenting procedures, Claim Procedure. Design for Environment: Impact, regulations from government, ISO system.

**Learning Outcomes**

Students will be able

1. With the application of product design principles student will able to modify/improve engineering systems or to develop new products.
2. The new systems could be designed by considering the concepts of ease of production, maintenance, handling, installation etc.
3. Translate the concepts of economics in design, optimization of design and human factors approach to product design.

**References:**

1. Gupta, V. and Murthy, P.N., *Introduction to Engineering Design Method*, McGraw Hill 1980.



2. Chitale, A. K. and Gupta, R. C., *Product Design and Manufacturing*, Prentice Hall of India 2004.
3. Ulrich, K. T. and Eppinger, S. D., *Product design and development*, Tata McGraw Hill Publications.
4. Kelvin, O. and Krista, W., *Product design*, Pearson Education, Delhi, 2001.
5. Bruce, M. and Rachel, C., *Creative product design*, Johan Willey & sons Ltd., New York, 2000.

**Course Title: Methods Engineering and Ergonomics**

**Paper Code: MEC 763**

**Course Objective:**

L	T	P	Credits
4	-	-	4

- To conduct time and motion study to improve the methods/system.
- To impart the knowledge on ergonomics to enhance productivity of the organization.

### UNIT -A

**Work Study:** Introduction, Component of work study, Definition, Need of work study, Applications and advantages of work study, Work study procedure.

**Method Study:** Definition, Objective and Procedure of method study, Recording Techniques: Process Chart, Outline/Operation process chart, Flow process chart. Two handed process chart, Multiple activity chart, Travel chart, Flow diagram, String diagram, Cyclegraph and Cronocycle graph.

**Motion and Film Analysis:** Micro motion study, Therbligs, SIMO Chart, Memo motion study, Models (2D and 3D)

### UNIT-B

**Work Measurement:** Definition, Objective and benefit of work measurement, Basic procedure of work measurement.

**Work Measurement Techniques**

**Work sampling:** Need, confidence levels, sample size determinations, random observation, and conducting study with the simple problems.

**Stop Watch Time Study:** Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors affecting rate of working, allowances and standard time determination.

**Predetermined Motion Time Study (PMTS)**

**Method Time Measurement (MTM)**

### UNIT-C

**Ergonomics:** Introduction, Areas of study under Ergonomics, System approach to Ergonomics model, Man-Machine System. Components of Man Machine System and Their functions – Work capabilities of Industrial Worker, Design of work space, chair table.

**Controls:** Hand controls and foot controls, location of controls and work place envelope. Recommendation about hand and foot push buttons, rotary selector switches, hand wheels, crank levers etc. Instruments and displays.

**Work Load:** Static and dynamic muscular work, Human motor activity, metabolism, physical work load, measurement of physical work load, mental work load, measurement of mental work load, repetitive and inspection work, work duration and rest pauses, principles of motion economy.

## UNIT-D

**Climate:** Heat Humidity: Body heat balance, effective temperature scales, and zones of discomfort, effect of heat on body and work performance

**Vibration:** Terminology, Response of body to low frequency (LF) vibration, vibrations and discomfort, effect on health of worker, high frequency vibration, effect of H.F. vibrations, methods of reducing vibrations, analysis.

**Noise:** Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance, reduction of noise, personal noise protection.

### Learning Outcomes

Students will be able to

1. With the application of product design principles student will be able to modify/improve engineering systems or to develop new products.
2. The new systems could be designed by considering the concepts of ease of production, maintenance, handling, installation etc.
3. Translate the concepts of ergonomics in design, optimization of design and human factors approach to product design.

### Reference books

- 1) Dalela and Ali, Mansoor. *Industrial Engineering and Management Systems*. New Delhi Standard Publishing Distributors. Print.
- 2) Wickens. *An introduction to Human Factors Engineering*. New Delhi: PHI. Print.
- 3) Ralph Barnes, *Motion and Time study*. John Wiley. 8th Edition. 1985. Print.
- 4) Sanders and McCormick E. J., *Human Factors in Engineering Design*. Tata McGraw Hill. 6th Edition. Print.
- 5) Wledon, *Engineered work Measurement*. ELBS. 1991. Print.
- 6) Shah, H.S. *Work study and Ergonomics*. New Delhi: Dhanpat Rai & Sons. 1992. Print.
- 7) Bridger. *Introduction of Ergonomics*. Tata McGraw Hill. 1995. Print.
- 8) Lyle, Yerges, F. *Sound, Noise and Vibration Control*. Van Nostrand. 1978. Print.

**Course Title: Industrial Engineering Lab**

**Paper Code: MEC 764**

**List of Experiments:**

L	T	P	Credits
-	-	4	2

1. To study different graphical tools for method study.
2. To draw flow process chart on different activities in Workshop/ Laboratory/ Office.
3. Computation of sales forecasting techniques and validation.
4. To conduct time study of bulb holder assembly operation of existing method.
5. Exercise on time study in athletic ground for 4\*100 m relay.
6. Exercise on performance rating to compute standard time for job.
7. Exercise on drawing String Chart by taking real time problem.
8. Sample exercise on ergonomic application.

**Course Title: Seminar and Dissertation Writing**

**Paper Code: MEC 765**

L	T	P	Credits
0	0	4	2

The students will present a seminar on a topic related to M. Tech scheme and the students will learn how to write the dissertation chapters.

**Learning Outcomes**

Students will be able to

1. Identify the probable area of research in which student wants to implement and integrate the knowledge and skills, gained during their graduation.
2. Learn how best to present in research papers.

**Course Title: Dissertation Phase-I**

**Paper Code: MEC 795**

L	T	P	Credits
0	0	12	6

As per policy document of DAV University, wide reference no. **DAVU/Regr/2016/2613**

**Course Title: Dissertation Phase-II**

**Paper Code: MEC 796**

L	T	P	Credits
0	0	24	12

As per policy document of DAV University, wide reference no. **DAVU/Regr/2016/2613**

# **PROGRAM ELECTIVES**



**Course Title: Advanced Mechatronics**

**Paper Code: MEC 702**

**Objective:**

L	T	P	Credits
4	-	-	4

- To introduce the students with the sensor technology, signal conditioning, digital electronics and control systems.
- To learn how to apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems.
- To study the hydraulic and pneumatic systems employed in manufacturing industry.
- To learn the CNC technology and industrial robotics as applications of Mechatronics in manufacturing automation.

**UNIT -A**

**Introduction:** Definition of Mechatronics. Mechatronics in manufacturing, products and design. Review of fundamentals of electronics. Digital Electronics: Digital logic, number systems, logic gates, Boolean algebra, Karnaugh maps, sequential logic. Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers.

**Sensor Technology:** Sensor and transducers, terminology, displacement, position, proximity - encoders, velocity – tacho generators, force - strain gauges, pressure, temperature-thermocouples, RTDs, thermistors, light sensors - photoelectric sensors, IR sensors, sensor selection.

**UNIT - B**

**Signal Conditioning & Data Presentation System:** Introduction to D-A and A-D converters, operational amplifier, protection, filtering, Wheatstone Bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse-modulation, Data presentation systems- display, data presentation elements, magnetic recording, testing calibration, interface D-A and A-D converters.

**Precision Mechanical Actuation:** Pneumatic actuation systems, electro-pneumatic actuation systems, hydraulic actuation systems, electro-hydraulic actuation systems, mechanical systems, types of motion, kinematics, inverse kinematics, timing belts, ball screw and nut, linear motion guides, linear bearings, harmonic transmission, bearings, motor / drive selection.

**UNIT - C**

**Drives:** stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Relays and solenoids, stepper motors, DC brushed and brushless motors, DC servo motors, AC / DC motors for non-servo motion drives, braking methods, pulse width modulated, Bipolar driver, Mosfet drives, SCR drives, variable frequency drives.

## UNIT - D

**Control System:** System transfer function, Laplace transformation and its applications, continuous and discrete processes, proportional control, integral control, differential control, PID control, digital controllers, control system performance, controller tuning, adaptive control, frequency response, PLC, PMC, Mechatronics design approach, possible mechatronics design solution for timed switch, wind screen, wiper motion, bathroom scale, pick and place robot, automatic camera, engine management system and bar code recorder. Introduction to MEMS, NEMS and nanotechnology.

### Learning Outcomes

Students will be able

1. Identify the suitable sensor and actuator for a Mechatronics system
2. Select suitable logic controls
3. Analyze continuous control logics for standard input conditions
4. Develop ladder logic programming
5. Design hydraulic/pneumatic circuits
6. Design a mechatronic system

### Recommended Books:

1. Kamm, *Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics*. New Delhi: Prentice-Hall of India. Print.
2. Koren, *Computer Control of manufacturing system*. New Delhi: Tata McGraw Hill. Print.
3. Groover. *Production Systems and CIM*. New Delhi: PHI. Print.
4. Maleki, *Flexible Manufacturing systems*. New Delhi: Prentice Hall. Print.
5. Kuo, B.C. *Feedback Control Systems*. New Delhi: PHI. Print.
6. Bolton, W., *Mechatronics: electronic control systems in mechanical and electrical engineering*, Longman, Singapore, 1999.
7. A. Smaili and F. Mrad, *Applied Mechatronics*. USA: Oxford University Press. Print., 2008.
8. Alicatore D. G. and Histan M. B., *Introduction to Mechatronics & Measurement Systems*. New York: McGraw-Hill. Print. Fourth Edition, 2007.
9. <https://nptel.ac.in/courses/112103174/1>

**Course Title: Computer Integrated Manufacturing System**

**Paper Code: MEC 703**

L	T	P	Credits
4	-	-	4

**Objective:** In this course, the student will

- Develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
- Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- Describe the integration of manufacturing activities into a complete system
- Acquire sensitivity to human-factors related issues as they affect decision making in the factory environment.

**UNIT-A**

Introduction, Automation definition, Types of automation, processing in manufacturing, Production concepts, CIM wheel, evolution of CIM, Financial justification of CIM, Challenges and trends, Benefits of CIM, Fundamentals of computer technology, need of CIM. NC, CNC, DNC, FMC, Management of CIM, Impact of CIM on personnel.

**UNIT –B**

FMS concept, Components, Layouts, planning and implementation, Tool Management systems-Tool monitoring, Work holding devices- Modular Fixturing, flexible Fixturing, flexibility, quantitative analysis of flexibility, application and benefits of FMS, automated material handling system –AGVs, Guidance methods, Automated storage and retrieval systems, computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems.

**UNIT –C**

Group technology, types of coding systems, production flow analysis, Benefits, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.

**UNIT –D**

Data-Manufacturing , data, types, sources, Structure of data models, Data base and DBMS-requirement, RDBMS, Shop floor control, Data logging and acquisition, Automated data collection, control types, fundamentals of communication, communication matrix, network architecture.

**Learning Outcomes**

Students will be able to

1. Apply knowledge of manufacturing engineering and management principles to design and evaluate automated manufacturing systems.

2. Analyze problems of manufacturing and industrial systems to formulate the design requirements for CIM Systems.
3. Design subsystems for CIM Systems by integrating automation with mechanical systems in manufacturing, assembly and testing.
4. Develop advanced tools for evaluating performance of automated systems and for data automation w.r.t materials, machines and other resources.

**References:**

- 1) Kant Vajpayee. S., 'Principles of Computer Integrated Manufacturing, Prentice Hall of India, 1999.
- 2) Radhakrishnan.P, Subramanyan. S,'CAD/CAM/CIM, New Age International publishers, 2000.
- 3) David Bedworth, Computer Integrated Design and Manufacturing, TMH, New Delhi, I Edition 1999.
- 4) Ranky, Paul G., Computer Integrated Manufacturing, Prentice Hall International 1999.
- 5) M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice Hall of India, New Delhi.
- 6) [http://ggn.dronacharya.info/MTech\\_ME/Downloads/QuestionBank/IIISem/ComputerIntegratedManufacturingSystems/NPTEL\\_LINKS\\_10052016.pdf](http://ggn.dronacharya.info/MTech_ME/Downloads/QuestionBank/IIISem/ComputerIntegratedManufacturingSystems/NPTEL_LINKS_10052016.pdf)

**Course Title: Robotics**

**Paper Code: MEC 705**

**Objectives:**

- To impart exposure to basic robot configurations, sensors, actuators.
- To impart knowledge about kinematics/ dynamics, control and programming of robots.

L	T	P	Credits
4	-	-	4

### UNIT-A

**Introduction to Robotics:** Introduction to automation and types, Robot definition, Brief history, Classification of Robots on the basis of configuration and other aspects, Control Method of teaching etc, specifications of robot systems, spatial resolution, accuracy, repeatability, Robot anatomy, work volume, drive systems, power transmission system, Joint notation scheme, control systems, Robot end effectors, Mechanism of operation, Mechanical and other types of grippers, tools as end effectors, End effectors interface.

### UNIT –B

**Robot Actuators Sensors and Controllers:** Actuator and drive elements, hydraulic, pneumatic and electrical drives, Criteria for selection of drives, Sensors like displacement, proximity and range sensors, touch, force sensors, machine vision etc, Robot cell layouts, design of work cells and control, Proportional, integral, derivative, PID control, robot as a work cell controller, use of interlocks.

### UNIT –C

**Kinematics and Dynamics:** Coordinate Frames, Mapping and Transformation, Forward kinematics of robots, D-H algorithm, solution of problems using D-H algorithm, Introduction to inverse kinematics, Existence of solutions, Uniqueness of solutions, solutions techniques, Acceleration of a rigid body, mass distribution, Newton's equation, iterative Newton Euler dynamic formulation, Lagrangian formulation of manipulator dynamics.

### UNIT –D

**Programming and Applications:** Methods of robot programming, Lead through programming, Motion interpolation, use of branching, Textual robot languages, structure, motion commands, speed control, end effector and sensor commands, Application of robots in industrial environments such as in assembly, welding, spray painting, machine loading and unloading etc.

### Learning Outcomes

Students will be able

1. Demonstrate the basic functioning of a robot

2. Identify various components of robots
3. Understand operation and application sensors/actuators for robot.
4. Carryout kinematic analysis, workspace analysis, and trajectory planning for a robot
5. Select an appropriate robot for given industrial inspection and material handling systems.
6. To explain the basic principles of programming and apply it for typical Pick & place, loading & unloading and palletizing applications.

**References:**

- 1) Richard D. Klafter, Thomas .A, ChmiElewski, Michael Negin, *Robotics Engineering an Integrated Approach*, Phi Learning.,2009.
- 2) S.R. Deb, *Robotics Technology and flexible automation*, Tata McGraw-Hill Education., 2009
- 3) Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, *Industrial Robotics, Technology programming and Applications*, McGraw Hill, 2012
- 4) Mittal and Nagrath, *Robotics and control*, , Tata McGraw Hill, 2010
- 5) Francis N. Nagy, AndrasSiegler, *Engineering foundation of Robotics*, Prentice Hall Inc., 1987.
- 6) Craig J.J., *Introduction to Robotics: Mechanics and Control*. Pearson. Print. 2018.
- 7) <http://www.digimat.in/nptel/courses/video/112101099/L01.html>

**Course Title: Computer Control of Machine Tools**

**Paper Code: MEC 711**

L	T	P	Credits
4	-	-	4

**Objective:** The aim of this course is to

- Teach the applications of various Computer Numerical Control Machines.
- Computer Aided Manufacturing- Processes, Operations.
- Design and Operational Characteristics of Key Hardware Components and Programming Techniques.
- Merits and Demerits of Computer Numerical Controlled (CNC) Machines.

**UNIT-A**

**Elementary Concepts in Numerical Control:** Requirement of Machine Tools and its Advantages over Conventional Manufacturing. Structure of NC System Economics of NC for m/c tools, Constructional details of N.C. m/c tools, MCU Structure and Functions, Technique and Procedure of Recuperating Accuracy and Productivity using NC.

**UNIT –B**

**Machine Actuation and Control:** Numerical Control Machine Actuation and Control Drives, Feedback Devices, Counting Devices, DAC and ADCs Interpolator systems along with the Optical, Pneumatic, Hydraulic, Electro- Mechanical and Electromagnetic Control Systems. Control Loop Circuit Elements in PTP system, Contouring System, Incremental and Absolute Systems, Definition and Designation of Control Axes, Tool and Zero Presetting, Work Holding and Setting up of NC M/c.

**UNIT –C**

**CNC, DNC and Adaptive Control Systems:** Types and functions of Computer Numeric Control (CNC), Types and functions of Direct Numeric Control (DNC), Need of Adaptive Control Types, Functions and Types of Adaptive Control-its uses & benefits, Advantages of Combined CNC/DNC Systems. Control systems for Positional Control and Tool Changing Systems, Digital Computer and its Functioning for m/c control, Microprocessor in CNC.

**UNIT –D**

**NC Part Programming:** NC part programming in FANUC system for Mechanical Components, Flexible Tooling, Tool Path Simulation on lathe and milling, Advanced Programming Features, Block Format and Codes, Tool Length and Radius Compensation, Computer Assisted Part Programming, the APT Language- Geometric, Motion, Post Processor and Auxiliary Statements.

**Learning Outcomes**

Students will be able to

1. Understand the current status of CAM systems in the industry.

2. Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning
3. To write APT and manual part programs using G and M codes for lathe and milling m/c.
4. Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.

**References:**

1. Koren, Yoram, *Computer control of manufacturing systems*, McGraw Hill, Singapore, 1983.
2. Kundra, T.K., Rao, P.N., Tewari, N.K., *Numerical control and computer aided manufacture*, Tata McGraw Hills, New Delhi, 1993.
3. Pabla, S., Adithan, M., *CNC Machines*, Willey Eastern, New Delhi.
4. Thyer, G.E., *Computer Numerical Control of Machine Tools*, Industrial Press, Incorporated, USA.1988, Second Edition.
5. <http://www.digimat.in/nptel/courses/video/112105211/L01.html>



**Course Title: Industrial Automation**

**Paper Code: MEC 721**

L	T	P	Credits
4	-	-	4

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

- To identify potential areas for automation and justify need for automation
- To select suitable major control components required to automate a process or an activity
- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.
- To identify suitable automation hardware for the given application.
- To recommend appropriate modeling and simulation tool for the given manufacturing application.

**UNIT-A**

**Introduction:** Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

**UNIT –B**

**Automated Manufacturing Systems:** Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS, and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies.

**UNIT –C**

**Control Technologies in Automation:** Industrial Control Systems, Process Industries versus Discrete- Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms.

**Computer Based Industrial Control:** Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, and SCADA Systems & RTU.

**Distributed Control System:** Functional Requirements, Configurations & some Popular Distributed Control Systems.

**UNIT –D**

**Modeling and Simulation for Plant Automation:** Introduction, need for system Modeling, building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants.

### **Learning Outcomes**

Students will be able to

1. Design, install and maintain automation and control systems.
2. Work at a high level in industry with automation and control systems.
3. Employ high-level PLC control systems in the computer integration of a manufacturing process.
4. Implement the skills required for automation, control and monitoring of industrial processes.
5. Implement industrial processes including discrete manufacturing, control of sequences, batch processing, and process control.
6. Implement computer integrated manufacturing (C.I.M.) and flexible manufacturing systems (F.M.S.).

### **References:**

- 1) Automation, Production Systems and Computer Integrated Manufacturing  
M.P. Grover, Pearson Education.5th edition, 2009.
- 2) Computer Based Industrial Control - Krishna Kant, EEE -PHI, 2nd edition, 2010.
- 3) An Introduction to Automated Process Planning Systems–TiessChiu Chang &Richard  
A. Wysk.
- 4) Performance Modeling of Automated Manufacturing Systems, - Viswanandham, PHI,  
1<sup>st</sup> Edition, 2009.
- 5) [https://onlinecourses.nptel.ac.in/noc18\\_ee12/preview](https://onlinecourses.nptel.ac.in/noc18_ee12/preview)

**Course Title: Non Destructive Testing****Paper Code: MEC 725**

L	T	P	Credits
4	-	-	4

**Objective:** To study and understand the various Non-Destructive Evaluation and Testing Methods, Theory and their Industrial Applications. Upon completion of this course, the students can able to use the various Non-Destructive Testing and Testing methods understand for Defects and Characterization of Industrial Component.

**UNIT-A**

**Introduction:** Non-destructive versus destructive testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, various physical characteristics of materials and their applications in NDT.

**Visual Inspection:** Introduction, basic terms associated with visual inspection, equipment and accessories used for visual inspection, Visual Detection of Discontinuities, Evaluation of test results, application, advantage and limitations.

**UNIT –B**

**Liquid Penetration Testing:** Introduction, principle, equipment, characteristics of penetrants and their types, developer, hazards precautions, Evaluation of test results, application, advantage and limitations.

**Radiographic Testing:** X-ray radiography principle, equipment & methodology-Type of industrial sources and application –Radiographic exposure factor and Technique-gamma ray and X-Ray equipment-Radiographic procedure, interpretation, image quality, Radiographic testing procedures for weld. Precautions against radiation hazards, application, advantage and limitations.

**UNIT –C**

**Magnetic Particle Testing:** Principle of magnetic particle testing, basic terms associated with magnetic particle testing, different methods to generate fields, Magnetic particle testing equipment, Magnetic particle testing procedures, method of de-magnetization, magnetic particle medium, Evaluation of indication, application, advantage and limitations.

**Ultrasonic Testing:** Introduction, principle of operation, basic terms associated with ultrasonic testing, type of ultrasonic propagation and probes, type of transducers, data representation, A-Scan, B-scan, C-scan, and Method for evaluating discontinuities, ultrasonic testing procedures for different component, application, advantage and limitations.

**UNIT –D**

**Eddy Current Testing:** Introduction, principle of operation, basic terms associated with eddy current testing, Factor effecting eddy current-defect-frequency-geometry-conductivity-Proximity (Lift off & Fill Factor), eddy current flow characteristics, test equipment, types of probes, eddy current application and signal display, advantage and limitations.

**References:**

1. Prasad, J and Nair, C. G. K. *Non-Destructive Testing and Evaluation of materials*. Tata McGraw Hill Education Private Limited 2011 Print.

2. Hellier, C. *Handbook of Non-Destructive Evaluation*. Tata McGraw Hill Education Private Limited 2003 Print.
3. Prakash, R. *Non-Destructive Testing Techniques*. 1st revised edition. New Age International Publishers. 2010 Print.
4. Mix, P. E. *Introduction to nondestructive testing*. Second Edition. A John Wiley & Sons, Inc., Publication. 2005 Print.
5. ASM Metals Handbook. *Non-Destructive Evaluation and Quality Control*. American Society of Metals, Metals Park, Ohio, USA, 200. Volume-17. 1990, 2007 Print.
- 6.

**Course Title: Casting and Welding Technology**

**Paper Code: MEC 751**

L	T	P	Credits
4	-	-	4

**Objective:** The main goal of this subject is

- To learn the industrial applications of welding and casting.
- To recognize the required data and information to optimize the design of each process.

**UNIT-A**

**Patterns, Moulding and Core Making Processes:** Pattern design, recent development in pattern design, material and construction, review and critical comparison of various established processes, recent developments e.g. low pressure and ferrous die casting, high pressure moulding, full mould process, flask less moulding, hot and cold box moulding, ceramic shell moulding etc. Sand Plants.

**Solidification:** Solidification of pure metals and alloys, nucleation and growth in alloys, progressive and directional solidification, centerline feeding resistance; rate of solidification, Chvorinov's Rule.

**UNIT-B**

**Gating and Riser:** Gating system and their characteristics, the effects of gate on aspiration, turbulence and dross trap, riser design, risering curves, NRL method riser design, feeding distance, Riser of complex casting, Casting Modulus, Feeder Modulus.

**Fluidity and Gases in Metals:** Measurement of fluidity, effects of various parameters on fluidity, methods of elimination and control of dissolved gases in casting.

**UNIT-C**

Welding and its classification, Electric arc heat source, arc characteristics, arc stability, arc welding power sources, power source characteristics, V-I relationship, different types of electrodes and their applications.

**Gas Metal Arc Welding:** Basic principle, equipments, welding parameters, different modes of metal transfer, various factors affecting metal transfer mode, pulsed MIG welding, Synergic MIG welding.

**Gas Tungsten Arc Welding:** Basic principle, equipment, influence of polarity on bead characteristics, different tungsten electrodes and shielding gases used, pulsed TIG welding and latest trends in TIG welding.

**UNIT-D**

**Submerged Arc Welding:** Basic principle, equipments, process variables and their effects, significance of flux-metal combination, modern developments, narrow gap submerged arc welding, and applications.

**Plasma Arc Welding:** Special features of plasma-arc, transferred and non-transferred arc, keyhole and puddle-in mode of operation, low current and high current plasma arc welding and their applications, plasma cutting, surfacing and applications.

**Resistance Welding:** Principle of contact resistance, temperature distribution, spot welding cycle, inter-relationship between process variables; choice of electrode materials, spot, seam, projection, stud, upset and flash butt welding.

**Learning Outcomes**

Students will be able

2. To understand basic manufacturing processes like casting and welding.
3. To learn various aspects of different manufacturing techniques such as various casting methods and welding methods.
4. To have a broad knowledge to design a casting process for a product and design of welded joints
5. To develop simplified manufacturing processes with the aim of reduction of cost and manpower.
6. To identify/control the appropriate process parameters, and possible defects of manufacturing processes so as to remove them.

**References:**

- 1) Parmar R. S., *Welding Processes and Technology*. New Delhi: Khanna Publishers. 2012. Print.
- 2) Nadkarni, S.V., *Modern Arc Welding Technology*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. 2009. Print.
- 3) Parmar R. S., *Welding Engineering and Technology*. New Delhi: Khanna. 2012. Print.
- 4) Lancaster J.F, *The Physics of Welding*, Pergamon Press, 1984
- 5) Richard L. Little., *Welding and Welding Technology*. New Delhi: McGraw Hill Education. 2017. Print.
- 6) <https://nptel.ac.in/courses/112107144/13>

**Course Title: Metrology and Computer Aided Inspection**

**Paper Code: MEC 761**

L	T	P	Credits
4	-	-	4

**Objective:** The aim of this course is to teach

- The applications of various Metrology techniques for a variety of problems occurring in industries.
- To understand various methods of inspection and understand the basic concepts in Metrology and Computer Aided Inspection.

**UNIT-A**

**Metrology Concepts:** Abbe's principle-need for high precision measurements-problems associated with high precision measurements.

**Standards for Length Measurement:** Shop floor standards and their classification -Light interference-Method of coincidence-Slip gauge calibration-measurement errors.

**UNIT –B**

**Metrology and Techniques:** Standards in metrology, definitions, Traceability, Characteristics Length & Angular measurements-Review of standard instruments, GD and tolerance procedure-Review of dimension & form tolerance and methods of measurement, Tolerance analysis, Surface metrology-Instruments, Methods and new approaches.

**Laser Applications in Metrology:** LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, On-line and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements.

**UNIT –C**

**Special Measuring Instruments and Techniques:** Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalization, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system. Surface and form metrology-Flatness, roughness, waviness, roundness, cylindricity, etc. Computer Aided Metrology-principles and interfacing, software metrology.

**UNIT –D**

**Co-ordinate Measuring Machine:** Types of CMM, Probes used, Applications, Non-contact CMM using electro optical sensors for dimensional metrology, Non-contact sensors for surface finish measurements, statistical evaluation of data using computer, Data integration of CMM and data logging computers.

**Sensors in Inspection:** Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing

applications laser sensors and limit switches. Advanced sensor technology-Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.

### **Learning Outcomes**

Students will be able to

1. Describe basic concepts of Metrology.
2. Select linear, angular and taper measuring instrument for measurement of various components
3. Discriminate between various screws by measuring their dimensions.
4. Separate different gears through measurement of various dimensions of gears
5. Discriminate capabilities of machining process by measuring surface finish of the component produced
6. Evaluate quality of surface produced using various methods
7. Select appropriate temperature measuring device for various applications
8. Describe methods of measurement for various quantities like force, torque, power, displacement, velocity/seed and acceleration.

### **References:**

- 1) Shotbolt, C.S. and Galyer. J., *Metrology for Engineers*, Cassell Publ., Fifth Edition, 1990.
- 2) Busch T. and Delmar R. Harlow, *Fundamentals of dimensional Metrology*, Cengage Learning; 5 edition
- 3) Thomas G. and Butter G., *Engineering Metrology*Worth PUB
- 4) Sabne Soloman, *Sensors and Control systems in Manufacturing*, McGraw Hill Book
- 5) Robert G. Seippel., *Optoelectronics for Technology and Engineering* Prentice Hall India.
- 6) [https://nptel.ac.in/courses/112102103/Module%20G/Module%20G\(2\)/p2.htm](https://nptel.ac.in/courses/112102103/Module%20G/Module%20G(2)/p2.htm)



**Course Title: Total Quality Management**

**Paper Code: MEC 762**

**Objective:**

The aim of this course is to help students understand and utilize

L	T	P	Credits
4	-	-	4

- The concepts of Total Quality Management and Continuous Process Improvement in order to improve product's quality and competitiveness.
- Introduction to the fundamental concepts of statistical process control, total quality management, and the application of these concepts.

### UNIT-A

**Introduction:** Basic concepts in Quality, Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership: Concepts, Role of Senior Management, Quality Council, Quality Statements, and Strategic Planning.

**Statistical Process Control (SPC):** The seven tools of quality, Statistical Fundamentals: Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Acceptance sampling methods-single, multiple and sequential sampling plans; Recent developments in inspection methods. Process capability, Six Sigma: Concepts, Steps and Tools, New seven Management tools.

### UNIT –B

**TQM Principles:** Customer satisfaction: Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement: Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement: Juran Trilogy, PDSA Cycle, 5S, Kaizen, Quality Circles, Quality Models for organizational excellence.

**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 –C

**TQM Tools:** Benchmarking: Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD): House of Quality, QFD Process, Quality by Design (Concurrent Engineering), Total Productive Maintenance (TPM): Concept, Improvement Needs, FMEA: Stages of FMEA.

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

## UNIT –D

**Quality Management Systems:** Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000: Concept, Requirements and Benefits. Certification Requirements, Evolving Standards, Benchmarking and Auditing, Reaching World Class Standards.

### Learning Outcomes

Students will be able

1. To gain basic understanding in total quality management relevant to manufacturing and service industry.
2. To implement the basic principles of TQM in manufacturing and service based organization.
3. To apply the tools and techniques of quality management to manufacturing and services processes.
4. To gain the knowledge on various ISO standards and quality systems.

### References:

- 2) Besterfield Dale H ,*Total Quality Management*, Prentice Hall College Div. Print-1995.
- 3) Oakland, *Total Quality Management*, Butterworth – Heinemann Ltd. Print-2003.
- 4) Feigenbaum.A.V.,*Total Quality Management*, McGraw-Hill. Print, 4<sup>th</sup> Edition 2004.
- 5) LogothetisN. ,*Managing for total quality from Deming to Taguchi and SPC*, PHI, Print-1993.
- 6) John Gilbert, *A slice by slice guide to TQM*, Affiliated East West Press,1993.
- 7) Waller Jenny, Allen Derek and Burna Andrew, *The TQM toolkit – a guide to practical techniques for TQM*, Kogan Page. Print-1995.
- 8) <https://nptel.ac.in/courses/110104080/>
- 9) <https://nptel.ac.in/courses/112107238/47>

**Course Title: Advance Materials**

**Paper Code: MEC775**

L	T	P	Credits
4	0	0	4

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

- Understand the different materials used industries
- Heat treatment of the materials
- Properties of the different materials

### UNIT-A

**Non-Ferrous Materials:** Copper and its Alloys, Aluminum and its Alloys, Nickel and its Alloys, Zinc and Its Alloys, Titanium and its Alloys, Magnesium and its Alloys, Cobalt and its Alloys, Lead and its Alloys

### UNIT –B

**Ferrous Materials:** Production of Iron and Steel, Cast Irons, Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Iron Carbon System, Time Temperature Transformation Relations, Heat Treatment of Plain Carbon Steels, Selective and Surface - Hardening

### UNIT –C

**Polymers, Composites and Ceramics:** Polymer Materials (Introduction), Polymer Structure, Thermoplastics, Thermosets, Elastomers, Types and Applications of Ceramics, Properties of Ceramics Materials, Glass, Cements, Refractories and Advanced Ceramics, Structure of Composites, Metal Matrix Composites, Ceramic Matrix Composites, Polymer Matrix Composites, Fiberglass, Carbon Fibre Reinforced Polymer Composites, Properties of Composites

### UNIT –D

**Miscellaneous Materials:** Smart Materials, Shape Memory Phenomenon and Alloys, Hydrogen Storage Alloys, Functionally gradient material, Adhesives, Metals for Nuclear energy, Sound Insulating Materials

### Learning Outcomes

Students will be able

1. To discover, development and apply the advanced materials at the heart of engineering innovation.
2. To understand the materials' properties, selection, processing and advanced design procedures.
3. to convey a detailed knowledge of advanced polymeric materials, composites, electromagnetic materials and metallic alloys with a particular emphasis on cost, performance, recyclability, ease of processing and manufacturing on engineering applications,

4. To understand composition, microstructure, processing and performance of advanced engineering materials.

**References:**

- 1) William F. Smith, Havad Hashemi and Ravi Prakash, "Material Science and Engineering", Tata McGraw Hill Education (P) Ltd, 2013.
- 2) William D. Callister, Jr. and Balasubramaniam, R., "Callister's Material Science and Engineering", Wiley India (P) Ltd, 2009.
- 3) Gandhi and Thompson, "Smart Materials and Structures", Chapman and Hall, 1992.
- 4) Gladius Lewis, "Selection of Engineering Materials" Prentice Hall, 1989.
- 5) Rama Rao, "Advances in Materials and their applications", Wiley Eastern Ltd, 1993
- 6) [https://onlinecourses.nptel.ac.in/noc18\\_mm12/course](https://onlinecourses.nptel.ac.in/noc18_mm12/course)

**Course Title: Casting and Welding Metallurgy**

**Paper Code: MEC 777A**

**Objective:** This course addresses

- The casting and welding metallurgy, and weld ability of stainless steels, aluminium and its alloys, and other nonferrous structural metals.
- The problems encountered in welding various metals and metal alloys

L	T	P	Credits
4	-	-	4

**UNIT-A**

**Principles of Solidification part-I:** Nucleation kinetics, basic concepts in crystal growth and solidification, solidification of single phase alloy, solidification of eutectics, and solidification of peritectics.

**Principles of Solidification part-II:** Columnar to equiaxed transition, microsegregation and macrosegregation, behaviour of insoluble particle at the solid or liquid interface, low gravity effect during solidification, interpretation and use of cooling curves.

**UNIT-B**

**Entrainment:** Entrainment defects-bifilms, bubbles, extrinsic inclusions, entrainment processes-surface turbulence, oxide skins from melt charged materials, pouring, oxide lap defect I & II, oxide flow tube, micro jetting, bubble trails, furling and unfurling, deactivation of entrained films, soluble, transient films, detrainment, evidence of bifilms, importance of bifilms, four common population of bifilms.

**UNIT-C**

**Basic Solidification Concepts:** Solute Redistribution during Solidification, Solidification Modes and Constitutional Supercooling, Microsegregation and Banding, Effect of Cooling Rate, Solidification Path

**Grain Structure and Microstructure within Grains:** Epitaxial Growth at Fusion Boundary, Nonepitaxial Growth at Fusion Boundary, Competitive Growth in Bulk Fusion Zone, Effect of Welding Parameters on Grain Structure, Weld Metal Nucleation Mechanisms, Grain Structure Control. Solidification Modes, Dendrite and Cell Spacing, Effect of Welding Parameters Refining Microstructure within Grains.

**UNIT-D**

**Post-Solidification Phase Transformations:** Ferrite-to-Austenite Transformation in Austenitic Stainless Steel Welds, Austenite-to-Ferrite Transformation in Low-Carbon, Low-Alloy Steel Welds.

**Weld Metal Solidification Cracking:** Characteristics, Cause, and Testing, Metallurgical Factors, Mechanical Factors, Reducing Solidification Cracking.

**Work-Hardened Materials:** Background, Recrystallization and Grain Growth in Welding, Effect of Welding Parameters and Process.

**Residual Stresses, Distortion, and Fatigue:** Residual Stresses, Distortion, Fatigue, Case Studies.

### Learning Outcomes

Students will be able

1. To understand the role of metallurgy in casting and welding processes method.
2. To understand the phenomenon of solidification behaviour in pure and alloys metals.
3. To understanding and study the different microstructural after casting and welding.
4. To improve mechanical propertied of the casting and weldment metals and can identify what type of heat treatment processes may be required under various conditions.
5. To understand and investigate the Phase Transformations and change their properties under casting and welding processes.
6. To understanding of work hardening and residual stresses developed during casting and welding processes.

### References:

- 1) A.S.M., *ASM Metals Handbook on Casting*. New Delhi: ASM International. Volume 15.
- 2) Nadkarni, S.V., *Modern Arc Welding Technology*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. 2009. Print.
- 3) Linnert, *Welding Metallurgy Volume I and II*. AWS. 2010. Print.
- 4) Kou, S., *Welding Metallurgy*, A Jhon Wiley and Sons, Inc., *Publication Second Edition*
- 5) RichardL. Little., *Welding and Welding Technology*. New Delhi: McGraw Hill Education. 2017. Print.
- 6) A.S.M., *ASM Metals Handbook on Casting*. New Delhi: ASM International. 1992.
- 7) Campbell J., *The Complete Casting Handbook*. New York: Elsevier.
- 8) <https://nptel.ac.in/courses/112107213/35>

**Course Title: Organization Theory and Behavior**

**Paper Code: MEC 781**

L	T	P	Credits
4	0	0	4

**Objective:**

- To provide basic knowledge of key approaches and Models relating to Organizational Behaviour.
- To understand ways of acting effectively and finding ways for controlling human behaviour.
- To apply different concepts relating to managing of conflicts, change, time and stress.

**UNIT – A**

**Conceptual Framework for Organizational Behavior**

**Nature of Organizational Behavior:** Concept, Nature, Disciplines contributing to OB, Foundations of OB, Human behavior approach, OB Models.

**Foundation of Organizational Behavior**

**UNIT –B**

**Individual Dimensions of Organizational Behavior**

**Nature of Human Behavior:** Caused or Autonomous, Process of behavior, Individual differences.

**Personality and Perception:** Concept, Personality theories, Personality development, Determinants of Personality, Personality and Behavior, Perceptual process, Perceptual selectivity, Perceptual organization, Interpersonal Perception.

**Learning, Attitudes and Values:** Concept, Component of learning process, Factors affecting learning, Learning and Conditioning theories, Theories of attitude formation, Factors in attitude formation, Attitude measurement, Attitude change, Method of attitude change, Factors affecting value formation, Types of values.

**UNIT –C**

**Group Dimensions of Organizational Behavior**

**Interpersonal Behavior:** Nature, Transactional analysis, Level of self-awareness, Ego status, Life script, Life positions, Stroking, Psychological games.

**Group Dynamics:** Concept, Formal and Informal groups, Committee, Task force, Quality Circle, Theories of group formation, Significance and dealing with informal groups, Group behavior, Norms, Cohesiveness, Decision making, Techniques of improving group decision making, Inter group behavior.

**Organizational Conflicts:** Concept, Positive and Negative aspect of conflict, Individual level conflict, Goal conflict, Role conflict, Interpersonal conflict, Group level conflict, Organization level conflict, Conflict management.

## UNIT –D

### **Structural and Cultural Dimensions of Organizational Behavior**

**Design of Organization Structure:** Concept, Mechanism of designing structure, Departmentation, Bases of Departmentation, Span of Management, Delegation of Authority, Centralization and Decentralization.

**Forms of Organization Structure:** Line and Staff organization structure, Line and Staff conflict, Overcoming Line and Staff conflict, Types of organization structure.

**Organizational Climate and Culture:** Concept, Developing sound Organizational Climate, Participation and Organizational Climate, Morale, Organizational Culture, Socio-culture features of India and their impact.

### **Learning Outcomes**

Students will be able to

1. Analyze the behavior of individuals and groups in organisations in terms of the key factors that influence organisational behaviour.
2. Assess the potential effects of organisational-level factors (such as structure, culture and change) on organisational behaviour.
3. Critically evaluate the potential effects of important developments in the external environment (such as globalisation and advances in technology) on organisational behaviour.
4. Analyse organisational behavioural issues in the context of organisational behaviour theories, models and concepts.

### **References:**

- 1) L.M.Prasad, *Organisational Behaviour*. S.Chand Publications. Print.
- 2) Stephen P. Robbins, *Organizational Behaviour*. Pearson Publications. *Print*.
- 3) Ahuja, K.K. *Organization Behaviour*. Kalyani Publishers. Print.
- 4) Schermerhorn, Hunt and Osborn. *Organisational Behaviour*. John Wiley, 9th Edition, 2008. Print.
- 5) Udai Pareek. *Understanding Organisational Behaviour*. 2nd Edition. Oxford Higher Education. 2004. Print.
- 6) Mc Shane & Von Glinov. *Organisational Behaviour*. 4th Edition. McGraw Hill. 2007. Print.



**Course Title: Material Management**

**Course Code: MEC 782**

**Objective:**

L	T	P	Credits
4	-	-	4

- To teach the applications of various material management techniques for a variety of problems occurring in daily life.
- Study of integrated approaches to material management.

### **UNIT-A**

**Integrated approach to materials management:** Introduction, materials productivity and role of materials management techniques in improved materials productivity. Cost reduction and value improvement, value analysis for right choice and rationalization of materials.

**Purchasing function:** Objectives, purchase requisitions, types of specification, centralized versus decentralized purchasing, timing of purchases. Purchasing research, identification of right sources of supplies. Make or buy decisions, vendor selection and vendor rating. Negotiations, purchase price analysis and price determination. Purchasing organization, procedures, forms, records and reports. Purchasing as a dynamic profession, transition to supply management.

### **UNIT –B**

**Inventory Management:** Inventory concepts, reasons for holding inventory, types of inventory, inventory reduction tactics. Inventory turnover ratio. Selective Inventory management: ABC, VED, and FSN analysis etc., identifying critical items with selective inventory management.

**Operating Policies:** Continuous review system, periodic review system, comparative advantages and disadvantages of continuous and periodic review systems, hybrid systems. Inventory management across the organization.

### **UNIT –C**

**Optimizing Inventory:** Assumptions for Wilson's lot size model, inventory costs, hidden costs, composition of costs, estimation of inventory related costs, lead time, stock out

point, number of time periods, calculating Economic Order Quantity (EOQ), sensitivity analysis of EOQ model.

**Special Inventory Models:** Finite replenishment rate model, lot size models with planned backlogging, generalized model with uniform replenishment rate, inventory model with lost sales, quantity discount model, one period decisions. Determination of safety stock, service level and uncertainty in demand. Information systems for inventory management.

## UNIT –D

**Stores Management:** Introduction, stores functions, stores organization, stores systems and procedures, stores accounting and verification systems, stores address systems, stores location and layout, store equipment.

**Standardization and Codification:** Classification of materials. Codification, objectives of codification, essential features of codification system, Brisch and Kodak systems, colour coding systems. Standardization and variety reduction.

### Learning Outcomes

Students will be able

1. Develop an ability to perform the role of a materials manager in an organization.
2. Shall be able to manage the activities of materials manager like purchasing, inventory analysis, storage etc.in a scientific manner.
3. Shall be able to improve due date performance through use of MRP techniques with in capacity constraints.
4. Shall be able to analyze the inventory situation of a company and suggest improvements.
5. Shall be able to practice material planning through modern materials management tools like JIT, DBR etc.
6. To lead the teams for effective decision making and coordinate to effect purchase at minimum cost.
7. Understand ethical issues in purchasing and negotiations.

### Reference Books:

- 1) Arnold and Chapman "*Introduction to Materials Management*", Pearson Education Asia, Fourth Edition, (2001).
- 2) Narsimhan, Mcleavey & Billington, "*Production Planning & Inventory Control*", Prentice Hall of India, Second Edition (2003).
- 3) Dobler Donald W., Burt David N., "*Purchasing and Supply Management*", Tata McGraw Hill, Sixth Edition (2001).
- 4) Menon K S, "*Purchasing and Inventory Control*", Wheeler Publishing New Delhi, Third Edition (1997).

- 5) Krajewski L J and Ritzman L P, "*Operations Management*", Pearson Education Asia, Sixth Edition (2004).
- 6) <https://nptel.ac.in/courses/112107238/51>

**Course Title: Entrepreneurship**

**Course Code: MEC 783**

**Objective:**

- Study of applications of various approaches of entrepreneurship.
- To study International entrepreneurship approaches.
- Case study

L	T	P	Credits
3	-	-	3

### **UNIT-A**

**Small Scale Industries:** Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

**Business Incubation:** Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society; future prospects. A few case studies (at least 2).

### **UNIT –B**

**Entrepreneurship Development Programmers':** Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

#### **STEP**

Introduction, Origin, Status in India, Success and failure factors, Govt. policies and incentives, future prospects in India.

### **UNIT –C**

**Special Aspects of Entrepreneurship:** Entrepreneurship, Social entrepreneurship, International entrepreneurship, rural entrepreneurship, Community Development, Women entrepreneurship.

### **UNIT-D**

**Industrial Sickness:** Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs.

**Network Marketing:** Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

#### **Learning Outcomes**

Students will be able to

1. Assess the commercial viability of new technologies, business opportunities and existing companies.
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market.

3. Write scientific reports and communicate the results in a professional manner.
4. Carry out scientific research in the field of entrepreneurship.

**Reference Books:**

- 1) Gupta, P.K., "*Strategic Entrepreneurship*" (Everest Publishing House), 2000.
- 2) Cleland David, "*Project Management – Strategic Design and Implementation*" (McGraw Hill). 5<sup>th</sup> Edition 2007.
- 3) Holl H David, "*Entrepreneurship-New Venture Creation*" (Prentice Hall of India). 1991.
- 4) Steed & Steed, "*Sustainable Strategic Management*" (Prentice Hall of India).
- 5) Kotler, "*Marketing Management*" (Prentice Hall of India), 2015.
- 6) Khalil Tarek, "*Management of Technology*" (McGraw Hill), 1999.
- 7) Steiner Henry, "*Engineering Economic Principles*" (McGraw Hill), 2<sup>nd</sup> Edition, 1996.
- 8) [https://onlinecourses.nptel.ac.in/noc19\\_ge08/preview](https://onlinecourses.nptel.ac.in/noc19_ge08/preview)

**Course Title: Management Information Systems**

**Paper Code: MEC 784**

L	T	P	Credits
4	0	0	4

**Objective:**

- To understand the importance of information in business
- To know the technologies and methods used for effective decision making in an organization.

**UNIT-A**

**Introduction:** Data, Information, Intelligence, Information Technology, Information System, evolution, types based on functions and hierarchy, System development methodologies, Functional Information Systems, DSS, EIS, KMS, GIS, International Information System.

**UNIT-B**

**System Analysis and Design:** Case tools - System flow chart, Decision table, Data flow Diagram (DFD), Entity Relationship (ER), Object Oriented Analysis and Design (OOAD), UML diagram.

**UNIT-C**

**Database Management System:** DBMS –HDBMS, NDBMS, RDBMS, OODBMS, Query Processing, SQL, Concurrency, Management, Data warehousing and Data Mart.

**UNIT-D**

**Security Control and Reporting:** Security, Testing, Error detection, Controls, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT, User Interface and reporting.

**New IT Initiatives:** Role of information management in ERP, e-business, e-governance, Data Mining, Business Intelligence, Pervasive Computing, Cloud computing, CMM.

**Learning Outcomes**

Students will be able to

1. Apply the concepts like data, information, normalization etc. in real life.
2. Help in designing suitable information system for the specific needs of a functional area/organization as a whole.
3. Analyze the errors in the flow of information in an organization and suggest suitable system to rectify this problem.
4. Work as team leaders/coordinators in the team created to develop and implement Computer based information system in an organization.
5. Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making.

6. Analyze and synthesize business information and systems to facilitate evaluation of strategic alternatives.

**Reference:**

- 1) Rahul de, MIS in Business, Government and Society, Wiley India Pvt Ltd, 2012.
- 2) Gordon Davis, Management Information System: Conceptual Foundations, Structure and Development, Tata McGraw Hill, 21st Reprint 2008.
- 3) Haag, Cummings and McCubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005. 9th edition, 2013.
- 4) Jawadegar, "Management Information System", TMH.
- 5) Raymond McLeod and Jr. George P. Schell, Management Information Systems, Pearson Education, 2007.
- 6) James O'Brien, Management Information Systems Managing Information Technology in the E-business enterprise, Tata McGraw Hill, 2004.
- 7) Ralph Stair and George Reynolds, Information Systems, Cengage Learning, 10th Edition, 2012.
- 8) Robert Schulte's and Mary Summer, Management Information Systems –The Managers View, Tata McGraw Hill, 2008.
- 9) Kenneth C. Laudon and Jane Price Laudon, Management Information Systems, Managing the digital firm, PHI Learning / Pearson Education, PHI, Asia, 2012.
- 10) <https://nptel.ac.in/courses/122105022/>

**Course Title: Industrial Psychology**

**Paper Code: MEC 785**

**Objective:**

- To understand the scope & Objective of Industrial Psychology.
- To get knowledge about recruitment, selection, training and development etc.
- To aware about employee stress management and health related issues.

L	T	P	Credits
4	0	0	4

#### **UNIT – A**

**Introduction to Industrial Psychology:** Introduction, Major Fields of Industrial Psychology, Basic Concepts and Characteristics of Industrial Psychology, Methods of Industrial Psychology, Importance of Industrial Psychology, Industrial Psychology and India.

**Job Satisfaction and Motivation:** Introduction, Morale, Motivation at Work, Motivation Theories, Job satisfaction, measuring job satisfaction

#### **UNIT – B**

**Leadership and Group Dynamics:** Introduction, Leadership vs Management, Leadership styles, Approaches of Leadership, Power and Politics in an organization, Ethics, values for managers, Corporate social responsibility, Group dynamics, Formal and informal groups, Teams.

**Stress Management:** Introduction, Stress and its types, Levels of Stress, Managing Stress, Organizational consequences of stress, Steps to be followed in stress management

#### **UNIT – C**

**Maintaining Healthy Environment:** Introduction, Environment for work, Engineering psychology and Ergonomics, Boredom, Fatigue, Monotony, Relieving Boredom, Fatigue and Monotony, Industrial accidents, Factories Act 1948.

**Training and Development:** Introduction, Need and Rationale of Training, Meaning and Nature of Training and Development, Importance of Training, Training Methods, Designing Training, Management Development Techniques, The strategic role of executive development.

#### **UNIT – D**

**Job Analysis:** Introduction, The Concept of Job, Position, Occupation and career, Objectives of Job Analysis, Types of Job Analysis, Purpose of Job Analysis, The process of Job Analysis, Job Analysis: Recent developments, Job Descriptions, Job Specifications, Job design, Approaches to job designing, Techniques of Job design, Job analysis in “Jobless” world.

**Recruitment and Selection: Reliability and Validity of Recruitment Tests:** Introduction, Purpose of Recruitment, Nature and Objectives of Recruitment, Sources of



Recruitment, Recruitment Procedure, Retention of Employees, The realistic job preview, Selection, Selection Tests, Group Discussion.

### **Learning Outcomes**

Students will

1. Understand the major areas of organizational and industrial psychology, including human resources; leadership development; employee training, motivation, and satisfaction; group dynamics, organizational climate; and team-building.
2. Acquire skill in collaborative teamwork, time management, self-motivation, and project planning.

### **References:**

- 1) Singh Narendar, *Industrial Psychology*. McGraw Hill. Print, 2011.
- 2) Spector, *Industrial and Organizational Psychology*. Wiley. Print. 6<sup>th</sup> Edition 2012.
- 3) Blum and Naylor, *Industrial Psychology*. CBS Publishers. Print. 2003.
- 4) Frank and Jeffrey, *Work in 21<sup>st</sup> Century, Introduction to Industrial and Organizational Psychology*. Wiley. Print. 4<sup>th</sup> Edition 2013.
- 5) <http://textofvideo.nptel.ac.in/109104105/lec1.pdf>

**Course Title: Tribology**

**Paper Code: MEC 786**

L	T	P	Credits
4	-	-	4

**Course Objectives:** The students will learn about

- Types, principles and analysis of Friction, Wear and Lubrication.
- Various tests used in Tribology.

**UNIT - A**

**Introduction:** Friction, wear and lubrication, types of engineering contacts: conforming and non-conforming, Types of motion: rubbing, sliding, oscillating, rolling, surface of interaction, elastic and plastic deformations, properties of materials, surface energy and flash temperature theory.

**Friction:** Laws of sliding friction, concept of adhesion, Tabor's model of elastic thermo friction, rolling friction, measurement of friction.

**UNIT - B**

**Wear:** Laws of wear, types of wear such as adhesive, declamation, abrasive, corrosive, fretting, erosive and oxidative. Measurement of wear and friction in atmosphere and different environments, Prevention and control of wear and friction in machines, wear of cutting tools and dies, study of abrasion in grading, lapping/ honing

**Lubrication:** Mechanism of lubrication, Boundary, squeeze film hydrodynamic and elasto hydrodynamic and hydrostatic lubrication, plasto hydrodynamic lubrication, solution of Reynolds's equation in two and three dimensional flow, pressure distribution load carrying capacity friction forces in oil film and coefficient of friction in journal bearing, Solid, Liquid and Gas lubricants types and their applications

**UNIT - C**

**Bearing Design:** Design of bearing, clearance in journal bearing, minimum film thickness, sommar field number, oil grooves and flow of oil in axial and circumferential grooves cavitation's and turbulence in oil bearings, Heat generation and cooling or bearing hydrostatic and dynamic and their applications in machine tools, Design of air bearings and other gas bearings.

**Rolling Friction:** Reynold slip, Heathe cote concept selection of roller bearings and their methods of lubrication design aspects and modes of bearing failures and elastohydrodynamic lubrication.

**UNIT - D**

**Tests and Instrumentation in Tribology:** Sliding friction and wear abrasion test, rolling contact and fatigue test, solid particle and erosion test, Corrosion test Special instruments for lubricant analysis such as optical and infrared spectroscopy and infra-red spectroscopy, atomic absorption and emission spectroscopy, mass spectroscopy, NMR spectroscopy, Xray-diffraction and chromatographic techniques, Use of transducers and

instruments in Tribology- film thickness measurement using modern techniques –  
Development of test rigs for Tribology research.

### **Learning Outcomes**

Students will be able to

### **References**

- 1) Bhusan Bharat. *Principles and Application of Tribology*. John Wiley & Sons, Ltd, 2013, Print.
- 2) Srivastva Sushilkumar. *Tribology in Industries*. S. Chand Publishing, 2001, Print.
- 3) Majumdar B.C. *Introduction to Tribology of Bearing*. S. Chand, 2008, Print.
- 4) Stachowiah G. W. and Batchelor, *Engineering Tribology*. Butterworth Heinemann, Oxford, 2005, Print.
- 5) Khonsari and Booser. *Applied Tribology: Bearing Design and Lubrication*. Wiley Publications, 2008, Print.
- 6) Gohar R., Rahnejat H., *Fundamentals of Tribology*, Imperial College Press, London, 2012, Print.

**Course Title: Maintenance and Reliability**

**Paper Code: MEC 787**

L	T	P	Credits
4	-	-	4

**Objective:** This course aware the students on

- Various maintenance management processes.
- Students to acquire knowledge and technique in reliability engineering and equip students to make decision on sound maintenance and reliability engineering.

**UNIT-A**

**Reliability Engineering:** Reliability concepts and patterns of failure, Failure data, and reliability function, failure rate and hazard rate, Numerical.

**Common Distributions in Failure Mechanisms:** Exponential, Weibull, Gamma, Reliability expressions for constant, Increasing and Decreasing Hazard Rates. Data Analysis, Probability plots for various distributions- Normal, log normal, extreme value, model selection for components failure, failure analysis, Causes and types of failures.

**UNIT-B**

**Reliability Prediction and Analysis:** System reliability- series, parallel and mixed configuration, block diagram method, fault tree and success tree methods, event tree method, Numerical.

**Reliability Design:** Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability.

**UNIT-C**

**Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement..

**Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terotechnology.

**UNIT-D**

**Condition Monitoring:** Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, concept of S/N ratio, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis.

**Safety Aspects:** Importance of safety, Factors affecting safety, Safety aspects of site and plant, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial.

### Learning Outcomes

Students will be able to

1. Understand the different statistical methods available for analysis of different processes
2. Understand the importance of the maintenance and process improvement functions within industry
3. Use the techniques, skills and modern engineering tools necessary for engineering practice.
4. Understand the various methodologies used in industry to estimate the level of reliability and remaining life of a critical component at a certain point in time, using statistical and mathematical techniques where appropriate
5. Meet desired needs that may include issues related to manufacturability, reliability, quality, environment, health and safety, ethics and society.

### References:

- 1) Manna, A., *A Textbook of Reliability and Maintenance Engineering*. New Delhi: I.K. International.
- 2) Khanna, O.P., *Industrial Engineering and Management*. New Delhi: Dhanpat Rai and Sons. 1994. Print.
- 3) Kelly, A., *Maintenance Planning and Control*. Butters worth & Co.1984. Print.
- 4) Srivastava, S.K., *Industrial Maintenance Management*. New Delhi: S. Chand & Co. Ltd. 2017. Print.
- 5) Gupta, A.K., *Reliability Engineering and Technology*. New Delhi: Macmillan India Ltd. 1996. Print.
- 6) Dhillon, B.S., *Reliability, Quality and Safety Engineering*. London: CRC Press.
- 7) <https://nptel.ac.in/courses/112107142/38>
- 8) <https://nptel.ac.in/courses/112105232/2>
- 9) <https://nptel.ac.in/courses/112107142/26>

**Course Title: Operations Research**

**Paper Code: MEC 788A**

L	T	P	Credits
4	-	-	4

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

- understand importance of optimization of industrial process management
- apply basic concepts of mathematics to formulate an optimization problem
- analyses and appreciate variety of performance measures for various optimization problems

### UNIT-A

**Introduction to Optimization Techniques:** Operation Research approach, scientific methods, introduction to models and modeling techniques, methodology and advantages of optimization techniques.

**Duality in Linear Programming, Integer Linear Programming:** Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, two phase method.

**Sequencing:** Introduction, processing N jobs through two machines, processing N jobs through three machines, processing N jobs through m machines.

### UNIT –B

**Inventory Model:** Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.

**Network Analysis:** Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.

### UNIT –C

**Queuing Models:** Concepts relating to queuing systems, basic elements of queuing model, role of Poisson & exponential distribution, concepts of birth and death process.

**Replacement & Maintenance Models:** Replacement of items, subject to deterioration of items subject to random failure group vs. individual replacement policies.

**Non Linear Programming** –One and Multi Variable Unconstrained Optimization, Kuhn-Tucker, Conditions for Constrained Optimization, Quadratic Programming, Separable Programming Convex programming. Non Convex Programming

### UNIT –D

**Simulation:** Introduction & steps of simulation method, distribution functions and random number generation.

**Introduction to Various Evolutionary Optimization Techniques:** i.e. Generic algorithm, NSGA, NSGA-II, Neural Network, Ant colony optimization, Particle swarm optimization etc.

### Learning Outcomes

Students will be able to

1. Describe clearly a problem, identify its parts and analyze the individual functions.
2. Feasibility study for solving an optimization problem.
3. Becoming a mathematical translation of the verbal formulation of an optimization problem.
4. To design algorithms, the repetitive use of which will lead reliably to finding an approximate solution
5. Evaluate and measure the performance of an algorithm.
5. Discovery, study and solve optimization problems.
6. Understand optimization techniques using algorithms.
7. Investigate, study, develop, organize and promote innovative solutions for various applications.

### References:

- 1) Taha, H. A. Operations Research -An Introduction (8<sup>th</sup> edition). New York: Macmillan Publishing Co. 2006.
- 2) Swarup, K., P. K. Gupta and M. Mohan. Operations Research. New Delhi: Sultan Chand & Sons, 2001.
- 3) Hadly, G. Non-Linear and Dynamic Programming. New Delhi: Addison Wesley, Reading Mass. 1967.
- 4) Rao, S. S. Optimization theory and Applications (4<sup>th</sup> edition). New Delhi: Wiley Eastern Ltd. 2009.
- 5) Hagan. T. Howard B. Neural Network Design 2<sup>nd</sup> Edition.
- 6) D. Kalyanmoy. Multi-Objective Optimization Using Evolutionary Algorithms First Edition.
- 7) <https://nptel.ac.in/courses/111105039/>

**Course Title: Business Policy and Strategies**

**Course Code: MEC 789**

L	T	P	Credits
3	-	-	3

**Objective:**

- To teach the different approaches and strategies used in business.
- To framework new policies in business.

### **UNIT-A**

**Introduction:** Definition, nature, scope, and importance of strategy; and strategic management (Business policy). The Strategic management model, Benefits of strategic management.

**Strategy Formulation:** Vision and Mission statements, Importance, Characteristics and components of Mission statement.

**Environmental Appraisal:** Concept of environment, components of environment (Economic, legal, social, political and technological). Environmental scanning techniques- ETOP, QUEST and SWOT (TOWS).

### **UNIT –B**

**The external assessment:** Economic forces, Technological Forces, Competitive forces  
Competitive Analysis: Porters Five Force Model

**The Internal Assessment:** Integrating Strategy and culture, Management, Finance, productions/ Operations, Research and Development, management Information System, value Chain, Evaluation matrix.

### **UNIT –C**

**Strategies in Action:** Objectives Types of Strategies, Integration Strategies, Intensive Strategies, Diversification Strategies, Defensive Strategies, Defensive strategies.

**Strategy Analysis and Choice:** Nature, Frame Work of strategy analysis and choice, Input stage, matching stage, Decision stage.

### **UNIT –D**

**Strategy Implementation:** Policies, Resource allocation, Managing Conflicts, managing Resistance to change, Leadership and corporate culture, Values, Ethics and Strategic control and operational Control. Organizational systems and techniques of strategic evaluation.



### **Learning Outcomes**

Students will be able to

1. Identify and recognise the various levels at which strategic decision making happens in an organization.
2. Make the framework for the new policies in business.

### **References:**

- 1) Kazmi, "*Business Policy & Strategic Management*" Tata McGraw Hill.
- 2) Thomson & Strickland, "*Strategic Management: Concept & Cases*" Tata McGraw Hill.
- 3) Ghemawat, "*Strategy & The Business Landscape*" Pearson Education Asia.
- 4) Ghoshal, Piramal, "*World Class in India*" Penguin Publishers.
- 5) Wheelen & Hungee, "*Strategic Management & Business Policy*" Addison-Wesley.
- 6) Pearce & Robinson, "*Strategic Management*" AITBS New York.
- 7) <https://nptel.ac.in/courses/110108047/>

**Course Title: Instrumentation and Control Engineering**

**Paper Code: MEC 790**

L	T	P	Credits
4	-	-	4

**Course Objectives:** Students will learn about:

- Basic concepts of control engineering, its instrumentation
- Sensors signal transmission,
- Transfer functions of mechanical, electrical, pneumatic and hydraulic systems, its graphical methods.

**UNIT-A**

**Introduction:** Review of basic principles of measurement & process control systems; Elements of instrumentations.

**Instrumentation System Elements:** Introduction, displacement sensors, speed sensors, fluid pressure sensors, fluid flow, liquid level, temperature sensors, sensor selection, signal transmission.

**UNIT-B**

**Measurement:** Principles of dynamic measurement; Transducers, amplifiers and recording systems; measurement of physical variables, i.e. motion, strain, force, torque, temperature, pressure and flow etc. Principles of optical, eddy current based and ultrasonic's based measurement devices for metrological applications; Interferometers; Principles of Holography; Calibration its importance and general principles.

**UNIT-C**

**Control Systems:** Concepts, Controller characteristics. Transfer functions of mechanical, electrical, pneumatic and hydraulic systems; Transients and frequency response; types of control action. Cascade control, feed-forward control, digital control system, control networks

**Process Controllers:** Introduction, on-off control, proportional control, derivative control, integral control.

**UNIT-D**

**Stability:** Concept, criterion and determination by analytical and graphical methods Routh, Hurwitz, Bode and Niquist, Relative stability

**Learning Outcomes**

Students will be able to

1. Use technical literature and other information sources to treat with industrial control and instrumentation engineering problems.

2. Demonstrate knowledge and understanding of chemical process systems as well as the operating principles of common instruments, instrumentation networks, sensors and display units
3. Apply instrumentation principles to specify industrial instruments, sensors and actuators for practical engineering processes, situations and problems.

**References:**

- 1) Doebelin, *Measurement Systems*, McGraw Hill, New Delhi (Pub. at Singapore). July 2017.
- 2) Nagrath & Gopal, *Control System Engg*, 2<sup>nd</sup> Edition-1982.
- 3) Benjamin C. Kuo, *Automatic Control Systems*, Prentice Hall of India, New Delhi. 3<sup>rd</sup> Edition 1975.
- 4) Ogata.K, *Modern Control Engg.*, Prentice Hall of India, New Delhi. 5<sup>th</sup> Edition 2010.
- 5) Holman, *Experimental Methods for Engineers*, McGraw Hill, New Delhi. 2007.
- 6) Gupta & Syal, *Introduction to Metrology*, Dhanpat Rai & Sons, New Delhi.
- 7) D.S. Kumar, *Mechanical measurements*, Metropolis, New Delhi. 4<sup>th</sup> Edition 2009.
- 8) <http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html>

# **OPEN ELECTIVES**

**Course Title: Business Analytics**

**Paper Code: MGT701**

L	T	P	Credits
3	-	-	3

**Course Objectives:** Students will learn about:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Manage business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

### UNIT-A

**Business analytics:** Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

**Statistical Tools:** Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

**Trendiness and Regression Analysis:** Modelling Relationships and Trends in Data, simple Linear Regression.

### UNIT-B

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

**Organization Structures of Business analytics,** Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

### UNIT-C

**Forecasting Techniques:** Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

**Monte Carlo Simulation and Risk Analysis:** Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

### UNIT-D

**Decision Analysis:** Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

**Recent Trends:** Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

### **Learning Outcomes**

Students will be able to

- Think critically in making decisions based on data and deep analytics.
- Use technical skills in predicative and prescriptive modeling to support business decision-making.
- Translate data into clear, actionable insights.

### **References:**

- 1) Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey,, *Business analytics Principles, Concepts, and Applications*, Pearson FT Press.
- 2) James Evans, *Business Analytics*, persons Education.

**Course Title: Industrial Safety****Paper Code: MEC707**

L	T	P	Credits
3	-	-	3

**UNIT-A**

**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT-B**

**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**UNIT-C**

**Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**UNIT-D**

**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

**Learning Outcomes**

Students will be able to

1. Interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces.
2. Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.
3. Collect, manage, and interpret information and data to identify trends and issues in the workplace.
4. Design, support, and evaluate health and safety programs and implement procedures using project management principles and processes appropriate to the task.
5. Affect/manage change by advancing OH&S principles within management systems, cultures, practices, and priorities.

**References:**

- 1) Higgins & Morrow, *Maintenance Engineering Handbook*, Da Information Services.
- 2) H. P. Garg, *Maintenance Engineering*, S. Chand and Company.
- 3) Audels, *Pump-hydraulic Compressors*, McGraw Hill Publication.
- 4) Winterkorn Hans, *Foundation Engineering Handbook*, Chapman & Hall London.



**Course Title: Cost Management of Engineering Projects**  
**Paper Code: CIV903**

L	T	P	Credits
3	-	-	3

### UNIT-A

**Introduction** and Overview of the Strategic Cost Management Process

**Cost concepts in decision-making**; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**Project**: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member.

### UNIT-B

**Importance Project site**: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

### UNIT-C

**Pricing strategies**: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

### UNIT-D

**Budgetary Control**; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

**Quantitative techniques** for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

### References:

- 1) *Cost Accounting A Managerial Emphasis*, Prentice Hall of India, New Delhi
- 2) Charles T. Horngren and George Foster, *Advanced Management Accounting*
- 3) Robert S Kaplan Anthony A. Alkinson, *Management & Cost Accounting*
- 4) Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting*, A. H. Wheeler publisher.
- 5) N.D. Vohra, *Quantitative Techniques in Management*, Tata McGraw Hill Book Co. Ltd.

**Course Title: Composite Materials**

**Paper Code: CIV904**

L	T	P	Credits
3	-	-	3

### UNIT-A

**Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

**Reinforcements:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

### UNIT-B

**Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

### UNIT-C

**Manufacturing of Polymer Matrix Composites:** Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

### UNIT-D

**Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

### References:

- 1) R.W.Cahn, *Material Science and Technology – Vol 13*, VCH West Germany.
- 2) WD Callister, Jr., *Materials Science and Engineering, An introduction*. Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
- 3) Hand Book of Composite Materials-ed-Lubin.
- 4) K.K.Chawla, *Composite Materials*.
- 5) Deborah D.L. Chung, *Composite Materials Science and Applications*.
- 6) Danial Gay, Suong V. Hoa, and Stephen W. Tasi, *Composite Materials Design and Applications*.

**Course Title: Waste to Energy**

**Paper Code: CIV905**

L	T	P	Credits
3	-	-	3

#### **UNIT-A**

**Introduction to Energy from Waste:** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

**Biomass Pyrolysis:** Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

#### **UNIT-B**

**Biomass Gasification:** Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

#### **UNIT-C**

**Biomass Combustion:** Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

#### **UNIT-D**

**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

#### **References:**

- 1) Desai, Ashok V., *Non Conventional Energy*, Wiley Eastern Ltd., 1990.
- 2) Khandelwal, K. C. and Mahdi, S. S., *Biogas Technology - A Practical Hand Book - Vol. I & II*, Tata McGraw Hill Publishing Co. Ltd., 1983.
- 3) Challal, D. S., *Food, Feed and Fuel from Biomass*, IBH Publishing Co. Pvt. Ltd., 1991.
- 4) C. Y. WereKo-Brobby and E. B. Hagan, *Biomass Conversion and Technology*, John Wiley & Sons, 1996.

# AUDIT COURCES

**Course Title: English for Research Paper Writing**

**Paper Code: ENG755**

L	T	P	Credits
2	-	-	0

**Course Objectives:** Students will learn about:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

**UNIT-A**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper,

**UNIT-B**

Abstracts. Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,

**UNIT-C**

Skills needed when writing a Review of the Literature skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

**UNIT-D**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

**References:**

- 1) Goldbort R, *Writing for Science*, Yale University Press (available on Google Books), 2006.
- 2) Day R, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006
- 3) Highman N, *Handbook of Writing for the Mathematical Sciences*, SIAM. Highman's book ,1998.
- 4) Adrian Wallwork , *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.

**Course Title: Disaster Management**

**Paper Code: CIV906**

L	T	P	Credits
2	-	-	0

**Course Objectives:** Students will learn about:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

**UNIT-A**

**Introduction:** Disaster- Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

**Repercussions of Disasters and Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem

**UNIT-B**

**Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches,

**Man-Made Disaster:** Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

**Disaster Prone Areas In India:** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

**UNIT-C**

**Disaster Preparedness And Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

**UNIT-D**

**Risk Assessment:** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival

**References:**

- 1) R. Nishith, Singh AK, *Disaster Management in India: Perspectives, issues and strategies*, New Royal book Company.
- 2) Sahni, Pardeep Et.Al. (Eds.), *Disaster Mitigation Experiences And Reflections*, Prentice Hall Of India, New Delhi.

**Course Title: Value Education**

**Paper Code: SGS708**

**Course Objectives:** Students will learn about:

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

L	T	P	Credits
2	-	-	0

**UNIT-A**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.

Moral and non- moral valuation. Standards and principles.

Value judgements

Importance of cultivation of values.

Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.

**UNIT-B**

Honesty, Humanity. Power of faith, National Unity.

Patriotism.Love for nature ,Discipline

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.

**UNIT-C**

Punctuality, Love and Kindness.

Avoid fault Thinking.

Free from anger, Dignity of labour.

Universal brotherhood and religious tolerance.

True friendship.

Happiness Vs suffering, love for truth.

Aware of self-destructive habits.

Association and Cooperation.

Doing best for saving nature.

**UNIT-D**

Character and Competence –Holy books vs Blind faith.

Self-management and Good health.

Science of reincarnation.

Equality, Nonviolence, Humility, Role of Women.

All religions and same message.

Mind your Mind, Self-control.

Honesty, Studying effectively

**References:**

1. Chakroborty, S.K. *Values and Ethics for organizations Theory and practice*, Oxford University Press, New Delhi.

**Course Title: Constitution of India**

**Paper Code: SGS709**

L	T	P	Credits
2	-	-	0

**Course Objectives:** Students will learn about:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

### UNIT-A

**History of Making of the Indian Constitution:** History, Drafting Committee, (Composition & Working)

**Philosophy of the Indian Constitution:** Preamble Salient Features.

**Contours of Constitutional Rights & Duties:** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

### UNIT-B

**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

### UNIT-C

**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

### UNIT-D

**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

#### References:

1. *The Constitution of India*, Government Publication, 1950 (Bare Act).
2. S. N. Busi, B. R. Ambedkar, *framing of Indian Constitution*, 1st Edition, 2015.
3. M. P. Jain, *Indian Constitution Law*, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, *Introduction to the Constitution of India*, Lexis Nexis, 2015.



**Course Title: Pedagogy Studies**

**Paper Code: EDU701**

L	T	P	Credits
2	-	-	0

**Course Objectives:** Students will learn about:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

### UNIT-A

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions Overview of methodology and Searching.

**Thematic overview:** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

### UNIT-B

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

### UNIT-C

**Professional development:** alignment with classroom practices and follow-up support Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

### UNIT-D

**Research gaps and future directions:** Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

#### References:

1. Ackers J, Hardman F (2001) *Classroom interaction in Kenyan primary schools*, Compare, 31 (2): 245-261.
2. Agrawal M (2004) *Curricular reform in schools: The importance of evaluation*, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign

**Course Title: Stress Management by Yoga**

**Paper Code: PHE721**

**Course Objectives:** Students will learn about:

- To achieve overall health of body and mind
- To overcome stress.

L	T	P	Credits
2	-	-	0

#### **UNIT-A**

Definitions of Eight parts of yog. (Ashtanga).

#### **UNIT-B**

Yam and Niyam.

Do's and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

#### **UNIT-C**

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects- Types of pranayam.

#### **References:**

1. Janardan Swami Yogabhyasi Mandal, *Yogic Asanas for Group Training-Part-I*, Nagpur
2. Swami Vivekananda, *Rajayoga or conquering the Internal Nature*, Advaita Ashrama (Publication Department), Kolkata

**Course Title: Personality Development through Life Enlightenment Skills**

**Paper Code: SGS710**

**Course Objectives:** Students will learn about:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students.

L	T	P	Credits
2	-	-	0

**UNIT-A**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (don't's)

Verses- 71,73,75,78 (do's).

**UNIT-B**

Approach to day to day work and duties.

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48; Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35; Chapter 18-Verses 45, 46, 48.

**UNIT-C**

Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68; Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.

Shrimad Bhagwad Geeta:Chapter 2-Verses 17; Chapter 3-Verses 36,37,42; Chapter 4-Verses 18, 38,39; Chapter 18 – Verses 37,38,63

**References:**

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. P.Gopinath, *Bhartrihari's Three Satakam (Niti-sringar-vairagya)*, Rashtriya Sanskrit Sansthanam, New Delhi.