

# SYLLABUS

With effect from 2018-2019  
Outcome Based Education and Choice Based Credit System

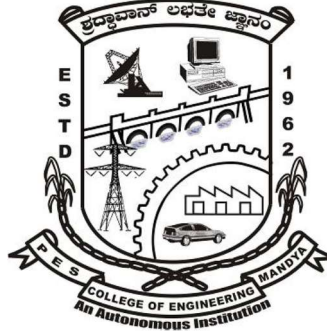
## ಪಠ್ಯಕ್ರಮ

ಶೈಕ್ಷಣಿಕವರ್ಷ 2018-19

ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ ಹಾಗೂ ಐಚ್ಛಿಕ ವಿಷಯಾಧಾರಿತ ಗಳಿಕೆ ಪದ್ಧತಿ

V and VI Semester

## BACHELOR DEGREE IN INDUSTRIAL & PRODUCTION ENGINEERING



## P.E.S. College of Engineering

(An Autonomous Institution Affiliated to VTU, Belagavi,  
Grant -in- Aid Institution (Government of Karnataka), World Bank Funded College (TEQIP)  
Accredited by NBA & NAAC and Approved by AICTE, New Delhi.)

## ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ-೫೧೨೧ ೪೦೧, ಕರ್ನಾಟಕ  
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

## Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight Undergraduate and Six Postgraduate programs. It consists of four M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13<sup>th</sup> June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

*Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.*

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills, Personality Development modules and Technical Skills have been added to the existing curriculum of the academic year 2018-19. Internship have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Technical Skills and Skill Oriented Lab are included in all undergraduate programs.

Dr. Umesh D R  
Deputy Dean (Academic)  
Associate Professor,  
Dept. of CS & Engg

Dr. Nagarathna  
Dean (Academic)  
Professor  
Dept. of CS & Engg.

### **Vision and Mission of the Institution**

#### **Vision**

**“PESCE shall be a leading institution imparting quality engineering and management education developing creative and socially responsible professionals.”**

#### **Mission**

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
- Promote research, product development and industry-institution interaction.

### **DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING**

#### **About The Department**

The Department of Industrial & Production Engineering was started during the year 1982 with a mission to produce the students of good management skill to cater the need of the advanced and globalized market which demand quality management people. The program offered in the department is B.E. in Industrial & Production Engineering. The department has very well experienced qualified teaching faculty among which three doctoral degree holders one is submitting his thesis and two are pursuing Post graduate courses.

The department strives hard to bring out well qualified students through all the available sources of teaching audio visual, interactive methods in teaching-learning process. The department has well-equipped laboratories, latest software facilities, to prepare the students industry ready when they become graduates.

The curriculum is designed involving industry, academia personnel to meet the demands of the current scenario and updated constantly according to industrial needs. The department regularly organizes technical talks by inviting experts from various industries and institutes, organizes industrial visits to enhance the practical knowledge of the students.

## Vision and Mission of the Department

- **VISION**

Contribute to achieve academic excellence for imparting quality education in I & P Engineering and to carry out the research activity on continuous basis to develop competent and social responsible engineers and managers.

- **MISSION**

1. To educate them in the fundamental concept, knowledge, skills in theory and practices.
2. To prepare them through skilled programmes for better Employment as engineers and managers or pursuit of advanced degrees in Industrial, Production and Mechanical Engineering fields.
3. To inculcate qualities of communication skills, professional personality and ethical values to make them the responsible and competent professionals.

### **Program Educational Objectives (PEO)**

**PEO1:** Industrial and Production Engineering program will prepare graduates who will have the ability to apply the principles and techniques of traditional and modern quantitative, qualitative analysis, synthesis and effectively interpret, evaluate, select, and communicate the desired alternative in both manufacturing and service industries.

**PEO2:** Industrial and Production Engineering program will prepare its graduates who will possess the required engineering competence in industrial engineering, production engineering and managerial skills.

**PEO3:** Industrial and Production Engineering program will prepare graduates, who possess communication skills, professional personality and ethical

### **Program Outcomes**

**PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Program Specific Outcomes (PSOs):**

**PSO 1:** Industrial & Production Engineering graduates will be able to apply the knowledge acquired in the program about materials and finishing process.

**PSO2:** Industrial & Production Engineering graduates will be able design product based on Ergonomic Principles.

## Bachelor of Engineering – III Year

### Scheme of Teaching and Examination [CBCS with OBE]

V – Semester										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18IP51	Management and Entrepreneurship	IP	4	-	-	4	50	50	100
2	P18IP52	Work Study and Ergonomics	IP	4	-	-	4	50	50	100
3	P18IP53	Design of Machine Elements	IP	4	-	-	4	50	50	100
4	P18IP54	Theory of Metal Cutting	IP	4	-	-	4	50	50	100
5	P18IP55X	Professional Elective - I	IP	2	2	-	3	50	50	100
6	P18IPL56	Mechanical Engineering Lab	IP	-	-	3	1.5	50	50	100
7	P18IPL57	Computer Aided Drafting and Geometric Modelling Lab	IP	-	-	3	1.5	50	50	100
8	P18IPL58	Skill Oriented Laboratory-I (Advanced Geometric Modelling –I)	IP	-	-	2	1	50	50	100
9	P18IP591	Technical Skills - I (Basic Managerial Skills)	IP	-	2	-	1	50	50	100
10	P18HU510	Aptitude and Reasoning Development - Advance (ARDI)	HM	-	2	-	1	50	50	100
<b>Total</b>							<b>25</b>	<b>500</b>	<b>500</b>	<b>1000</b>

Professional Elective-I		
Sl. No	Course Code	Course title
1	P18IP551	Composite Materials
2	P18IP552	Industrial Robotics
3	P18IP553	Computer Integrated Manufacturing
4	P18IP554	Modern Machining Methods

Technical Skills - I		
Sl. No	Course Code	Course title
1	P18IP591	Basic Managerial Skills
2	P18IP592	Communication and Group Discussion Skills
3	P18IP593	Creativity and Problem Solving Skills
4	P18IP594	Interpersonal Skills

## Bachelor of Engineering – III Year

### Scheme of Teaching and Examination [CBCS with OBE]

VI – Semester										
Sl. No	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18IP61	Engineering Economics	IP	4	-	-	4	50	50	100
2	P18IP62	Theory of Metal Forming	IP	4	-	-	4	50	50	100
3	P18IP63	Quality Assurance and Reliability	IP	4	-	-	4	50	50	100
4	P18IP64X	Professional Elective - II	IP	2	2	-	3	50	50	100
5	P18IPO65X	Open Elective-I	IP	3	-	-	3	50	50	100
6	P18IPL66	Industrial Engineering Lab	IP	-	-	3	1.5	50	50	100
7	P18IPL67	Computer Aided Analysis Lab	IP	-	-	3	1.5	50	50	100
8	P18IPL68	Skill Oriented Laboratory-II (Advanced Geometric Modelling –II)	IP	-	-	2	1	50	50	100
9	P18HU693	Technical Skills – II (Internals of C Programming)	HM	-	2	-	1	50	50	100
<b>Total</b>							<b>23</b>	<b>450</b>	<b>450</b>	<b>900</b>

Professional Elective-II		
Sl. No	Course Code	Course title
1	P18IP641	Plant Layout and Design
2	P18IP642	Human Resource Management
3	P18IP643	Control Engineering and M/C Tool Drive
4	P18IP644	Lean Manufacturing Systems

Open Elective-1		
Sl. No	Course Code	Course title
1	P18IPO651	Principles of Marketing
2	P18IPO652	Financial Management
3	P18IPO653	World Class Manufacturing
4	P18IPO654	Management Information System

<b>Course Title: Management and Entrepreneurship</b>			
<b>Course Code: P18IP51</b>	<b>Sem: V</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture: 52 Hr Exam: 3Hr</b>		<b>Weightage: CIE: 50, SEE: 50</b>	

**Prerequisites:** The students should have basic knowledge of management, organization and the types of organization.

### Course Learning Objectives (CLO)

At the end of the Course the students should be able to,

1. Explain the Nature, Characteristics, Level and Scope of Management.
2. Explain the concept of planning, organising, directing, Motivating and controlling of workers in the organization.
3. Describe the concept of entrepreneurship, types of entrepreneur and role of entrepreneur in economic development.
4. Summarize the steps involved to start a small scale industry (SSI) and the role of supporting agencies to start the SSI.
5. Identify the business opportunities in the market, and importance of ownership in an industry.

### Relevance of the Course

Management and entrepreneurship is a basic subject which deals with the concept of,

1. Management that is planning, organising, directing and staffing activities of an organization.
2. Evolution of Entrepreneurship, development of Entrepreneurship, steps in entrepreneurial process and Role of entrepreneurs in Economic Development,
3. Need, Objectives, Scope & role of SSI in Economic Development, Government Support for SSI during 5 year plans,
4. Project Identification; Project Selection; Project Report, and Identification of Business Opportunities,
5. Partnership & kinds of partners in an industry.

### Course Content

#### Unit – I

**MANAGEMENT:** Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management – Management as a science, art or profession – Management and administration – Roles of management, Levels of management, skills and competence for effective managing, development of management thought – early management approaches – modern management approaches classical approach and neo classical approach.

**9 Hours**

*SSC: Social Responsibility of Manager.*

#### Unit – II

### PLANNING, ORGANIZING AND STAFFING:

**PLANNING:** Nature, purpose of planning process – objectives - Types of plans (Meaning only) - Decision making — steps in planning & planning premises – Hierarchy of plans.

**ORGANIZING:** Nature and purpose of organization, principles of Organizations – Types of organization – Documentation, Committees - Centralization vs. Decentralization of authority and responsibility, span of Control.

**STAFFING:** Nature and importance of Staffing – process of selection and recruitment (in brief).

**10 Hours**

*SSC: Importance of planning process, MBO and MBE (Meaning only).*



### Unit -III

#### **DIRECTING, CONTROLLING AND ENTREPRENEUR:**

**DIRECTING:** Meaning and nature of directing – Leadership styles and motivation theories, communication – Meaning and importance – Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling – Methods of establishing control (in brief).

**ENTREPRENEUR:** Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship – Evolution of Entrepreneurship, development of Entrepreneurship, steps in entrepreneurial process, Role of entrepreneurs in Economic Development: Entrepreneurship in India; Barriers of Entrepreneurship.

**12 Hours**

*SSC: Essentials of a sound control system, Roles of Women Entrepreneurs in Economic Development.*

### Unit -IV

**SMALL SCALE INDUSTRY:** Definition; Characteristics; Need and rationale: Objectives: Scope; role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI – Government policy towards SSI; Different Policies of SSI.; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization & Globalization on S.S.I., Effect of WTO/GATT.

**INSTITUTIONAL SUPPORT:** Different Schemes; TECKSOK; KSSIDC; KSIMC; DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC.

**11 Hours**

*SSC: Ancillary Industry and Tiny Industry, KIADB Role for SSI.*

### Unit – V

**PREPARATION OF PROJECT:** Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

**10 Hours**

*SSC: Contents and Specimen of a project Report.*

#### **TEXT BOOKS:**

1. **Principles of Management** – P.C. Tripathi, P.N. Reddy; Tata McGraw Hill, 5th Edition 2012.
2. **Management and Entrepreneurship** – N. V. R. Naidu & T. Kirshna Rao, I. K. International, New Delhi – 2008.

#### **REFERENCE BOOKS:**

1. **Management Fundamentals** - Concepts, Application, Skill Development– 6th Edition, Robert Lusier –Thomson
2. **Entrepreneurship Development** – S S Khanka – S Chand & Co.
3. **Management** – Stephen Robbins – Pearson Education, PHI -17<sup>th</sup> Edition.
4. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai–Himalaya Publishing House
5. **Entrepreneurship Development**– Small Business Enterprises – Poornima M Charantimath – Pearson Education –2006, 2<sup>nd</sup> Edition.

#### **Course outcomes**

At the end of the Course the students should be able to,

1. Define the meaning, nature, levels and characteristics of management.

2. Describes the nature, types, purpose of planning and taking decision under different conditions, and defines the different organization structures and staffing policies and procedures.
3. Demonstrate the motivation, leadership theories and communication process model, and define the entrepreneurship concept, process and barriers in entrepreneurship.
4. Explain institutional supports given by the government to start Small Scale Industry.
5. Recognize the guide lines to be followed for writing the project report, and to survey the market.

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Define the meaning, nature, levels and characteristics of management.	1							2		3				
Describes the nature, types, purpose of planning and taking decision under different conditions, and defines the different organization structures and staffing policies and Procedures.	2							2		3		2		
Demonstrate the motivation, leadership theories and communication process model and Define the entrepreneurship concept, process and barriers in entrepreneurship.	2	2			2			3	3	3	2	2		
Explain the Institutional supports given by the government to start Small Scale Industry.	2	2			1			3		2	2	2		
Recognize the guide lines to be followed for writing the project report, and to survey the market.	2							2		3				

1-Low, 2-Moderate, 3-High

<b>Course Title: Work Study and Ergonomics</b>			
<b>Course Code: P18IP52</b>	<b>Sem: V</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture:52 Hr Exam: 3Hr</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** Students should have the knowledge of activities of Workshop/Machine shop, Layouts, Stop watch, fundamentals of light, sound, vibration.

### **Course Learning Objectives:**

At the end of the Course the students should be able to,

1. Summarizing the basics of the Productivity and Work study and various methods of Wages and Incentives.
2. Pointing out the drawbacks of present method and design the best method.
3. Comparing the different methods of calculating standard time of a work.
4. Explaining the fundamentals of Ergonomics.
5. Developing the Man/machine system on foundation of Ergonomics

## **Course Content**

### **Unit – I**

**PRODUCTIVITY & WORK STUDY:** Basic needs, Quality of life and Productivity, Definition of productivity, Productivity in the individual enterprise, The task of Management, Definition of Work study, How the total time of a job is made up, Interrelationship of the various methods used to reduce ineffective time, wage rates, wage incentives and its types, Straight and differential piece rate system, Emerson efficiency plan, Halsey plans, Rowan plan, group incentives. Work study as a valuable tool, Techniques & Basic procedure of work study, direct means of raising productivity, **10 Hours**

*SSC: Human Factor in the application of the work study.*

### **Unit – II**

**METHOD STUDY:** Definition, Procedure, Selection of work, Process chart symbols, Outline process and flow process charts, critical examination, Flow and string diagrams, multiple activity chart, travel chart, principles of motion economy, classification of movements, two-handed process chart Micro motion study. Other recording techniques. **10 Hours**

*SSC: Development of improved methods, define, install and maintain.*

### **Unit – III**

**WORK MEASUREMENT:** Definition, purpose, uses, Procedure, techniques, Work sampling: Need, determination of sample size, procedure for selecting random observations, conduction of study with the simple problems, Time study: Definition, basic steps in time study. Recording the information, breaking the jobs into elements, types of elements, determination of sample size, timing elements by stop-watch, rating & standard Rating, factors of affecting rate of working, scales of rating, determination of basic time, allowances and standard time determination. Predetermined time standards, Definition, advantages and criticisms, Applications, Methods time measurement (MTM). **12 Hours**

*SSC: Time study equipment, selecting the job for Time study*

### **Unit– IV**

**INTRODUCTION TO ERGONOMICS:** Introduction, Consequences of not using Ergonomics, areas of study covered under ergonomics, system approach to ergonomics models, Man-Machine system, Characteristics of Man-Machine system, work capabilities of industrial worker, Functions performed by Man and Mechanism involved, General principles for carrying out the physical activities. **10 Hours**

*SSC: Development of stress in human body and their consequences, Suggestions for prevention.*

**Unit – V**

**DESIGN OF MAN-MACHINE SYSTEM:** Concept of fatigue in industrial work, Displays, Quantitative qualitative representation and alphanumeric displays. Controls and their design criteria, control types, relation between controls and displays. Design of work places, influence of climate on the efficiency of human performance, Influence of noise, vibrations and lighting systems on human performance.

**10 Hours**

**SSC:** *Layout of panels and machines.*

**TEXT BOOKS:**

1. Introduction to work study- ILO, IV Revised Edition, 2003.
2. Text book of Work Study and Ergonomics– S Dalela and Saurabh, Standard Publishers Distributors, 5th edition,1999

**REFERENCE BOOKS:**

1. Motion and Time study- Ralph M Barnes, John Wiley, 8th Edition, 1985.
2. Human Factors in Engineering Design-6th Edition, M S Sanders and E J McCormic, Mc Graw Hill.

**Course Outcomes:**

At the end of the Course the students should be able to,

1. Understanding the fundamentals of the Productivity, Workstudy and various types of Wages and Incentives.
2. Analyze the present method and develop the best method.
3. Compute the standard time for a work.
4. Understanding the Ergonomics and its principles.
5. Design the Man/machine system on basis of principles of Ergonomics.

**Course Articulation Matrix**

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
Understanding the fundamentals of the Productivity, Work study and various types of Wages and Incentives.	3	2		2	2			1			2		1	
Analyze the present method and develop the best method.	3	2	1	2	3	2				3	1	2	1	1
Compute the standard time for a work.	2	3		2	2	1						1		
Understand Ergonomics and its principles.	3	2	2	1	2	3	1	1				1		3
Design the Man/machine system on basis of principles of Ergonomics.	3	3	2	2	3	3		1			1	1		3

1-Low, 2-Moderate, 3-High

<b>Course Title: Design of Machine Elements</b>			
<b>Course Code: P18IP53</b>	<b>Sem: V</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture:52 Hr Exam: 3Hr</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** Students should have the knowledge of using Design Data Hand Book, knowledge on stress, strain, tension, compression, shafts, gears etc.

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to,

1. Define the concept Static strength; Static loads and Failure of materials...
2. Understand the concept of spur and helical gear and stress, tension, and compression in springs.
3. Solve the problems on mechanical joints and rivets, welds.
4. Solve the problems on shaft sections under varying loads, etc.,
5. Solve the problems on Ball and Roller bearing.

**Relevance of the Course:**

Strength of materials and Theory of machines is a basic subject which deals with the concept

1. Static strength; Static loads and Failure of materials.
2. Stress, tension, and compression in springs.
3. Shaft sections under varying loads.
4. Spur and helical gear – Problems.

## Course Content

### Unit – I

**Design for static strength:** Design considerations: Codes and Standards, Static strength; Static loads and factor of safety; Theories of failure -Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Maximum strain theory. Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. Combined Stress concentration factor.

**10 Hours**

*SSC- Members subjected to Bi-axial stresses*

### Unit –II

**Design for fatigue strength:** Introduction, S -N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors –size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Soderberg and Goodman, Stresses due to combined loading.

**10 Hours**

*SSC- Impact load due to axial loading.*

### Unit – III

**Mechanical joints: Riveted Joints** -Types, rivet materials, Failures of Riveted joints, Efficiency, riveted joint for boiler or pressure vessels.

**Welded Joints** -Types, Strength of butt and fillet welds, welds subjected axial loads, Eccentric loading - welds subjected to bending moment, and torsional moments.

**10 Hours**

*SSC- study on Riveted brackets.*

### Unit – IV

**Design of gears:** Introduction to Spur, Helical and bevel gears. Design of spur gears, stresses in gear tooth, Lewis equation, form factor, dynamic and wear load.

**Design of springs:** Types of springs -stresses in Helical Coil springs of circular and non-circular cross sections. Tension and compression springs. Design in leaf spring. (Simple problems).

**11 Hours**

*SSC- problems on helical gears.*

### Unit – V

**Design of shafts:** Torsion of shafts, design for strength & rigidity, with steady loading, ASME& BIS codes for design of transmission shafting, Design of shafts under different loads: Combined loads & Fluctuating loads.

**Lubrication and bearings:** Mechanisms of Lubrication - Viscosity, bearing modulus, coefficient of friction, minimum oil film thickness-Heat Generated, Heat dissipated, bearing materials, lubricants and properties. Ball and Roller Bearings: Bearing life, equivalent bearing load, selection of bearings of different types (Problems only on Ball and Roller Bearings). **11 Hours**  
*SSC- problems on journal bearing*

#### TEXT BOOKS:

1. **Mechanical Engineering Design** -Joseph Edward Shigley's, Tata McGraw Hill, New Delhi 2014.
2. **Machine Design** -.VL. Maleev and Hartman, CBS Publishers & Distribution, New Delhi, 2001.

#### DESIGN DATA HAND BOOK:

1. **Design Data Hand Book**-K. Mahadevan and Balaveera Reddy, CBS Publication fourth edition, 2013.

#### REFERENCE BOOKS:

1. **Machine Design** -Robert .L, Norton -Pearson Education Asia, New Delhi, 2014.
2. **Design of Machine Elements** -V. B. Bahandri, -Tata McGraw Hill Publishing Co. Ltd., New –Delhi, 2000.
3. **Machine Design** -R.S.Khurmi, J. K.Gupta. – Eurasia publishing house private Ltd. New Delhi, 2005.

#### Course Outcome

At the end of the Course the students should be able to,

1. Describe the theories of failures and determine the dimensions of mechanical components subjected to different types of static load.
2. Compute the dimensions of the machine elements subjected to fatigue and impact loads.
3. Distinguish between different mechanical joints and design welded and riveted joints for various loads.
4. Design spur gear and different types of spring for different applications.
5. Design the shaft for different load condition and comprehend the mechanism of lubrication and compare design of bearing for different applications.

### Course Articulation Matrix

Course Outcome – CO	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Describe the theories of failures and determine the dimensions of mechanical components subjected to different types of static load.	2	2	2		2							2	1	2
Compute the dimensions of the machine elements	2	2	3		2							3		2
Distinguish between different mechanical joints and design welded and riveted joints	1	1	2		2							2		2
Design spur gear and different types of spring for	3	3	3		3							3		3
Design the shaft for different load condition and comprehend the mechanism of lubrication and compare design of bearing for different applications.	1	2	2		2							3	1	3

1 – Low, 2 – Moderate, 3 – High

<b>Course Title: Theory of Metal Cutting</b>			
<b>Course Code: P18IP54</b>	<b>Sem: V</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture:52 Hr Exam: 3Hr</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** The students should have undergone the course on Elements of Mechanical Engineering, Mechanics of Materials and Production Technology.

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to,

1. Define the mechanism of metal cutting principles and formation of chips in different types of metals. Explain the terminology of Single Point and Multi Point cutting tools.
2. Explain the cutting forces involved and their relationship with respect to the resultant force in orthogonal metal cutting process.
3. Describe the concept of Machinability and Economics of Machining.
4. Explain the effect of temperature in metal working and the purpose and types of lubricants used in the process.
5. Explain the properties of different types of materials used in manufacturing tools and their properties.

**Relevance of the Course:**

Theory of Metal Cutting is a subject which deals with the concept of,

1. Metal cutting principles, types of metal cutting, formation of chips, etc. Different types of tools and their nomenclature systems.
2. Different forces involved in the process and their relationship.
3. Temperature generation and the ways of reducing the temperature.
4. Different types, purpose and properties of Cutting fluids.
5. Different materials used to manufacture the tools and their properties.

## Course Content

### Unit – I

**PROCESS OF METAL CUTTING:** Metal Cutting, Metal Cutting Principle, Types of Metal Cutting Process, Chip Formation, Chip Thickness Ratio, Chip Breaker, Cutting Speed, Feed and Depth of Cut – Economical cutting speed, Tool Geometry – Single Point Cutting Tool and Multipoint Cutting Tool (only drill bit), Tool Nomenclature Systems –ASA, Recommended tool angles. **09 Hours**

*SSC- Effect of cutting parameters on Tool Geometry*

### Unit - II

**MECHANICS OF METAL CUTTING:** Cutting forces in Orthogonal Cutting, Stress and Strain in the Chip, Shear Strain, Work done and Power required, Power Consumed in Metal cutting, Determination of shear plane angle, Merchant's Circle diagram and analysis, Co-efficient of friction, Measurement of Cutting Forces – Reasons for measuring cutting forces, Dynamometry, Types of Dynamometers (Mechanical, Lathe tool and Milling), Problems on Merchant's Circle diagram. **11 Hours**

*SSC- Hydraulic and pneumatic dynamometers*

### Unit - III

**TOOL WEAR AND TOOL LIFE:** Machinability, Machinability Index, Objectives of Machining. Tool Failure-types of tool wear, Tool Life, Relationship between the Cutting Speed and Tool Life, Effect of Feed and Depth of cut on Tool Life. Economics of Machining - Basic Objectives of Economical Machining, Production Cost, Economic Tool Life, Optimum Cutting Speed for Maximum Production, Tool Life for Maximum Profit. **12 Hours**

*SSC- Cost Analysis – Cost per Component*



#### Unit – IV

**CUTTING FLUIDS:** Cutting Fluids, Sources of Heat in Metal Cutting, Thermal Aspects of Metal Machining, Functions of Cutting Fluids, Types of Cutting Fluids, Selection and Application of Cutting Fluids, Effect of Cutting Fluid on Cutting Speed and Tool Life, Recommended Cutting Fluids and Reuse of Cutting Fluids. Factors Affecting Heat Generation, Measurement of Temperature- Tool Work Thermocouple Technique.

**10 Hours**

*SSC- Temperature Distribution in Metal Cutting*

#### Unit - V

**TOOL MATERIALS AND THEIR PROPERTIES:** Characteristics of tools materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, sialon, CBN, UCON, recommended cutting speeds for the above tools, tool & die steels – air, water, oil hardening of tools and their applications.

**10 Hours**

*SSC- Composite tools*

#### Text Books:

1. Fundamentals of Metal Cutting and Machine Tools, B. L Juneja and G. S. Sekhon, Willy Eastern Limited, 2015
2. Tool Engineering and Design-G. R. Nagpal, Khanna Publishers -6TH Edition.

#### Reference Books:

1. Metal cutting theory, Black P. H, MC Graw Hill, 1996.
2. Metal cutting theory and cutting tool design, Arshinov and Atekseev, Mir Publishers, 1976.
3. Fundamentals of Machining and Machine Tools”, R. K. Singal, I K International Publishing house Pvt. Lt, 2008.
4. Metal Cutting Principles, M. C. Shaw Oxford & I.B.H, 1st Edition.
5. Metal Cutting and Tool Design”, Dr. B. J. Ranganath, Vikas Publishing House, 1999.

#### Course Outcomes:

At the end of the Course the students should be able to

1. Recognize the geometry of cutting tools based on the materials used for machining.
2. Elaborate on mechanics of machining in metal cutting, and to demonstrate the measurement of cutting forces for various machining operations.
3. Identify the tool life based on different cutting speed, feed and depth of cut and understand the importance of economy in machining.
4. Govern cutting tool temperature and appreciate the importance of cutting fluids.
5. Explain the characteristics and properties of different tool material.

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Recognize the geometry of cutting tools based on the materials used for machining.	2	2											1	
Elaborate on mechanics of machining in metal cutting, and to demonstrate the measurement of cutting forces for various machining operations.	2	2		2	2								2	
Identify the tool life based on different cutting speed, feed and depth of cut and understand the importance of economy in machining.	2	2			2								2	2
Govern cutting tool temperature and appreciate the importance of cutting fluids.	2	2			2								3	2
Explain the characteristics and properties of different tool material.	2	2			3								3	3

<b>Course Title: Composite Materials</b>			
<b>Course Code: P18IP551</b>	<b>Semester: V</b>	<b>L-T-P-H : 2 -2- 0-4</b>	<b>Credit:3</b>
<b>Contact Period - Lecture: 52Hrs.;Exam: 3 Hrs.</b>		<b>Weightage: CIE: 50 %; SEE: 50%</b>	

**Prerequisites:** The students should have basic knowledge of material science & production technology.

### **Course Learning Objectives (CLO):**

At the end of the Course the students should be able to,

1. Explain the role of reinforcement and matrix in composite materials. Analyze the role of Prepegs in composites.
2. List the application & uses of composites materials.
3. Derive an expression for the Number of elastic constants, Hooke's law for two-dimensional angle lamina in composites.
4. Explain the laminate codes in developing composite materials.
5. Explain the different methods of composite material synthesis and testing methods for composites.

### **Relevance of the Course:**

Composite Materials is a basic subject which deals with the concept of,

1. Matrix & Reinforcement in Composite materials.
2. Hooke's law for different types of composite materials,
3. Stress-Strain relations for lamina of arbitrary orientation,
4. ABD Matrix for Laminates and Simple Numerical Problem.
5. Manufacturing and Testing of composite materials.

## **Course Content**

### **UNIT-I**

**Introduction to Composite Materials:** Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.

**Advanced Composites:** Polymer Nano composites – Introduction, Nano clay, Carbon Nano fiber.  
**10 Hours**

*SSC: Introduction to Carbon Nanotubes.*

### **UNIT-II**

**Applications:** Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment.

**Metal Matrix Composites:** Reinforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.  
**9 Hours**

*SSC: Future Potential of Composites, Application of MMC in Locomotive Industries.*

### **UNIT- III**

**Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, Numerical problems.  
**11 Hours**

*SSC: Engineering Constants of an Angle Lamina.*

### **UNIT- IV**

**Macro Mechanical Analysis of Laminate:** Introduction, code, Kirchhoff hypothesis, CLT, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Numerical problems.  
**10 Hours**

*SSC: Types of Laminates Codes Used.*

### UNIT-V

**Manufacturing and Testing:** Layup and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining, joining and repair. NDT tests – Purpose, Types of defects. NDT method - Ultrasonic inspection, Radiography, Acoustic emission.

**12 Hours**

*SSC: Processing of thermoplastic composites, Acoustic ultrasonic method*

**Text Books:**

1. Mein Schwartz, “Composite Materials Handbook”, McGraw Hill Book Company, 1984.
2. Autar K. Kaw, “Mechanics of composite materials”, CRC Press New York, 8<sup>TH</sup> Edition 2005.

**Reference Books:**

1. Rober M. Jones, “Mechanics of Composite Materials”, McGraw Hill Kogakusha Ltd.
2. Michael W, Hyer, “Stress analysis of fiber Reinforced Composite Materials”, McGraw Hill International.
3. Composite Material Science and Engineering, Krishan K. Chawla Springer.
4. P. K. Mallik, “Fibre Reinforced Composites”, Marcel Decker, Inc 1993, CRC Press, Third Ed.

**Course Outcomes:**

Upon successful completion of this course, the students will be able to

1. Identify and classify the different types of fiber and matrix materials used in commercial composites and Nano composites.
2. Outline various applications of composites, its characterization and Role of MMC in engineering application.
3. Derive the expression for Hooke’s Law, Maximum Stress and Strain Theory and number of elastic constants.
4. Distinguish the different orientation of laminates and Kirchhoff hypothesis used in composites.
5. Summarize various methods of composite fabrication techniques and also understand the importance of ceramic matrix composites.

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Identify and classify the different types of fiber and matrix materials used in commercial composites and nano composites.	2												2	2
Outline various applications of composites, its characterization and Role of MMC in engineering application.	2	1			2								2	2
Derive the expression for Hooke's Law, Maximum Stress and Strain Theory and number of elastic constants.	3	2			2								2	2
Distinguish the different orientation of laminates and Kirchhoff hypothesis used in composites.	3	2			2								2	2
Summarize various methods of composite fabrication techniques and also understand the importance of ceramic matrix composites.	2	2			3								2	2

1-Low, 2-Moderate, 3-High

<b>Course Title: Industrial Robotics</b>			
<b>Course Code:P18IP552</b>	<b>Sem: V</b>	<b>L-T-P-H: 2-2-0-4</b>	<b>Credits: 3</b>
<b>Contact Period: Lecture:52Hr Exam: 3Hr</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** Basic knowledge of Theory of Machines

**Course Learning Objectives:**

At the end of the Course the students should be able to:

1. Understand Classifications, geometrical and configuration.
2. Know the difference between accuracy and repeatability. Understand basic components and motion analysis of robots.
3. Learn Euler formulations and trajectory planning processes of Robots.
4. Understand the programming languages and Robot cell design and control.
5. Understand different types of sensors.

**Course Content**

**Unit – I**

**Automation in Manufacturing :** Introduction : Automation and robotics, brief history of robotics, social and economic aspects of robots, advantages and disadvantages of using robots, advantages and disadvantages of using robots in industries. Overview of robots – present and future applications.

**Classification And Structure of Robotic Systems:** Classifications, geometrical configuration, wrist and its motions and effectors and its types, links and joints. Robot drive system: Hydraulic, electric and pneumatic drive system resolution, accuracy and repeatability. **11 Hours**

*SSC: Advantages and disadvantages of drive systems.*

**Unit – II**

**Control System and Components:** Basic control system concepts and models, transformation and block diagram of spring mass system, controllers – NO and OFF, promotional, integral, proportional –plus- integral, transient and response to second order system.

**Robot Motion Analysis :** Kinematics – Introduction, direct and inverse kinematics, rotation matrix, composite rotation matrix, rotation matrix about and arbitrary axis, Euler angles representations, homogeneous transformations, links, joints and their parameters. **11 Hours**

*SSC: Stewart mechanism parallel-link robot.*

**Unit – III**

**Robot Arm Dynamics:** La Grange Euler formulations– joint velocities, kinetic energy potential energy and motion equations of robot manipulator, Newton, Euler formulations- Rotating coordinate systems,.

**Trajectory Planning:** Introduction, general considerations on trajectory planning, joint interpolated trajectories, 4 – 3 – 4 trajectory example. Planning of Cartesian path trajectories- Homogeneous transformation matrix. **10 Hours**

*SSC: Applications of Robots in Automotive Industry.*

**Unit –IV**

**Robot Programming:** Methods of robot programming, Lead through programming methods, a robot program as a path in space, motion interpolation, commands-WAIT, SIGNAL, capabilities & limitations of Lead through methods.

**Robot Cell Design and Control:** Robot cell layouts, work cell control, error detection and recovery, graphical simulation of robotic work cell. Economic analysis for robots-method. **10 Hours**

*SSC: Material Handling Application in automotive industry.*

**Unit – V**

**Sensors:** Transducers and sensors, Sensors in robots- tactile sensors, non - tactile sensor, proximity

sensing, range sensing, and force – torque sensors. Elements of computer vision, sensing and digitizing function in machine vision – image device – lighting techniques – analog to digital signal convention – sampling – quantization – encoding – image – storage, Image processing and analysis.

**10 Hours**

**SSC:** *Application of Sensors in Automotive Industry.*

### TEXT BOOKS

1. Groover, “Industrial Robotics”, Tata McGraw-Hill Education, 2012
2. Yoram Korem, “Robotics” McGraw Hill Intl. Book Co., New Delhi, 1985
3. Fu, Gonzales and Lee, “Robotics”, McGraw Hill. Edition, 1987

### REFERENCE BOOKS

1. Robotics Engineering An integrated approach - Richard D Klafter, Thomas A Chmielewski, Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.
2. Robert J. Schilling, “fundamentals of Robotics” McGraw Hill. Edition, 1987

### Course Outcomes:

The students should be able to

1. Explain necessity of basics of Industrial Robots application.
2. Describe basic components of Robots and solve problems on motion analysis.
3. Illustrate trajectory planning processes of Robots and able to solve problems on Euler formulations.
4. Explain different programming languages and Robot cell design and control.
5. Demonstrate sensor application in robots.

### Course Articulation Matrix

Course Outcome – CO	Program outcome														
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
Explain necessity of basics of Industrial Robots application.	3	2	2		1								1		
Describe basic components of Robots and solve problems on motion	2	2	2		1								1		
Illustrate trajectory planning processes of Robots and able to solve problems on Euler formulations.	2	2	2		1								1		
Explain different programming languages and Robot cell design and control.	3	2	2		1								2		
Demonstrate sensor application in robots.	3	2	2		1								2		

L-Low, M-Moderate, H-High.

<b>Course Title: Computer Integrated Manufacturing</b>			
<b>Course Code</b> : P18IP553	<b>Semester</b> : V	<b>L – T – P–H</b> : 2 – 2 – 0 – 4	<b>Credits</b> : 3
<b>Contact Period – Lecture</b> : 52 Hrs ; <b>Exam</b> : 03 Hrs		<b>Weightage</b> : CIE : 50%	<b>SEE</b> : 50%

**Prerequisites:** The students should have undergone the course on CAD/CAM, Robotics and Operations Management.

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to,

1. Define the meaning and types of Computer Integrated Manufacturing systems.
2. Analyze the Transfer line without storage – upper bound and lower bound approach.
3. Explain the functions of different parts feeding devices and elements of parts delivery system.
4. Explain the concept of automated guided vehicle system used.
5. Understand the concept of robots, robot configuration and different robot motion.

**Relevance of the Course:**

Computer Integrated Manufacturing is a subject which deals with the concept of,

1. Computer Integrated manufacturing system.
2. CIM manufacturing process.
3. Automated flow line and line balancing.
4. Automated guided vehicle system.
5. MRP, Inputs of MRP and Capacity Planning, CNC and Robots programming.

## Course Content

### Unit – I

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS** : Introduction, Automation definition, types of automation, CIM, processing in manufacturing, production concepts, Mathematical Models – Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, work – in – process, WIP ratio, TIP ratio, Problems using mathematical model equations.

**HIGH VOLUME PRODUCTION SYSTEM** : Introduction Automated flow line – symbols, objectives, work part transport – continuous, Intermittent synchronous, pallet fixtures, Transfer Mechanism – Linear – Walking beam, roller chain drive, Rotary – rack and pinion, Ratchet & Pawl, Geneva wheel, Buffer storage, control functions – sequence , safety, Quality. **11 Hrs.**

**SSC:** *Automation for machining operation.*

### Unit – II

**ANALYSIS OF AUTOMATED FLOW LINE & LINE BALANCING** : General terminology and analysis, Analysis of Transfer Line without storage – upper bound approach, lower bound approach and problems, analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with simple problem, Partial automation – with numerical problems, flow lines with more than two stages, Manual Assembly lines, line balancing problem.

**MINIMUM RATIONAL WORK ELEMENT** : Work station process time, Cycle time, precedence constraints, Precedence diagram, Balance delay methods of line balancing – largest Candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering above methods. **11 Hrs.**

**SSC:** *Problems on Computerized line balancing.*



### Unit – III

**AUTOMATED ASSEMBLY SYSTEMS :** Design for automated assembly systems, types of automated assembly system , Parts feeding devices – elements of parts delivery system – hopper, part feeder, Selectors, feedback, escapement and placement analysis of Multi station assembly

**10 Hrs.**

*SSC: Machine analysis of single station assembly.*

### Unit – IV

**Automated Guided Vehicle System:** Introduction, Vehicle guidance and routing, system management, Quantitative analysis of AGV's with numerical problems and application.  
**COMPUTERIZED MANUFACTURING PLANNING SYSTEM:** Introduction, Computer aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement planning,

**10 Hrs.**

*SSC: Concepts of MRP and CRP.*

### Unit –V

**CNC MACHINING CENTERS:** Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.

**ROBOTICS:** Introduction to robot configuration, Robot motion, programming of Robots end effectors.

**10 Hrs.**

*SSC: Robot Sensors and Robot Applications.*

### TEXT BOOKS:

1. Automation, Production system & Computer Integrated manufacturing,- M. P Groover Pearson India, 2007 2<sup>nd</sup> edition.
2. Principles of Computer Integrated Manufacturing, - S. Kant Vajpayee, Prentice Hall India.

### REFERENCE BOOKS:

1. Computer Integrated Manufacturing, - J. A. Rehg & Henry. W. Kr CAD/ CAM by Zeid, Tata McGraw Hill.

### Course outcomes

At the end of the Course the students should be able to,

1. Explain the mathematical models, the terms used in mathematical models, and different types of transfer mechanisms used.
2. Define the upper bond and lower bond approach, Work station process time, Cycle time, precedence constraints, Precedence diagram, Balance delay methods of line balancing, explain the effect of storage in industry.
3. Design the assembly systems and parts feeding devices.
4. Explain the role and importance of AGV, CAPP and MRP.
5. Explain the different elements of CNC, the steps involved in writing the CNC part programming and the concept of robots, robot configuration and different robot motion.

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
Explain the mathematical models, the terms used in mathematical models, and different types of transfer mechanisms used.	2		2		2								1		1
Define the upper bond and lower bond approach, Work station process time, Cycle time, precedence constraints, Precedence diagram, Balance delay methods of line balancing, explain the effect of storage in industry.	2		2		2								1		1
Design the assembly systems and parts feeding devices.	2		2		2								1		1
Explain the role and importance of AGV, CAPP and MRP.	2		2		2								1		
Explain the different elements of CNC, the steps involved in writing the CNC part programming and the concept of robots, robot configuration and different robot motion.	2		2		2								1		

1-Low, 2-Moderate, 3-High

<b>Course Title: Modern Machining Methods</b>			
<b>Course Code: P18IP554</b>	<b>Sem: V</b>	<b>L-T-P-H: 2-2-0-4</b>	<b>Credits: 3</b>
<b>Contact Period: Lecture:52Hrs Exam: 3Hrs</b>		<b>Weightage : CIE : 50%</b>	<b>SEE : 50%</b>

**Prerequisites:** Students should have the knowledge on Modern machining technique of different types of machining processes and also the rate of metal removal.

### **Course Learning Objectives**

At the end of course the students should be able to,

1. Identifying the classification of unconventional machining processes.
2. To understand the principle, mechanism of metal removal of various unconventional machining processes.
3. To study the various process parameters and their effect on the component machined on various unconventional machining processes.
4. To understand the applications of different processes.

### **Relevance of the Course**

Production Technology-II and Theory of metal cutting is a basic subject which deals with the concept of,

1. Conventional methods such as metal cutting theory, MRR etc.....
2. Material properties.
3. Cutting fluids.
4. Different types of tool and process characteristics.
5. Effects on temperature materials and tools.

## **Course Content**

### **Unit – I**

**Introduction:** History, Classification, Comparison between conventional and non-conventional machining process selection.

**Abrasive jet machining (AJM):** Introduction, working principle, Variables in AJM, Process characteristics – Material removal rate, Applications, Advantages & Disadvantages.

**Water jet machining:** Jet cutting equipment, Process and Practical application. **10 Hours**

**SSC:** *Surface finishing of AJM and WJM*

### **Unit – II**

**Mechanical process:** Ultrasonic machining (USM): Introduction, Equipment, tool materials & tool Size, Abrasive slurry, Tool feed Mechanism, Cutting tool system design- Magnetostriction assembly, Tool cone (Concentrator), Exponential concentrator of circular cross section & rectangular cross section. Mechanics of cutting: Theory of Miller, Effect of parameter, Material removal rate, Accuracy. Applications, Advantages & Disadvantages. **11 Hours**

**SSC:** *surface finish of USM*

### **Unit – III**

**Laser beam machining:** Principle, Material Removal, Cutting speed and accuracy of cut, Metallurgical effects, Advantages and limitations

**Plasma arc machining (PAM):** Plasma, Non thermal generation of plasma. Mechanism of metal removal, PAM parameters, Types of torches, Accuracy & Surface finish, Applications, Advantages and limitations.

**Electron beam machining (EBM):** Generation and control of electron beam, Comparison of thermal and non-thermal process. Applications, Advantages and limitations. **11 Hours**

**SSC:** *Difference between PAM & EBM*

### **Unit – IV**

**EDM process and characteristics:** Introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode wear, Dielectric fluids, Flushing and types, Metal removal rate, Accuracy and surface finish, , Applications,

advantages and disadvantages.

**Wire EDM:** Principle, elements, process variables, characteristic and application. **10 Hours**

**SSC:** Selection of Electrode Material for EDM

#### Unit – V

**Electrochemical machining:** Electrochemical machining (ECM): Introduction, Study of ECM machine, Elements of ECM process, Chemistry of the process, Metal removal rate, Accuracy and surface finish. Process of Electrochemical Grinding, Deburring and Honing.

**Chemical machining (CHM):** Introduction, Elements of Process, Chemical blanking process steps, application, Advantages & limitations. **10 Hour**

**SSC:** Applications of Electrochemical Grinding, Deburring and Honing.

#### TEXT BOOKS

1. Modern machining process – Pandey and Shan, TATA McGraw Hill 2016.
2. Advance Machining Processes by Vijay K. Jain – Allied Publishers Private Ltd, 2013

#### REFERENCE BOOKS

1. Production Technology - HMT TATA McGraw Hill 2016.

#### Course Outcome

At the end of course the students should be able to,

1. Explain the principles and applications of AJM, & WJM
2. Discuss the basic principles involved in ultrasonic machining.
3. Identify the issues involved in thermal metal removal process.
4. Describe various parameters which govern the different techniques of analysing EDM process and characteristics.
5. Illustrate the chemistry and metal removal process in electro-chemical and chemical machining techniques.

### Course Articulation Matrix

Course Outcome – CO	Program Outcome													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Explain the principles, methodology and applications of AJM, & WJM	2		2		1		1					2	1	
Discuss the basic principles involved in ultrasonic machining.	2		2		2		1						2	
Identify the issues involved in thermal metal removal	2		2		2		1						2	
Describe various parameters which govern the different techniques of analysing EDM process and characteristics.	3		2		1		2					2	2	
Illustrate the chemistry and metal removal process in electro-chemical and chemical machining techniques.		2	2		2		1						2	

1 – Low, 2 – Moderate, 3 – High

<b>Course Title: Mechanical Engineering Lab</b>			
<b>Course Code: P18IPL56</b>	<b>Sem: V</b>	<b>L-T-P-H: 0-0-3-3</b>	<b>Credits: 1.5</b>
<b>Contact Period: Lecture:39 Hrs</b>		<b>Exam: 3Hrs</b>	<b>Weightage: CIE:50; SEE:50</b>

**Prerequisites:** The students should have studied Engg. Thermodynamics and Fluid Mechanics.

**Course Learning Objective:** The course aims at empowering the students with practical knowledge about properties of fuels, performance of IC Engines as well as skill enhancement.

### **Course Content**

1. Determination of Flash point and Fire point of lubricating oil using Abel, Pensky Martins Apparatus
2. Determination of Calorific value of solid and gaseous fuels.
3. Determination of Viscosity of lubricating oil using Redwoods and Saybolts – Viscometers.
4. Performance Tests on Four stroke Petrol Engine, Calculations of IP, BP, Thermal efficiencies, SFC, FP and heat balance sheet
5. Performance Tests on Four stroke Diesel Engine, Calculations of IP, BP, Thermal efficiencies, SFC, FP and heat balance sheet
6. Planimeter.
7. Calibration of Pressure Gauge
8. Calibration of Thermocouple
9. Calibration of Venturimeter
10. Flow through pipes
11. Performance test on centrifugal pump
12. Performance test on Reciprocating pump

### **Scheme for Examination:**

Two Questions (Including PART-A & B) -	40 Marks
Viva – voce	- <u>10 Marks</u>
Total	<u>50 Marks</u>

### **Course Outcomes (CO)**

At the end of the course the students should be able to,

1. Determine properties like Flash point, Fire point, and viscosity of lubricating oil
2. Estimate the calorific value of solid and gaseous fuel
3. Estimate the irregular areas using the Planimeter
4. Conduct performance test on I.C.Engine.
5. Conduct performance tests on Venturimeter and pumps

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Ability to Determine properties like Flash point, Fire point, and viscosity of lubricating oil	2	1		2									2	
Ability to Estimate the calorific value of solid and gaseous fuel.	3	1		2									2	
Ability to Estimate the irregular areas using the Planimeter	2	1		1									1	
Ability to Conduct performance test on I.C. Engine	3	1		2									2	
Ability to Conduct performance tests on Venturimeter and pumps	3	1		2									2	

1 – Low, 2 – Moderate, 3 – High

<b>Course Title: Computer Aided Drafting and Geometric Modelling Lab</b>			
<b>Course Code: P18IPL57</b>	<b>Sem: V</b>	<b>L-T-P-H: 0-0-3-3</b>	<b>Credits: 1.5</b>
<b>Contact Period: Lecture:39Hrs Exam: 3Hrs</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** The students should have undergone the course on Computer aided Engineering drawing and Machine Drawing.

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to,

1. Produce computer-aided mechanical drawings of components and assemblies of machine parts and other mechanical Equipments.
2. Interpreting and applying drafting standards.
3. Using software for CAD such as Solid Works, etc.,
4. Drawing sectional views and Assembly drawings.
5. Drawing Surface Modelling for Simple Components.

**Relevance of the Course:**

Computer aided machine drawing is a basic subject which deals with the concept of,

1. Visualizing the 2D and 3D drawings,
2. Creating CAD drawings,
3. Interpreting and applying the drawing standards such as dimensioning, scaling, etc.,
4. Use of design software such as Solid Works environment,
5. Drawing Assembly drawings using top down and bottom up approach.

### Course Content

**Solid Works Basics:** Introducing Solid Works, Navigating SolidWorks Interface.

**Working with sketches:** Opening a sketch, Identifying sketch entities, Exploring sketch settings, Sketch blocks, working with Reference Geometry, Creating planes, Sketch Relations.

**Creating simple parts:** Symmetry, Relative size or direct dimensions, Offset, Hole Wizard, Cutting a slot, Fillets and Chamfers, Editing Sketch Relations and Copying and Moving Sketch Entities.

**Pattern and Mirroring:** Linear and Circular Pattern, Mirror Entities, Dynamic Mirror, Symmetry sketch relation and Mirroring in 3D sketches.

**Solid Modelling:** Primitive creation, Simple solid shapes - Boolean operations and Surface operations: Chamfering, rounding, filleting. Drafting and shelling.

**Dimension and Tolerance:** Dimensions on Drawings, reference dimensions, dimension options, adding tolerances and Dimensioning Styles.

**Assembly:** Identifying the Elements of an Assembly, Assembly layout sketch, Assembly reference geometry, History-based and non-history based portions of the assembly tree, Parts and Subassemblies, Folders, Mates, Assembly features, Component patterns and mirror components, Creating subassemblies from existing parts and Grouping subassemblies by relative motion.

**Surface Modelling:** Basic Surfacing, Revolved Surface, Swept Surface, Filleting Surfaces etc.

**Minimum of 10 Exercises in Modelling of Mechanical components and 4 assemblies using parametric feature based projects using CAD Software.**

**Text books**

1. Matt Lombard, “Solid Works bible”, Wiley Publishing, Inc, USA.
2. Solid Works Manual by Dassault System Inc.

**Scheme for Examination:**

Two Questions	-	40 Marks
Viva – voce	-	10 Marks
Total	=	50 Marks

**Course Outcomes (COs):**

At the end of the Course the students should be able to,

1. Recognize the drawing concepts
2. Use CAD software such as Solid Works, Solid Edge etc.
3. Develop machine parts and parts of equipment's in 3D.
4. Construct sectional views and Assembly drawings.
5. Develop surface models.

### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Ability to learn Recognize the drawing concepts	3	1										2		
Ability to use CAD software such as Solid Works, Solid Edge etc.	3	1	2		2							2		
Ability to develop machine parts and parts of Equipments in 3D.	3	1	2		2							2		
Ability to construct sectional views and Assembly drawings.	3	1	2		2							2	1	
Ability to develop surface models	3	1	2		2							2	1	

1 – Low, 2 – Moderate, 3 – High



<b>Course Title: Advanced Geometric Modelling -I</b>			
<b>Course Code: P18IPL58</b>	<b>Sem: V</b>	<b>L-T-P-H: 0-0-2-0</b>	<b>Credits: 1</b>
<b>Contact Period: Lecture:12 Hrs</b>		<b>Exam: 1.5 Hrs</b>	<b>Weightage: CIE:50; SEE:50</b>

**Prerequisites:** Knowledge of Engineering Graphics and modeling techniques

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to do;

1. Create parts using Different CAD/CAM Packages like CATIA, Unigraphics, NX, Creo etc.
2. Create complex geometric models.
3. Surface Modelling.

**Relevance of the Course:**

Advanced Geometric Modeling is very much essential for the students to be ready with complete knowledge of design and drawing techniques to compete in the current industrial scenario. In this regard it is attempt to train the students in the use of different CAD Packages.

## Course Content

**Introduction.**

Concept of Parametric Modeling, Feature Based Modeling, User Interface, Mouse operations, File types and Management, drawing profiles.

**Sketcher.**

Profile toolbar, operation (corner, chamfer, relimitations, transformations, project 3D element), constraints, types of constraints, workbench. Sketch tools, visualization toolbar, user selection filter.

**Modeling of Machined component.**

Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfer, Types of Hole. Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points), Simple Draft.

**Advance Design features.**

Axis System, Types of draft, Shell, Stiffener, rib slot, Multi-section solid, Removed Multi-section solid.

**Multibody concept.**

Copy Paste, Paste special, Insert body, Boolean Operations (Add, Remove, Intersect), Transformation (Translation, Mirror, Scaling, Affinity). Negative body concept (Boolean Operations), Parameters, Formula, Relations.

**Views.**

Aux, Section, Details, Clipping, Broken, View properties, DATUMS & Tolerance

**Annotations.**

GD & T Symbols, Note, Leaders, Table, Symbols (Machining, Roughness, Welding, Custom), Dress-up Toolbar.

**Exercises.**

**Text Books:**

CAD CIM Technologies by Prof. Sham Tickoo, Purdue University Calumet, USA ISBN-978-1-932709-94-0.

<b>Course Title: Technical skills-I (Basic Managerial Skills)</b>			
<b>Course Code:P18IP591</b>	<b>Sem: V</b>	<b>L-T-P-H: 0-2-0-2</b>	<b>Credits: 1</b>
<b>Contact Period: Lecture:12 Hr Exam: 1.5 Hrs</b>		<b>Weightage : CIE : 50% SEE : 50%</b>	

**Prerequisites:** Basics of Management

### **Course Learning Objectives**

At the end of the Course the students should be able to,

1. Develop leadership skills.
2. Judge the changes in the system
3. Prepare for the Decision making
4. Plan the motivation required for the employees.
5. Predict the conflict and arrange for the cooperation

### **Relevance of the Course:**

Basic managerial skill is an important Technical skill course in BE (Industrial and Production) program that make the students a good manager by inculcating managerial skills.

### **Course Content**

#### **Unit 1**

**Leadership:** Leadership: The Panchshila of Leadership, What the Experts Have to say?, Effectiveness: Five Practices, Six Considerations, Managers and Leaders: What's the Difference?, Manager: Developer of a Team, What's keeping Your Work Group from Becoming a Team? , Manager: Developer of people, How to Deal with Your Boss, Tips for Supervisors, Six Tips for Organizers. **3 hours**

#### **Unit II**

**Change:** Change: Warm-up Discussion, Global Trends in Our Changing World, How to Plan a change, how to see a value in Resistance to change, Individual Resistance Factors, Continuous Change: Continuous Learning, Listen to the Customer, Creativity: A Managerial Skill. **2 hours**

#### **Unit III**

**Decision Making:** Five Research-based Cautions, Managers do things right; Leaders do the right things, Decision Making: A question of style, which Style, When? , Which Style in these Cases? Brainstorming, General Aides toward Improving Group Decision Making. **2 hours**

#### **Unit IV**

**Motivation:** A Reason to Work, Motivation: Do You Agree with these Assumptions? , Motivational Menu: Your Choice?, Three deep needs of the human person, The Changing Nature of Work, More Thoughts on Motivation, What kind of Participation Does a Worker Really Want? **2 hours**

#### **Unit V:**

**Conflict and Cooperation:** More Light on the Eye of the Beholder, The Nature of Prejudice, How to Handle Rumours? , First Information Report, How to Reduce Interpersonal Conflict?, The Greatest Challenge: Teamwork, Intergroup Conflict Resolution: Three Techniques, How to Negotiate?, Negotiating 'On the Merits', Negotiation Exercise, How to Negotiate with a Union? , How to Negotiate with Management? **3 hours**

### **Text book:**

1. **Basic managerial skills for all, McGrath S.J,9<sup>th</sup> edition, PHI**

### **Reference books:**

### **Course Outcomes (CO's)**

At the end of the Course the students should be able to,

1. Apply the leadership skills.
2. Interpret the changes in the system
3. Show the Decision making quality
4. Devise the motivation required for the employees.

Identify the conflict and compile the cooperation.

<b>Course Title: Aptitude and Reasoning Development - ADVANCE (ARDI)</b>			
<b>Course Code: P18HU510</b>	<b>Sem: V</b>	<b>L-T-P: 0-0-2</b>	<b>Credits: 1</b>
<b>Contact Period: Lecture:32 Hr</b>	<b>Exam: 3 Hrs</b>	<b>Weightage : 50%</b>	<b>CIE : 50% SEE :</b>

**Prerequisites:** Vocabulary builder, Concept of Percentage.

### Course Learning Objectives (CLOs)

This course aims to

1. Describe the importance of reading with comprehension.
2. Explain seven dimensions approach to better reading skills.
3. Explain the purpose, plan and the ways to identify specific details in a paragraph for better comprehension.
4. Formulate easier ways to solve problems of averages.
5. Explain the Application of the technique of alligation while solving weighted average and mixture problems.
6. Describe the concepts of profit, loss, discount, Marked price.
7. Explain the application of percentage in our daily life.
8. Discover different ways to identify the progressions and to compare between AP < GP and HP.
9. Explain the basic concepts in calculating simple interest and compound interest.
10. Differentiate between simple interest and compound interest and describes the importance of compound interest and its behavior.

### Course Content

#### Unit – I

Reading Comprehension:

Introduction: Read more and more, The process of writing and its relevance to the process of writing, how reading skills are important for aspects other than the reading comprehension questions, the daily reading scheme.

Seven dimension approach to better reading skills:

Developing the ability of understanding vocabulary in context, Ability to identify and understand main ideas, Ability to predict and identify supporting details, Understanding the use of transition and idea organization patterns, Inferences, Identifying purpose and tone, Recognizing and evaluating arguments and their common structures.

Theory of reading comprehension:

Solving RC passages is an exact science, tackling RC on the basis of evaluation of support, All passages have a topic, purpose and a plan, Other things to pick up while reading the passage– The tonality and other software related the author's viewpoint in the passage, specific details and their use in the passage, Types of questions asked in reading comprehension passage. **8 hrs**

#### Unit II

Averages and Alligations mixtures:

Average: relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. Alligation method: situation where allegation technique, general representation of alligations, the straight line approach, application of weighted average and alligation method in problems involving mixtures. Application of alligation on situation other than mixtures problems. **6 Hrs**

#### Unit III

Permutation and Combination: Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of

$2n$ , Arrangement in a circle.

Probability: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes. **6 Hrs**

#### Unit IV

##### Progression:

**Arithmetic Progression:** sum of given number of terms in an A.P., arithmetic mean, to insert a given number of arithmetic means between two given quantities,  $n$ th term of an A.P., finding common difference of an A.P. given 2 terms of an A.P., types of A.P.s— increasing A.P.s and decreasing A.P. s

**Geometric:** to find, the geometric mean between two given quantities, to insert a given number of geometric means between two given quantities, sum of a number of terms in a G.P. Types of G.P.s— increasing G. P. s type one and two , decreasing G. P. s type one and two.

Harmonic Progression: to find the harmonic mean between two given quantities , theorems related with progressions, solved examples sample company questions. **4 Hrs**

#### Unit V

**Coding Decoding:** Letter Coding, Number coding, symbol coding

Crypt arithmetic: Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm

**Data Interpretation:** Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data— Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs. **8 Hrs**

##### Reference books:

1. The Trachtenberg speed system of basic mathematics, published by Rupa publications.
2. CAT Mathematics by Abhijith Guha. published by PHI learning private limited.
3. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal , published by S. Chand private limited.
5. Quantitative aptitude for CAT by Arun Sharma, published by McGraw Hill publication.

#### Course Outcomes (CO)

After learning all the units of the course, the student is able to:

1. Apply the approach of seven dimension to better reading skills. L2
2. Solve the questions under reading comprehension confidently with higher accuracy than random reading. L4
3. Apply the technique of allegation for effective problem solving. L2
4. Interpret the requirement of different methods of calculating average and apply the right method at right scenario. L4
5. Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest. L5
6. Formulate the equations for summation and other functions for all the kinds of progressions— AP, GP and HP. L1

Course Assessment Matrix													
Course Outcome (CO)		Program Outcome											
		1	2	3	4	5	6	7	8	9	10	11	12
Apply the approach of seven dimension to better reading skills.	L2	-	-	-	-	-	-	-	-	2	-		-
Solve the questions under reading comprehension confidently with higher accuracy than random reading.	L4	-	-	-	-	-	-	2	-	2	-		-
Apply the technique of alligation for effective problem solving.	L2	3	-	-	-	-	-	-	-	-	-		-
Interpret the requirement of different methods of calculating average and apply the right method at right scenario.	L4	2	-	-	-	-	-	-	-	2	-		-
Formulate the equations for summation and other functions for all the kinds of progressions– AP<GP and HP.	L5	3	-	-	-	-	-	-	-	2	-		-
Effective solve the problems of coding decoding and crypt arithmetic and Interpret the data given in the graphical format and infer the results.	L1	2	-	-	-	-	-	-	-	-	-		-
1 – Low, 2 – Moderate and 3 – High													

<b>Course Title: Engineering Economics</b>			
<b>Course Code: P18IP61</b>	<b>Sem: VI</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture: 52Hrs Exam: 3Hrs</b>		<b>Weightage: CIE: 50; SEE: 50</b>	

**Prerequisites:** Basic engineering Mathematics

### Course Learning Objectives

At the end of the Course the students should be able to,

1. Illustrating the basics of Economics and the Interest & the various Interest factors
2. Analyzing the various projects using Present worth and Equivalent annual comparison methods
3. Determining the Rate of return and Depreciation of various Projects/Assets
4. Comparing the different Alternatives & Replacement criteria in the back ground of inflation, time value of money & Sources of capital
5. Computing the cost of a product/project & assessing the Breakeven point

### Relevance of the Course Description

Engineering Economics is a foundation course in BE (Industrial and Production) program that equip the students in analyzing the various projects in the background of time value of money.

## Course Content

### Unit – I

**INTRODUCTION:** Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making: Intuition and Analysis, Tactics and Strategy. **INTEREST AND INTEREST FACTORS:** Interest rate, simple interest Compound interest and compound-interest factors, Cash-flow diagrams, Exercises and Discussions.

**11 Hours**

*SSC: Sensitivity and Sub optimization.*

### Unit – II

**PRESENT WORTH COMPARISON:** Conditions for present worth comparisons, Basic Present worth comparisons patterns, Assets with unequal lives, infinite lives, , Pay – back comparison, Exercises, Discussions.

**EQUIVALENT ANNUAL WORTH COMPARISONS:** Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Use of sinking fund method, Exercises and Discussions.

**11 Hours**

*SSC: Future worth comparisons*

### Unit – III

**RATE OF RETURN CALCULATIONS:** Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions.

**DEPRECIATION:** Causes of Depreciation, Basic methods of computing depreciation charges: Straight-line, Declining balance, Sum-of the Years-Digits & Sinking fund Methods. **10 Hours**

*SSC: Tax concepts and types.*

### Unit – IV

**STRUCTURAL ANALYSIS OF ALTERNATIVES:** Identifying and Defining alternatives, classification of alternatives.

**REPLACEMENT ANALYSIS:** Deterioration, obsolescence, inadequacy

**EFFECTS OF INFLATION:** Causes, consequences and control & Measuring of inflation, Lease or Buy decisions

**FINANCIAL MANAGEMENT:** Types of capital, Cost of capital concept

**10 Hours**

*SSC: Sources of Finance*

**Unit – V**

**ESTIMATING & COSTING:** Introduction, Need, Elements of product cost, Determination of selling price, Allocation of overheads, and Estimation for simple components.

**BREAK-EVEN ANALYSIS:** Basic Concepts, Linear break even analysis.

**10 Hours**

**SSC:** *Non-linear break even analysis*

**TEXT BOOKS:**

1. Engineering economics- RIGGS J.L and others , 4th edition, Tata McGraw Hill, 2015 Reprint
2. Engineering economics- R.K. Hegade, Sapna Book house, 1st edition, 2015 Reprint

**REFERENCE BOOKS:**

1. Engineering economy -THUESENH.G. PHI, 2002
2. Engineering Economy – NVR. NAIDU, KM BABU and G. RAJENDRA, New Age International Pvt. Ltd. – 2006
3. Engineering economics- K.R.Phaneesh, Sudha Publications, 3rd revised edition, 2008

**Course Outcomes (CO's)**

At the end of the Course the students should be able to,

1. Understanding the fundamentals of the Engineering economics.
2. Compare the various Project(s) using present worth/ Equivalent Annual worth methods.
3. Compute the Rate of return of the Project(s) and Depreciation charges of the Machine/Equipment
4. Analyze the various alternatives & criteria of replacement, Sources of capital and predict the effect of inflation on it.
5. Estimate the cost of a product/process and Judging the Breakeven point

**Course Articulation Matrix**

Course Outcome (CO)	Program Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Understanding the fundamentals of the Engineering economics (Unit – I)	2	2	2	1						1	1			
Compare the various Project(s) using present worth/ Equivalent Annual worth methods. (Unit – II)	2	1	3	2						2	1		1	1
Compute the Rate of return of the Project(s) and Depreciation charges of the Machine/Equipment(Unit – III)	2	2	3	1						2	1		1	1
Analyze the various alternatives & criteria of replacement, Sources of capital and predict the effect of inflation on it. (Unit – IV)	2	2	3	2			2			2	1	1		
Estimate the cost of a product/process and Judging the Breakeven point – (Unit – V)	2	2	3	2				1		2	1	1	1	1

1-Low, 2-Moderate, 3-High



<b>Course Title: Theory of Metal Forming</b>			
<b>Course Code:P18IP62</b>	<b>Sem: VI</b>	<b>L-T-P-H: 4-0-0-4</b>	<b>Credits: 4</b>
<b>Contact Period: Lecture:52Hrs</b>	<b>Exam: 3Hrs</b>	<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** The students should have undergone the course on Elements of Mechanical Engineering, Mechanics of Materials and Production Technology.

### **Course Learning Objectives (CLO).**

At the end of the Course the students should be able to,

1. Derive an Expression for Von Mises criterion and Tresca criterion and classify the forming process and Role of Lubrication in Forming Process.
2. Explain different types of Forging and Rolling Process and their Defects.
3. Explain the role of Extrusion Equipment in used in Extrusion process and wire and Tube drawing Process.
4. Describe the shearing, blanking, punching, and bending of sheet metal.
5. Explain the HERF and Steps in Powder Metallurgy Process.

### **Relevance of the Course**

Theory of Metal Forming is a basic subject which deals with the concept of,

1. Metal forming process such as Forging, Rolling, Extrusion and Drawing.
2. Material properties and structure.
3. Hot and cold operations, temperature, friction developed during the process.
4. Simple process like punching, stretching, Shearing and bending etc.
5. Principle of HERF and Powder Metallurgy Process.

## **Course Content**

### **Unit - I**

#### **FUNDAMENTALS OF METAL WORKING:**

Elements of the Theory of Plasticity: Flow curves, True stress and True strain, Yield Criteria for ductile materials, Von Mises criterion and Tresca criterion (no numerical problem).

Fundamentals of Metal working: Classification of forming processes, Mechanics of Metal working – slab method, flow stress determination, temperature in Metal working, Hot working, Cold working, Warm working, strain rate effects, metallurgical structure, friction and Lubrication.

**10 Hours**

*SSC: Residual stresses in Metal Forming.*

### **Unit – II**

**FORGING:** Classification of forging operation, forging equipment, forging strain, open die forging, closed die forging and forging defects.

**ROLLING:** Classification of rolling mills- hot and cold. Rolling forces and geometrical relationships in rolling, simplified analysis of rolling load, defects in rolled products.

*SSC: Precision and Powder Metallurgy Forging process, Applications of Cluster and planetary Mills.*

**11 Hours**

### **Unit – III**

**EXTRUSION:** Classification, equipment's used, hot extrusion, deformation, lubrication and defects in extrusion, analysis of extrusion processes, hydrostatic extrusion, tube extrusion, production of seamless pipe and tubing, Extrusion defects.

**DRAWING OF RODS, WIRES AND TUBES:** Rod and wire drawing process, drawing dies, analysis of wire drawing, wire and tube drawing. Defects in drawing, tube drawing. **11 Hours**

*SSC: Impact extrusion, Residual Stresses in Rods, Wires and Tubes.*

### **Unit- IV**

**SHEET METAL FORMING PROCESS:** Introduction, Forming methods, shearing, blanking,

punching, bending, spring back, elimination of spring back, spinning, deep drawing stretch forming, redrawing, reverse drawing, defects in drawing, factors affecting drawability ratio.

**10 Hours**

**SSC:** The application of sheet metal working in various sectors.

#### Unit- V

**HIGH ENERGY RATE FORMING (HERF):** Introduction to HERF, Process advantages, explosive forming, electro discharge forming and electromagnetic forming, Rubber forming.

**POWDER METALLURGY:** Basic steps in Powder metallurgy brief description of methods of production of metal powders, advantages and limitations.

**10 Hours**

**SSC:** Principle of HERF Process, Characteristics of Metal powders.

#### TEXT BOOKS:

1. Mechanical Metallurgy - Dieter. G. E - McGraw Hill, 2015.
2. Manufacturing Process III, Radhakrishna K, Sapna Book House 2013

#### REFERENCE BOOK:

1. ASM- Metals handbook, Sach G. fundamentals of working of metals, Pergamon Press.
2. Manufacturing Engineering and Technology by Serope Kalpakjian & Stevan

#### Course Outcomes

At the end of the Course the students should be able to,

1. Explain the theory behind the forming of the metal.
2. Demonstrate the concept of forging of metals, forces and defects involved in rolling of metals.
3. Recognize the basic knowledge of extrusion and drawing metals and the defects.
4. Demonstrate the basic concept of sheet metal forming processes and methods involved in forming process.
5. Identify the basic methods of high energy forming process, powder metallurgy and its applications.

#### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PS O2
Explain the theory behind the forming of the metal.	2	1												
Demonstrate the concept of forging of metals, forces and defects involved in rolling of metals.	2	2			3							2	1	
Recognize the basic knowledge of extrusion and drawing metals and the defects.	2	2			3							2	2	
Demonstrate the basic concept of sheet metal forming processes and methods involved in forming process.	2	2			2							1	2	
Identify the basic methods of high energy forming process, powder metallurgy and its applications.	2	2			3							2	2	

1-Low, 2-Moderate, 3-High.

<b>Course Title: Quality Assurance and Reliability</b>			
<b>Course Code: P18IP63</b>	<b>Semester: VI</b>	<b>L – T – P–H : 4 – 0 – 0 –4</b>	<b>Credits: 4</b>
<b>Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.</b>		<b>Weightage: CIE: 50 %;</b>	<b>SEE: 50%</b>

**Requirements:** Students should have the knowledge Quality, Quality audit concept, audit reporting X bar and S control charts with variable sample size, control charts for individual measurements, Fraction non- conforming (defectives) development and operation of control chart Guidelines for implementing control charts, accepting sampling, Failure models of components, reliability, MTBF, Failure rate , Redundancy, etc.

### **Course Objectives:**

At the end of the Course the students should be able to,

1. The aim of the course is to provide the students an opportunity to gain the knowledge in the field of Quality,
2. Apply the fundamental concepts of Quality principal and to solve the Quality problems.
3. To demonstrate the advantages, applications, limitations of the several of Quality functions and charts.
4. To gain the knowledge for various control charts for attributes.
5. The students gain the knowledge of different sampling inspection and to understand the different methods of Failure models of components, MTBF, Failure rate, common failure rate curve, types of failure.

## **Course Content**

### **Unit-I**

**Introduction:** Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality Improvement. Quality costs – four categories costs and hidden costs.

**Quality Assurance:** Definition and concept of quality assurance, Quality assurance function, departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing audit activities, audit reporting, ingredients of a quality program.

**10 Hours**

*SSC: Brief discussion on sporadic and chronic quality problems. Introduction to Quality function deployment.*

### **Unit-II**

**Statistical Process Control:** Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Process capability – Basic definition, standardized formula.

**Control Charts For Variables:** Controls charts for X bar and Range R, statistical basis of the charts, development and use of X bar and R charts, interpretation of charts. Control charts for X bar and standard deviation (S), development and use of X bar and S chart. Brief discussion on – Pre control X bar and S control charts with variable sample size, control charts for individual measurements.

**12 Hours**

*SSC: Relation to product tolerance and six sigma concept of process capability.*

### **Unit -III**

**Control Charts For Attributes:** Controls chart for fraction non- conforming (defectives) development and operation of control chart, brief discussion on variable sample size.

Control chart for non-conformities (defects) – development and operation of control chart for

Department of Industrial and Production Engineering constant sample size and variable sample size.  
Choice between variables and attributes control charts. **10 Hours**

**SSC:** Guidelines for implementing control charts.

#### Unit -IV

**Sampling Inspection:** Concept of accepting sampling, economics of inspection, Acceptance plans – single, double and multiple sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans. **10 Hours**

**SSC:** Normal distribution concept.

#### Unit -V

**Reliability and Life Testing:** Definition of reliability, MTBF, MTTF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, parallel and series-parallel device configurations, Redundancy and improvement factors evaluations. **10 Hours**

**SSC:** Failure models of components.

#### Text Books:

1. Introduction to statistical Quality Control- D C Montgomery 3rd Edition, John Wiley and Sons.
2. Quality Planning & Analysis- J M Juran, Frank M Gryna; 3rd edition, Tata McGraw Hill.

#### Reference Books:

1. Statistical Quality Control- Grant and Leavenworth, 6th Edition McGraw Hill,
2. The QS9000 Documentation Toolkit- Janet L Novak and Kathleen C Bosheers, 2nd Edition, Prentice Hall PTR.
3. ISO 9000 a Manual for Total Quality Management-, Suresh Dalela and Saurabh, 1st Edition, S Chand and Co.
4. Total Quality Management-I Kesavan R.K. International, New Delhi – 2007.
5. Statistical Quality control – M. Mahajan, Dhanpat Rai & Co. (p) LTD

#### Course Articulation Matrix

Course Outcome (CO)	Program Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Understanding the fundamentals of Quality function and concept of quality assurance (Unit – I)	2	2	2	1										
Demonstrate the concept of statistical process control and control charts for variables (Unit – II)	2	1	3	2									1	
Analyze the Controls chart for fraction non-conforming (defectives) development and operation of control chart, t(Unit – III)	2	2	3	1									1	
Analyze the various sampling inspection (Unit – IV)	2	2	3	2										
Estimate the reliability and life testing – (Unit – V)	2	2	3	2									1	

## Electives

<b>Course Title: Plant Layout &amp; Design</b>			
<b>Course Code: P18IP641</b>	<b>Semester: VI</b>	<b>L – T – P -H: 2 – 2 – 0 - 4</b>	<b>Credit: 3</b>
<b>Contact Period: 52Hrs.; Exam:3 Hrs.</b>		<b>Weightage: CIE: 50%; SEE: 50%</b>	

**Prerequisites:** Concept of Work study and Engineering ergonomics.

### Course Learning Objectives (CLOs).

This course aims to:

1. **Understand** and **apply** the concept of different plant layouts and plant design [L3]
2. **Understand** the ability to **identify** the objective to recognize about plant location problems.[L3]
3. The student should be able to **understand** the concept of objectives of plant layout [L2]
4. **Apply** the basic concepts of material and processing [L3]
5. **Understand** the general concept of material handling equipment and storage in plant layout [L2]

### Course Learning Outcome

1. **Apply** the concept of different plant layouts and plant design
2. Ability to **identify** the objective to recognize about plant layout and students will outline the concept of different plant layout.
3. The student should be able to classify the plant layout and problems
4. **Apply** the basic concepts of material and processing
5. The student should be able **Evaluate** the concept line balancing in plant layout

### Relevance of the Course:

Plant layout and design helps in developing the systematic and economic plant layout for manufacturing systems, also aims in reducing the production time during the process. The course aims at understanding the material equipment and storage system. It helps the students in applying these ideas to summarize which material handling is suitable for process.

## Course Content

### Unit-I

**Introduction to plant design:** Types of manufacturing processes, Plant design: Graphical portrayal of some of the phases of plant design, Acquisition of capital, Product design, Sales planning for requirements, Selection of the production of process, Make or buy, Plant size, Product price range, Plant location, plant layout, building-type selection, Diversification, Organization development. Factors influencing plant location, Theories of plant location and location economics.

*SSC: Advantage of transportation medium.*

**10 hours**

### Unit-II

**Sales planning for plant design:** Introduction, Importance of sales planning, Determination of volume of output, Market method, Market research. Plant location: Introduction, Plant location problem, Levels of location problems, Influence of location on plant layout, Location factors, Location theory and models.

*SSC: Plant site selection guide.*

**10 hours**

### Unit-III

**The plant-layout problem:** Introduction, Plant layout problem, why layout problems develop, Classes of plant layout problems, Objectives of good plant layout, Classical types of layouts, Evolution of plant layout, Advantages of good plant layout, Organization for plant layout, Qualifications for plant layout engineer, Size of plant department.

*SSC: Trends in plant layout.*

**10 hours**

**Unit-IV**

**Data Collection:** Introduction, material and processes, Routing, Analysis of Operation process chart, Calculation of equipment requirements (simple problems), Analysis of Product flow,

**Industrial building and grounds:** relationship between buildings and the layout, construction or modernization, building design,

**Evaluation of layouts:** Measures of effectiveness, Systematic evaluation: sequence demand – straight line method.

**SSC:** space requirements.

11 hours

**Unit-V**

**Materials handling equipment:** Introduction, conveyers; portable conveyers, power conveyers, overhead conveyers, cranes; mobile crane, overhead traveling crane, elevators and hoists. Industrial vehicles; fork trucks, high lift platform truck, powered hand trucks, industrial tractor, Methods of storage in the industries.

**Line balancing:** requirement for line balancing, Assembly line balancing and problems on Dr. J R Jackson method

**SSC:** Selection of material handling equipment.

11 hours

**Text Books:**

1. James M Apple, “Plant Layout and Material handling” 3<sup>rd</sup> Edition, John, Wiley and Sons, ISBN 0-471-07171-4
2. Francies, R.L. and White, J.A. “Facility layout and Location”, Mc Graw Hill 2<sup>nd</sup> Edition, 2009
3. James M Moore, “Plant Layout Design” - McMillan Company. Published by Prentice Hall College Div, New York (1962)

**Reference Books**

1. Muther Richard, “Practical layout”, Mc Graw Hill-1955.
2. SundereshHeragu, “Facilities Design” PWS Publishing Company, ISBN-0-534-95183.
3. ChandrashekarH , B Raghavendra Reddy, Facility planning and layout design, First Edition 2007, Technical Publication , Pune.

**Course Articulation Matrix**

Course Outcome – (CO)	Program outcome													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
Apply the concept of different plant layouts and plant design	2	2	1	1										
Ability to identify the objective to recognize about plant	2	2	1	1										
The student should be able to classify the plant layout and problems	2	2	1	1										
Apply the basic concepts of material and processing	3	2	1	1										
Able to evaluate the concept line balancing in plant layout	3	2	1	1										

1-Low, 2-Moderate, 3-High

<b>Course Title: Human Resource Management</b>			
<b>Course Code:P18IP642</b>	<b>Sem: VI</b>	<b>L-T-P-H: 2-2-0-4</b>	<b>Credits: 3</b>
<b>Contact Period: Lecture:52Hr Exam: 3Hr</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** The students should have undergone the course on Management and Entrepreneurship.

### **Course Learning Objectives (CLO)**

At the end of the Course the students should be able to,

1. Able to define the evolution and objectives of Human Resource Management.
2. Able to understand the concept of Job Analysis.
3. Able to understand the concept Recruitment and Selection.
4. Able to understand the concept of Performance Appraisal and Human Resource Accounting.
5. Able to understand the different acts such as Factory Act, ESI Act, etc.,

### **Relevance of the Course**

Human Resource Management is a basic subject which deals with the concept of,

- Evolution, Scope, Objectives, principle and policies of HRM.
- Recruitment and Selection process.
- Training and Development process.
- Industrial Relations.
- Industrial Act, Factory Act, ESI Act, etc.,
- Industrial Disputes.

## **Course Content**

### **Unit - I**

**INTRODUCTION:** Introduction, Evolution of HRM, Scope of HRM, Functions and Objectives of HRM – Societal Objectives, Functional Objectives, Organizational Objectives and Personal Objectives. Policies and Principles of HRM.

**HUMAN RESOURCE PLANNING:** Introduction, Uses and benefits of HRP, Importance of HRP, Factors affecting HRP, HRP Process - Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting. Job Analysis - Job Description, Job Specification.

**SSC:** *Process of Job Analysis and its Benefits.*

**10 Hours**

### **Unit – II**

**RECRUITMENT:** Introduction, Factors affecting Recruitment process, Recruitment Process, Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process.

**SELECTION:** Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion exit interview.

**12 Hours**

**SSC:** *Group Discussion and different types of selections.*

### **Unit – III**

**TRAINING AND DEVELOPMENT:** Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods.

**PERFORMANCE APPRAISAL:** Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counselling based on Annual Confidential Reports.

**12 Hours**

*SSC: Different methods of Counselling.*

**Unit – IV**

**COUNSELLING AND HUMAN RESOURCE ACCOUNTING:** Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting and various methods of accounting.

**10 Hours**

*SSC: Advantages of Communication Process.*

**Unit – V**

**INDUSTRIAL RELATIONS:** Indian trade union act, standing orders act, Indian factories act, ESI act.

**INDUSTRIAL DISPUTES AND SETTLEMENT:** Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal and Adjudication. **08 Hours**

*SSC: Industrial Tribunal and Adjudication.*

**TEXT BOOKS:**

1. Dr. K Ashwathappa, “Human Resources Management”, Tata McGraw Hill, Edition 2008.
2. Hersey and Blanchard, “Management of Organisations Behaviour”, Prentice Hall of India 10th Edition – 2016.

**REFERENCES BOOKS:**

1. Decenzo and Robbins, “Personnel / Human resource Management”, PHI, 2002.
2. CB Marmora, “Management of Human Resources”, Himalaya Publication House, 2003
3. Arun Monappa, “Industrial Relations”, TMH, ISBN – 0-07- 451710-8

**Course Outcome**

At the end of the Course the students should be able to,

1. Define Scope, Evolution, Function of HRM and able to understand the importance of HRP.
2. Understand the process of Recruitment and Selection process
3. Define the importance and different methods of Training, Development and Performance Appraisal process.
4. Understand process of Counselling and the different methods of Human Resource Accounting process.
5. Understand the importance of Industrial Relations and the importance of different types of Industrial Acts.



### Course Articulation Matrix

Course Outcome – (CO)	Program outcome													PS O1	PS O2
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12			
Define Scope, Evolution, Function of HRM and able to understand the importance of HRP.			3	2	2	3	3		2			2			
Understand the process of Recruitment and Selection process.	2	2	1	2		3	3		2			1			
Define the importance and different methods of Training, Development and Performance Appraisal process.	3		1	2		3	3								
Understand process of Counselling and the different methods of Human Resource	2		2	2		3	3	2	2			2			
Understand the importance of Industrial Relations and the importance of different types of Industrial Acts.	2		2	2		3	3		2			1			

1-Low, 2-Moderate, 3-High

<b>Course Title: Control Engineering and Machine Tool Drive</b>			
<b>Course Code: P18IP643</b>	<b>Sem: VI</b>	<b>L-T-P-H: 2-2-0-4</b>	<b>Credits: 3</b>
<b>Contact Period: Lecture:52 Hr</b>		<b>Exam: 3Hr</b>	<b>Weightage: CIE:50; SEE:50</b>

**Prerequisites:** Basic knowledge of electrical engineering and Kirchhoff's law, Newton's Law, Free body diagram, Fundamentals of Vibration, elements of mechanical Engineering.

**Course Objectives (CO).**

At the end of the Course the students should be able to:

**Course Learning Objectives:**

1. The objective of the course is to provide the students an opportunity to gain the knowledge in the field of Control Engineering and Machine tool Drive.
2. To learn the response analysis of control systems using first order differential equations and to solve simple problems.
3. Demonstrate the block diagrams and signal flow graphs and to solve problems.
4. To learn the basic feature and Kinematic requirements of Machine tools and different drives.
5. The students should learn the knowledge to analyze and design the gear box.

## Course Content

### Unit-I

**BASIC OF CONTROL SYSTEM:** Concept of automatic controls, classification of control systems, open and closed loop systems, concepts of feedback, Requirement of an ideal control system. Any two Real time application of open and closed loop control system, Feedback and feed forward system, Comparison of close loop and open loop system. Multivariable control systems Modelling of control system: Analysis of mechanical systems (Translation motion and Rotational motion) Equivalent mechanical system (node system), Electrical systems, Analogous systems (loop analysis and node analysis). Electro mechanical systems: DC Servomotors (field controlled and armature controlled). **10 Hours**

*SSC: Deterministic and stochastic control systems.*

### Unit-II

**TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS:** Definition and classification of time response, Standard test inputs, Derivation of steady state error, Effect of input (Type of Magnitude) on steady state error (Static Error Coefficient Method), Effect of Change in G(s) H(s) on Steady State Error: step, ramp, parabolic, Simple problems.

*SSC: Disadvantages of static error coefficient method.*

**10 Hours**

### Unit-III

**BLOCK DIAGRAMS SIGNAL FLOW GRAPHS:** Derivation of Transfer function of simple closed loop system, Rules for Block Diagram Reduction, Critical Rules, Procedure to solve block diagram in canonical form, Problems on block diagram.

Signal flow graphs: Properties of signal flow graphs, Terminology, Methods to obtain Signal Flow Graph, Mason's gain formula, Problems on signal flow graph. **10 Hours**

*SSC: Advantages of block diagram.*

### Unit-IV

**BASIC FEATURE AND KINEMATIC REQUIREMENTS OF MACHINE TOOLS:** Machine tool, characteristics, Objectives, production capacity, classification, stiffness and rigidity, control system, safety and convenience, cutting motion and forces, Essential requirement, Design of basic features of a machine tool, common type of slide ways, Method of production of surfaces, General requirements of machine tool design **12 Hours**

**SSC:** *Materials for bed and guides.*

### Unit-V

**KINEMATIC DRIVES OF MACHINE TOOLS :** Machine tool drive, classification, individual and group drive, electric motors for drive, stepped and stepless drive, Layout of speeds in Arithmetic , Geometric and Logarithmic progression, Mechanical stepless drives, PIV drive, Hydraulic drives for shaper, milling machine, practical subdivisions and Number of stages in geared transformation, Machine tool spindle speeds, Ray diagram, Speed diagram, Gear box design,(Problems on Gear box design), Ruppert drive (gear box with clutch drives) problems on Ruppert drive. **10 Hours**

**SSC:** *clutch system in machine tool.*

### TEXT BOOKS:

1. **Modern Control Engineering** –K Ogatta, Prentice Hall (India) Pearson Education 2003.
2. **Automatic Control Systems**-Francis. H Raven 5<sup>th</sup>Edition.McGraw Hill 1995.
3. **Principles of Machine tools**-Sen and Bhattacharyya
4. **Machine Tool Engineering** – G.R. Nagpal, Khanna Publishers, 1999.

### REFERENCE BOOKS:

1. **Feedback control system**-Schaum'S series.2001
2. **Control systems**-I J Nagarath& M Gopal, New age International Publishers 2002
3. **Control systems** –M Gopal.TATAMcGraw Hill New Delhi 2<sup>nd</sup>Edistion 2002.
4. **Control Engineering** –U A BakshiV.U. Bakshi. Technical Publications Pune.New edition.
5. **Modern Control Systems**- Richard C Drof and Robert.H.Bishop Addison- Wesley,8<sup>th</sup> Edition,1998.
6. **Automatic Control System** –B.CKuo- Prentice Hall (India),1995.
7. **System Dynamics & Control**-EroniniomezTho Learning 2002.

### Course Outcomes:

1. The students should learn and understand necessity of basics of Control Engineering and Machine tool Drive.
2. Students will be able to identify and learn response analysis of control system and solve engineering problems.
3. The students will be able to solve the block diagrams and signal flow graphs.
4. Students should be able to demonstrate the general features of machine tools.
5. Students should be able to solve the given gear box.

### Course Articulation Matrix

Course Outcome – CO	Program outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
Ability to apply knowledge in the field Control Engineering and Machine Tool Drive	2	3	1	2	1							
Ability to identify and learn response analysis of control system and solve engineering problems.	2	3	2	1	1							
Ability to identify formulate block diagram and signal flow graphs and solve engineering	2	2	2	2	1							
Ability to demonstrate the general features of machine tools	2	2	3	1	2							
Ability to analyze and solve the given gear box	2	2	3	1	2							

<b>Course Title: Lean Manufacturing System</b>			
<b>Course Code:P18IP644</b>	<b>Sem: VI</b>	<b>L-T-P-H: 2-2-0-4</b>	<b>Credits: 3</b>
<b>Contact Period: Lecture:52Hrs Exam: 3Hrs</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** Students should have the knowledge on reduction of waste using different lean methods.

**Course Learning Objectives:**

**At the end of course the students should be able to:**

1. Learn the basic concept of Lean Manufacturing and methods to be adopted for implementing lean practices.
2. Understand the continuous improvement concept, principles and work involvement.
3. Understand the different concepts of 5S, 3M, VSM, etc.

**Course content**

**UNIT 1**

**Introduction:** Mass production system, origin of lean production system, necessity, lean revolution in Toyota, systems and systems thinking, basic image of lean production, customer focus. Standards in the lean system, total productive maintenance.

**SSC:** Compare traditional and Lean thinking.

**10 Hours**

**UNIT 2**

**Stability of lean system:** standardized work, Elements of standardized work, charts to define standardized work, man power reduction, overall efficiency - standardized work and kaizen, common layouts.

**Lean tools:** 5S system, why-why analysis, Ishikawa diagram, value stream mapping. **11 Hours**

**SSC:** Industrial applications of Lean tools.

**UNIT 3**

**Theory of Constraints:** Introduction, steps to improve process flow, buffer management, Layout management.

**Standardization of operations:** job rotation, Improvement activities to reduce work force and increase worker morale.

**Shortening of production lead times:** Practical procedures for reducing setup time. **10 Hours**

**SSC:** Types of Layouts used in automotive Industries.

**UNIT 4**

**Just In Time:** Principles of JIT, JIT system, Kanban, Kanban rules, expanded role of conveyance, production levelling. Jidoka concept.

**Poka-yoke (mistake proofing) systems,** inspection systems and zone control, use of Poka-yoke systems, three paths of Poka-yoke, Poka-yoke Detection Methods. **10 Hours**

**SSC:** Differentiate between push and pull system.

**UNIT 5**

**Lean Six Sigma:** Definition, principles, DMAIC phases, Design for six sigma, DMADV phases, choosing between DMAIC and DMADV.

**Worker Involvement and Systematic Planning Methodology:** Involvement, Kaizen circle activity, Hoshin planning system- PDCA, phases of Hoshin planning. **11 Hours**

**SSC:** How to implement Lean (case study).

**TEXT BOOKS:**

1. **Lean Production Simplified by Pascal Dennis,** A Plain Language Guide to the World's Most Powerful Production System, (Second edition), Productivity Press, New York, 8th edition 2014.
2. **Lean six sigma by A Wiley brand,** Gopal jee enterprises Delhi, Second edition, 2015

**REFERENCES:**

1. **The Machine that changed the World:** James P. Womack, Daniel T. Jones and Daniel Roos, First edition, Simon and Schuster, 2007.

2. **Toyota production system** –An integrated approach to just in time by Yasuhiro Monden – Engineering and Management press – Institute of Industrial Engineers Norcross Georgia 3rd edition 1998.
3. **“Just in Time Manufacturing”**, M. G. Korgaonker MacMillan. Reprinted 2011

**Course Outcome:**

1. Recognize the underlying philosophy and different Standards of the Toyota Production System.
2. Analyse the elements of standards and different lean tools in the lean system.
3. Explain Improvement activities to reduce work force and increase worker morale, setup reduction and bottleneck analysis.
4. Illustrate the concepts and implementation of Jidoka, JIT and Poka-yoke systems.
5. Explain importance Lean six sigma and how to manage people in a Lean environment in order to sustain improvements in production method.

**Course Articulation Matrix**

Course Outcome – (CO)	Program outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Recognize the underlying philosophy and different Standards of the Toyota Production System.	2	2	1		2							2		1
Analyse the elements of standards and different lean tools in the lean system.	2	2	1		3							2		1
Explain Improvement activities to reduce work force and increase worker morale, setup reduction and bottleneck analysis	2	2	1		2							2		1
Illustrate the concepts and implementation of Jidoka, JIT and Poka-yoke systems.	2	2	1		3							2		1
Explain importance Lean six sigma and how to manage people in a Lean environment in order to sustain improvements in production method.	1	1	1		3							2		1

1-Low, 2-Moderate, 3-High.

## Open Electives

<b>Course Title: Principles of Marketing</b>			
<b>Course Code: P18IPO651</b>	<b>Semester: VI</b>	<b>L-T- P-H: 3-0- 0-3</b>	<b>Credits: 3</b>
<b>Contact Period - Lecture: 52Hrs.;Exam: 3 Hrs.</b>		<b>Weightage: CIE: 50 %; SEE: 50%</b>	

**Prerequisites:**

Students should have the knowledge of activities of Basics of Management, Statistics.

**Course Learning Objectives (CLOs):**

This Course aims to;

1. Illustrate the Basics of Marketing and its Management [L2]
2. Understanding the customer by through the Marketing information systems [L2]
3. Analyzing and comparing the consumer and Business Markets [L4]
4. Explaining the Product, Service and related strategies [L2]
5. Composing the proper Pricing and Distribution strategies [L6]
6. Designing the suitable Promotion system and maximizing the use of online marketing system [L6]

**Relevance of the Course:**

A principle of Marketing is an Open Elective course in BE program, which teaches basics of Marketing management and its techniques. It helps the students to become perfect engineer who can survive and challenge the competitive world by learning Marketing skills and hence can manage their organizations.

### Course Content

#### Unit - I

**Introduction:** Definition of Marketing, The marketing process, understanding the market place and customer needs, Designing a customer- driven marketing strategy, The changing marketing landscape , Companywide Strategic planning, Marketing strategy and the Marketing mix, Managing the Marketing effort.

**Managing Marketing Information Systems to Gain Customer Insights:** Marketing Information and customer insights, Assessing Marketing information needs, developing marketing information, Marketing research, other marketing information considerations.

**11 Hours**

*SSC: Company's Micro and Macro Environment.*

#### Unit - II

**Consumer Markets and Buying Behaviour:** Model of consumer behavior, classification of consumer goods Characteristics affecting Consumer behavior, Types of buying decision behavior, buying decision, Process, The buyer decision process for new products.

**Business Markets and Business Behavior:** Scope, classification of business goods, characteristics of business markets, A model of business buyer behavior, participants in the Business buying process, major influences on business buyers, Business buying process. E-procurement.

*SSC: Market Segmentation and Market targeting.*

**11 Hours**

#### Unit -III

**Product & Services:** The concept of a product, Levels of product, Individual product and service decisions: product line decisions, product mix decisions, services marketing, New –product; idea, new – product development process, product life cycle strategies.

**Product Related Strategies:** Branding strategy: Building strong brands, Packaging, Labeling.

**10 Hours**

*SSC: Product support services.*

#### Unit -IV

**Pricing:** Definition, Factors to consider when setting prices, New product pricing strategies product mix pricing strategies, price adjustment strategies, Initiating and Responding to price changes. Public policy and pricing.

**Distribution:** The nature and importance of Marketing channels, channel behavior and organization, channel design decisions, channel management decisions.

**10 Hours**

*SSC: Marketing logistics and supply chain management.*

#### Unit – V

**Promotion:** Advertising: Definition, objectives, Budget, Developing strategy, Public relations, Personal selling: Definition, Nature, Role of the sales force, the personal selling process, Sales Promotion: Definition, objectives and Tools.

**Direct and Online Marketing:** Benefits, Forms (Briefly)

**10 Hours**

*SSC: Managing the sales force.*

#### Text books:

1. Principles of Marketing- Philip Kotler, Gary Armstrong, PHI,. 13th edn, 2013
2. Marketing Management S.A Sherlaker, 2011

#### Reference books:

1. Fundamentals of Marketing- William J Stanton, McGraw Hill, 1994.
2. Marketing Management Text & Cases- Rajagopal, Vikas Publishing House, 2008

#### Course Outcome

1. Understanding the Marketing and its Management and marketing information systems
2. Describing and distinguishing the consumer and Business Markets and their behaviors.
3. Explaining the Product, Service and related strategies.
4. Proposing Pricing and Distribution strategies.
5. Composing the suitable Promotion system and using the online marketing system.

Course Articulation Matrix															
Course Outcomes		Program Outcomes											PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Understanding the Marketing and its Management and marketing information systems	2				1	1				1		1		
CO2	Describing and distinguishing the consumer and Business Markets and their behaviors.	1	2				1	1		2	2		2	1	
CO3	Explaining the Product, Service and related strategies	2				2	1		1			1	1		
CO4	Proposing Pricing and Distribution strategies.	1					1				1	1	2		
CO5	Composing the suitable Promotion system and using the online marketing system.	1	1	2		3		1	2		2	1			

Course Title: Financial Management			
Course Code: P18IPO652	Semester: VI	L-T-P-H: 3-0-0-3	Credit:3
Contact Period: Lecture:52 Hrs	Exam: 3Hrs	Weightage: CIE:50%; SEE:50%	

## Course Content

### Unit – I

**Introduction:** Evolution of Financial Management, Financial Decisions in firm, Goals, Forms of business organization, Risk- Return Tradeoff.

**Risk And Required Return:** Risk and return relationship, Business risk, financial risk, and risk in portfolio context, expected rate of return. **10 Hours**

*SSC: Capital asset pricing model.*

### Unit – II

**Capital Budgeting:** Risk analysis in Capital Budgeting, Cost of Capital – Debt, Preference, Equity forms of capital.

**Working Capital Management:** Characteristics of current assets, Factors influencing working capital requirement, Level of current assets, determination of operating cycle and cash cycle. **10 Hours**

*SSC: Cash requirement for working capital.*

### Unit – III

**Long Term Financing:** Financing Decisions versus Investment Decisions, Sources of Long-Term Finance: Equality Capital, Retained Earnings, Preference Capital, Term Loans, Raising Long-Term Finance: Venture Capital, Initial Public Offering, Public Issue by Listed Companies, Rights Issue. **10 Hours**

*SSC: Debentures.*

### Unit – IV

**Capital Structure and Firm Value:** Assumption, Definition and approaches, Modigliani and Miller Mode, Capital Structure decisions – EBIT, EPS analysis, ROI, ROE analysis and Cash Flow comparative Analysis

**Dividend Value and Firm Value Models,** Reasons for payment of dividends, Dividend Policy, Bonus shares and stock splits. **10 Hours**

*SSC: Dividend policies in practice.*

### Unit - V

**International Financial Management:** World Monitoring system, Foreign Exchange Markets, International Parity Relationships, International Capital budgeting, Financing Foreign Operations, Raising Foreign Currency Finance, Financing Exports, Documents in International Trade, Foreign Exchange Exposure, Management of Foreign Exchange Exposure.

**Financial Management In Public Sector Enterprises:** Capital Budgeting, Long-term Financing, Working capital Management, Financial Controls, Privatization. **12 Hours**

*SSC: Memorandum of Understanding.*

### Text books:

1. Financial Management -Theory and practice, Prasanna Chandra TMH ISBN– 0-07-044501-X, 5<sup>th</sup> Edition.
2. Financial accounting -B.S. Raman, United publication Vol II

### Reference Books:

1. Financial Management .Tex t& Problems -Khan & Jain, TMH .ISBN 0—07-460208-X
2. Financial management -IM Pandey. Vikas Pub. House ISBN 0- 7069-5435-1.



Course Articulation Matrix															
Course Outcomes		Program Outcomes											PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	The students should learn the financial decision making.	2	1									3	1	1	
CO2	The students should be able to learn cash flow information and taxes.	2	1		1							3	1		
CO3	The students should be able to learn the risk analysis in capital budgeting.		1		1			1			1		1		1
CO4	Students should be able to learn the principles and techniques of financial management.	2										2			
CO5	Students should be able to learn the International Capital budgeting.	2			1	1					1	1	1		

<b>Course Title: World Class Manufacturing</b>			
<b>Course Code: P18IPO653</b>	<b>Semester: VI</b>	<b>L – T – P–H : 3 – 0 – 0 –3</b>	<b>Credits: 3</b>
<b>Contact Period - Lecture:52 Hrs. Exam:3 Hrs.</b>		<b>Weightage: CIE: 50 %; SEE: 50%</b>	

## Course Content

### Unit – I

**Introduction to World Class Manufacturing:** Manufacturing Excellence and Competitiveness, What is world-Class Manufacturing-Hall’s framework of world-Class Manufacturing (WCM), Gunn’s Model of World-Class Manufacturing.

**World Class Manufacturing:** The philosophy of world-class Manufacturing-The First Principles of World-Class Manufacturing, The practices of World-Class Manufacturing-The customers Interface, The Supplier Interface, World-Class Practices in the factory. **11 Hours**

*SSC: Maskell’s Model of World-Class Manufacturing.*

### Unit – II

**Principles and Practices of WCM:** Data collection plan, research-internal public domain sources, outside expert’s etc. original research, site visits, and code of conduct. Analyzing the gap: Top displaying data, deciding and combining best work practices.

**Systems and Tools for WCM:** The integration imperative, information management tools: product and process design tool, bar code systems. Material processing and handling tools: flexible manufacturing systems, rapid prototyping. **10 Hours**

*SSC: Value Stream Mapping.*

### Unit – III

**Benchmarking:** Definition, Need, Metrics, phases and managing benchmarking process, training and code of conduct, future scope and benchmarking process. What to benchmark: concept of step zero, priorities, business processes – linking to goals etc, investigation, documentation, performance measures, improving business processes. Whom to benchmarks: Developing candidate list, systematic search, refining the initial list. **10 Hours**

*SSC: Objectives of Bench Marking.*

### Unit – IV

**Reengineering:** Importance of 3Cs-customers takes charges, competition intensifies, and change becomes constant. Definition of Business Process Reengineering – fundamentals rethinking.

**Rethinking business process, new world of and enabling role of information technology.**

**Quality Systems:** ISO 9000-2000, IS 14000, Frame Work for Business Excellence – Malcolm Baldrige Award, Deming’s Award. **10 Hours**

*SSC: Case studies on Re-Engineering in Industries.*

### Unit – V

**Six Sigma:** The Basics, The core of Six Sigma(DMAIC), design for Six Sigma, DFSS and the customer, Quality time and the Bottom line, core of DFSS-IDOV method DFSS Metrics.

**Activity Based Management (ABM):** Introduction, Traditional Cost Systems, Activity Based activity Based Costing, Activity Based Management, ABM Implementation, and Case Study.

**Theory of Constraints (TOC):** Theory of Inventive Problem Solving **11 Hours**

*SSC: Implementing DFSS.*

### Text books:

1. Hammer, Michael and James Champy. Reengineering the corporation-A Manifesto for Business revolution, Nicholas Brealey Publishing ,London.- 1995
2. Finding and Implementing Best Practices- Business Process Benchmarking, Champ ,Robert C. Vision Books , New Delhi – 2008
3. World Class Manufacturing- A Strategic Perspective-Sahay B S, Saxena K B C, Ashish Kumar, MacMillan – India Ltd, ISBN 0333- 93-4741.
4. Six sigma for Managers- TMH 2002,Greg Brue,, ISBN- 0-07- 048639-5

**Reference books:**

1. Design for Six Sigma -Grege, TMH 2003,ISBN 0-07-058120
2. Clyde M. Creveling, Design for Six Sigma Technology and Product Development –Pearson Education – 2008.
3. Total Quality Management -Dale H. Besterfield, carol Besterfield- Minchna, glen H Besterfield and Mary Besterfield –Scare, ,3<sup>rd</sup> edition Pearson education, ISBN 81-297-0260-6

**Course Articulation Matrix**

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
<b>CO1</b>	Recognize different frame work models followed by quality Guru's and the Principles of WCM and Practices used in Factory.	2			2	2				3	2				
<b>CO2</b>	Summarize the Importance of Data Collection Methods used and Tools used in Factory while implementing WCM.	2				2	2		3						
<b>CO3</b>	Analyse the different methods of Bench Marking Process, and significance of Value Stream Mapping.	2				3		2		2					
<b>CO4</b>	Recognize fundamental concepts of Reengineering and Quality system and Importance of ISO in Manufacturing Industries.	2		2	3		3								1
<b>CO5</b>	Employing Six Sigma concepts in industries and Impact of Activity Based Management and Theory of Constraints.	2		2		2	2			2					1

<b>Course Title: Management Information System</b>			
<b>Course Code: P18IPO654</b>	<b>Semester: VI</b>	<b>L – T – P-H : 3 – 0- 0-3</b>	<b>Credit: 3</b>
<b>Contact Period - Lecture: 52 Hrs.; Exam: 3 Hrs.</b>		<b>Weightage: CIE: 50 %; SEE: 50%</b>	

## Course Content

### Unit – I

**Fundamentals Of Information Systems:** Information systems in business, fundamentals of information systems, solving business problems with information systems.

**Information Systems For Business Operations:** Business information systems, Transaction processing systems, management information systems and decision support systems. Artificial intelligence, technologies in business. **12 Hours**

*SSC: Information system for strategic applications and issues in information technology.*

### Unit – II

**Issues in Managing Information Technology:** Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT.

*SSC: Social challenges of information technology.*

**10 Hours**

### Unit – III

**Introduction To E-Business:** E-commerce frame work, Media convergence, Consumer applications, Organization applications.

**E-BUSINESS MODEL:** Architectural frame work for E-commerce, Application services and transaction Models – B2C Transactions, B2B Transactions. **10 Hours**

*SSC: Intra-Organizational Transactions.*

### Unit – IV

**E-Business Model:** WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web.

**Consumer-Oriented E-Commerce:** Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment. **10 Hours**

*SSC: Mercantile Process Models.*

### Unit – V

**Electronic Data Interchange (EDI):** EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI.

**10 Hours**

*SSC: Digital Signatures and EDI.*

#### **Text books:**

1. Management Information systems- Managing Information Technology in the Internet Worked Enterprise- Jams. A O'Brien – Tata McGraw Hill publishing company limited, 2004.
2. Management Information Systems - Laudon & Laudon PHI, 2012.

#### **Reference books:**

1. Management Information systems- S. Sadogopan. PHI, 2005
2. Information system s for modern management - G.R. Murdick PHI, 2ndEdition, 2015

Course Articulation Matrix															
Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
<b>CO1</b>	Telling the fundamentals of Information systems and suitable Information systems for business operations.	3		1			1		1		2				
<b>CO2</b>	Outlining the Issues in managing information technology.		2	2					1		2				1
<b>CO3</b>	Illustrating the E-business and developing its model.	2	2	3	1						1		1		
<b>CO4</b>	Developing the E-business model and consumer-oriented E-commerce.		2	3	1						1		1		
<b>CO5</b>	Understanding the EDI.	3		2		2					2	1			1

<b>Course Title: Industrial Engineering Lab</b>			
<b>Course Code: P18IPL66</b>	<b>Sem: VI</b>	<b>L-T-P-H: 0-0-3-3</b>	<b>Credits: 1.5</b>
<b>Contact Period: Lecture: 39Hrs Exam: 3Hrs</b>		<b>Weightage: CIE: 50; SEE: 50</b>	

**Course objective:** To train the students with the practical knowledge of instruments, methods of analysis, application of work study and Ergonomics in engineering system design.

**Prerequisites:** Students should have studied the Work Study.

**Course Learning Objectives (CLO):**

After completion of lab the student should be able to:

- Learn the various processes of layouts and charts for an industry.
- Determine the Performance ratings of different activities.
- Analyse the effect of different noise levels at work places.
- Determine the acceptance samplings and normal distribution.
- Determine the effect of work on human efficiency.

**Course Outcomes (COs)**

After completion of lab the student should be able to:

1. Construct the Charts and diagrams to record the methods
2. Illustrating the Principles of motion economy, Acceptance sampling and Normal distribution.
3. Evaluate the effect of work, Noise on human body
4. Determine the Rating and Standard time for simple operations
5. Design of Displays and controls

**Course Contents**

1. Recording Techniques: preparing the following charts and diagrams
  - Out line process chart
  - Flow process chart
  - Flow diagram
  - Multiple activity charts
  - String diagram
  - Two handed process charts
2. Application of principle of motion economy
3. Measurement of effect of work on human body (Ergometer, Treadmill)
4. Conceptual design of displays and controls
5. Rating exercises
6. Determining the standard time for simple operation using stop watches and PMTS (using video camera)
7. Application of Acceptance Sampling Techniques (single sampling plan & Plotting the O.C. Curve)
8. Experiments to generate data the results in normal distribution, and its interpretation.
9. Effect of Noise on human efficiency.
10. Introduction to ECG, EMG & BP Measurements
11. Demonstration on Tecnomatix software and Jack Simulation Software.  
Case study on carrying of object for Jack and Jill

**Scheme of Examination:**

Experiments	: 40 Marks
Viva – Voce	: 10 Marks
Total	<b>: 50 Marks</b>

**Course Articulation Matrix**

Course Outcome – (CO)	Program outcome (ABET/NBA)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Construct the Charts and diagrams to record the methods.	2	2										2		
Illustrating the Principles of motion economy, Acceptance sampling and Normal distribution.	2	2										2		
Evaluate the effect of work, Noise on human body.	2	2	1									2		1
Determine the Rating and Standard time for simple operations.	3	2	1									2		1
Design of Displays and controls.	2	2	1									2		2

<b>Course Title: Computer Aided Analysis Lab</b>			
<b>Course Code: P18IPL67</b>	<b>Semester: VI</b>	<b>L-T-P-H : 0 - 0 - 3 - 3</b>	<b>Credit:1.5</b>
<b>Contact Period - Practical: 39Hrs. Exam: 3Hrs.</b>		<b>Weightage: CIE: 50 %; SEE: 50%</b>	

**Course Learning Objective:**

The course aims at prepare the students to use Finite Element Analysis tools for solving simple structural problems to enhancing their analysis skills in the field of Computer Aided Engineering.

**Course Outcomes (COs)**

At the end of the course the students should be able to:

1. Explain the applications of commercial FEA packages like ANSYS 2015.
2. Solve structural engineering problems using ANSYS
3. Validate finite element results with analytical or experimental results.
4. Apply the right finite elements techniques on various kind of machine parts

**Course content**

1. Introduction to ANSYS Application software
2. Application of line elements: bars of constant cross section area, tapered cross section area, stepped bars.
3. Application of line elements: Plane trusses, beams with point, uniform and variable loads.
4. Application 2-D elements: Beams, Plate with hole
5. Application of 2-D elements to axisymmetric problems.
6. Modal analysis of fixed - fixed beam
7. Simple Harmonic analysis of axially loaded bar, Fixed - fixed beam
8. Buckling analysis of columns.
9. Modelling of torsion problem.

**References:**

1. Saeed Moaveni, "Finite Element Analysis Theory and Application with ANSYS", Pearson Education
2. ANSYS 15 Documentation.

**Course Articulation Matrix**

<b>Course Outcome – (CO)</b>	<b>Program outcome</b>													
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PSO 2</b>
Ability to describe the applications of FEA packages and Validate finite element results with analytical or experimental results.	3	2			2							2		
Ability to Solve structural engineering problems using ANSYS.	3	2			2							2		



<b>Course Title: Skill Oriented Lab-II (Advanced Geometric Modelling –II)</b>			
<b>Course Code: P18IPL68</b>	<b>Sem: VI</b>	<b>L-T-P-H: 0-0-2-0</b>	<b>Credits: 1</b>
<b>Contact Period: Lecture:12 Hrs Exam: 1.5 Hrs</b>		<b>Weightage: CIE:50; SEE:50</b>	

**Prerequisites:** Knowledge of Engineering Graphics and modeling techniques

**Course Learning Objectives (CLO):**

At the end of the Course the students should be able to do;

1. Create parts using Different CAD/CAM Packages like CATIA, Unigraphics, NX, Creo etc.
2. Create complex geometric models.
3. Surface Modelling.

**Relevance of the Course:**

Advanced Geometric Modeling is very much essential for the students to be ready with complete knowledge of design and drawing techniques to compete in the current industrial scenario. In this regard it is attempt to train the students in the use of different CAD Packages.

## Course Content

**Surfacing Modeling.**

Tool bars, Surface Creation (Extrude, Revolve, Sphere, Cylinder), Surface Modification, Surface Editing (Trim, Split, Shape Fillet, Close Surface, Thickness). Offset, Fill, Blend, Join, healing, Project-Combine.

**Advanced Surfacing.**

Adaptive Sweep, Sweep (ALL), Multi-section Surface. Hole, Mating Flange, Bead, Blend Corner.

**Wire-frame Modeling.**

Point, Line, Planes, Curves, Circle-Conic.

**Assembly.**

Types of assembly approach, Types of Constrains and DOF, placement of components in the Assembly, Manipulating Components.

BOTTOM UP Approach, TOP DOWN Approach, Part, Product, Component, Space Analysis, Reuse Pattern, Assembly Drafting:- Scene( Exploded View), Bill of material, Balloon creation, Graph Tree Reordering.

**Exercises.**

**Text Books:**

CAD CIM Technologies by Prof. Sham Tickoo, Purdue University Calumet, USA ISBN-978-1-932709-94-0.

<b>Course Title : Technical Skills – II ( Internals of C Programming)</b>			
<b>Course Code : P18HU693</b>	<b>Semester : VI</b>	<b>L-T-P:H : 0-2-0: 02</b>	<b>Credits : 01</b>
<b>Contact Period : 26Hrs</b>	<b>Exam Hours : 3 Hrs</b>	<b>Weight age :CIE: 50% ,SEE : 50%</b>	
<b>Prerequisites : -</b>			

### **COURSE OUTCOME:**

To enable students to:

- Strengthen their understanding of **Introduction to Computer Science, C, and Data Structures**
- Write effective codes on **C Programming**

### **OVERALL SYLLABUS BREAKUP:**

<b>Sl. No.</b>	<b>Module name</b>	<b>Classroom (Hours)</b>	<b>Lab (Hours)</b>	<b>Total duration (Hours)</b>
1.	<b>Introduction to Computer Science</b>	2	0	2
2.	<b>C Programming</b>	0	14	14
3.	<b>Introduction to Data Structures</b>	4	6	10
<b>Total Hours</b>		<b>6</b>	<b>20</b>	<b>26</b>

### **LEARNING OUTCOMES**

- After undergoing training in this course, the students will be in a position to –
  - Write complete program based on the requirements and to debug.
  - Frame effective programs using C programming and Data Structures.

### **ASSESSMENTS**

- Each of the modules (C and Data Structures) will have two types of assessments -
  - Multiple-choice assessment for programming logic, concepts and debugging
  - Coding

**COURSE PLAN:****C Programming**

Sl. No.	Topics covered	Learning outcome	Type of learning	Duration
1.	<b>Introduction to Computer Science:</b> <b>Basic Structure of Computers:</b> Basic Operational Concepts, Bus Structures, Performance– Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. <ul style="list-style-type: none"> <li>● <b>Operating System - An Introduction:</b>                Definition and functions of operating systems. Discussion on evolution of operating systems and different structures of operating systems.</li> </ul>	<ul style="list-style-type: none"> <li>● Understand the basics of computer structure and operation of computers and their peripherals and need of Operating System.</li> </ul>	Class - 2	2
2.	<b>C Programming Language:</b> <ul style="list-style-type: none"> <li>● <b>Basic level of Snippets for</b> <ul style="list-style-type: none"> <li>○ Understanding basic syntax</li> <li>○ If - else statement</li> <li>○ Switch case</li> <li>○ Struck</li> <li>○ For loop</li> <li>○ While and do - while loop</li> <li>○ Array</li> <li>○ Strings</li> <li>○ Pointers</li> <li>○ Function</li> <li>○ String</li> <li>○ File handling</li> <li>○ Pre-processing</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● Understand the concepts of snippets in a programming term for a small region of reusable source code, machine code, or text. In C it could be part of the program - A Function, typed or a part of the algorithm or code.</li> <li>● Understand the concepts of programs as sequences or machine instructions.</li> </ul>	Lab - 14	14
3.	<b>Introduction to Data Structures:</b> Data Structures Basics: Structure and Problem Solving, Data structures, Data structure Operations, Algorithm: complexity, Time- space tradeoff. <ul style="list-style-type: none"> <li>○ Linked List</li> <li>○ Stack and Queue</li> <li>○ Searching and Sorting Techniques</li> </ul>	<ul style="list-style-type: none"> <li>● Understand common data structures and the algorithms that build and manipulate them including various sorting and searching algorithms. Data structures include arrays, linked lists, stacks, queues, Features, properties, applications, enumerators, and performance issues.</li> </ul>	Class – 4 Lab - 6	10