SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2021 – 2022

B. Tech. (INDUSTRIAL ENGINEERING)

Published By

Dr. R. S. Pande

Principal
Shri Ramdeobaba College of Engineering & Management
Ph. : 0712-2580011 Fax : 0712 - 2583237
ISO 9001 : 2015 CERTIFIED ORGANISATION

About the Department

The Department was established in the year 1984 and has been accredited by National Board of Accreditation in the year 2014 for six years. The department is having well-equipped laboratories with advanced Equipment/ Software/ Experimental setups worth more than Rs.1 Crore. Postgraduate program was established in the year 2004 with the intake of 18 seats. The department is actively engaged in giving consultancy to several industries around Nagpur. Department has completed consultancy of assignments more than 30 lakh in Maharashtra State Road Transport Corporation. The department received following grants from A.I.C.T.E. in the past.

1. EDC Entrepreneurship Development Cell, Rs. 4 Lacs, Dec. 2012
2. Coordinate Measuring Machine (CMM), Rs. 13 Lacs, Jan 2013
3. CNC Milling Machine, (RPS) Rs. 22 Lacs, July 2013

Industrial Engineering Society is in place which provides a platform to the students and staff to reveal their talent through various technical, curricular and co-curricular activities.

Salient Features of the Department

1. Alumni have achieved higher position in Multi-National Companies.
2. Highest placement amongst private institutes in the region.
3. Excellent academic results with numerous universities rankers/highest CGPA.
4. Students excel in Professional Examinations.
5. Students outshine in various sports activities of University /State level.
6. State-of-Art infrastructure.
7. Experienced, enthusiastic & dedicated staff with research aptitude.
   - No. of Ph.D. : 07
   - Ph.D.(Pursuing) : 04
8. Faculty members have to their credit more than 200 research publications.
9. Faculty is having thorough interactions with outside world.
10. Department carries out Industrial visits and industry-based projects on regular basis.
11. Association with Indian Institution of Industrial Engineering Mumbai
12. Software available with the department Simul8, WITNESS, Technomatics, MOST Software (WM + PDMS), SPSS, Primavera

Department Vision

To be a leader in imparting knowledge of creating efficient and effective systems for manufacturing and service organizations

Department Mission

- To nourish a learning environment conducive to foster innovations in Industrial Engineering
- Improvement in Industrial productivity by devising systems and quality standardsSintering the engineering knowledge by research support. Absorption of such knowledge in teaching and learning process and its replication to quasi-similar situations.

Program Educational Objectives

1. The students of Industrial Engineering shall be prepared to work in any Engineering organization, pursue higher studies or start their own entrepreneurial project.
2. Industrial Engineering students shall have the expertise to create the integrated systems of man-machine- material for productivity improvement. Students shall have the ability to provide financially viable systems.
3. The students shall have the general understanding and competency of designing and evaluating the interfacing systems of Information and Technology, Mechanical and Production Engineering.
4. Exposure to management courses shall inculcate into the students a sense of professionalism. Involvement ofthe graduates with student bodies shall help them shape their personalities as it will hone their communication skills, build team-spirit and generate social awareness.
5. The students shall have the desire to pursue higher studies and engage themselves in life- long learning in the context of technological changes.

Program Outcomes

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.

6. **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.
7. **Environment and sustain ability :** Understand the impact of the professional engineering solutions in societal& environmental contexts and demonstrate the knowledge of & need for sustainable development.
8. **Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
10. **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.
11. **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 multi-disciplinary environments.
12. **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.

Programme Specific Outcomes

1. Understand the foundations of the linkage between the quality, productivity and cost.
2. Ability to add value to systems, process, products, services and people

Teaching Scheme for First Year (Semester I & II) Bachelor of Engineering
Group 1 : Semester - I / Group 2 : Semester - II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PHT158	Mechanics, Optics and Acoustics	3	1	0	4	40	60	100	03
2.	PHP158	Mechanics, Optics and Acoustics Lab	0	0	3	1.5	25	25	50	–
3.	MAT152/ MAT151	Differential Equations, Linear Algebra, Statistics & Probability/ Calculus	3	0/1	0	3/4	40	60	100	03
4.	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	–
5.	EET151	Basic Electrical Engineering	3	1	0	4	40	60	100	03
6.	EEP151	Basic Electrical Engineering Lab	0	0	2	1	25	25	50	–
7.	MET151	Engineering Graphics & Design	1	0	0	1	40	60	100	03
8.	MEP151	Engineering Graphics & Design Lab	0	0	4	2	50	50	100	–
9.	HUT152	Constitution of India	2	0	0	0	–	–	–	–
10.	PEP151	Yoga / Sports	0	0	2	0	–	–	–	–
		TOTAL	**12**	**2/3**	**13**	**17.5/18.5**			**650**	

Group 2 : Semester - 1 / Group 1 : Semester - II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CHT151	Chemistry	3	1	0	4	40	60	100	03
2.	CHP151	Chemistry Lab	0	0	3	1.5	25	25	50	–
3.	MAT151/ MAT152	Calculus/Differencial Equations, Linear Algebra, Statistics & Probability	3	1/0	0	4/3	40	60	100	03
4.	CST151	Programming for Problem Solving	4	0	0	4	40	60	100	03
5.	CSP151	Programming for Problem Solving Lab	0	0	2	1	25	25	50	–
6.	IDT151	Creativity, Innovation & Design Thinking	1	0	0	1	20	30	50	1.5
7.	INT151	Workshop/Manufacturing Practices	1	0	0	1	20	30	50	1.5
8.	INP151	Workshop/Manufacturing Practices Lab	0	0	2	1	25	25	50	–
9.	HUT151	English	2	0	0	2	40	60	100	03
10.	HUP151	English Lab	0	0	2	1	25	25	50	–
		TOTAL	**14**	**2/1**	**9**	**20.5/19.5**			**700**	

Scheme of Teaching & Examination of Bachelor of Engineering (Industrial Engineering)

Semester III

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	MAT258	Introduction to Statistics & Probability - I	3	0	0	3	40	60	100	3
2.	INT251	Principles of Mechanical Engineering - I	3	0	0	3	20	30	50	2
3.	INP251	Principles of Mechanical Engineering -I lab	0	0	2	1	25	25	50	-
4.	INT252	Manufacturing Engineering - I	3	0	0	3	40	60	100	3
5.	INP252	Manufacturing Engineering - I Lab	0	0	2	1	25	25	50	-
6.	INP253	Machine Drawing Laboratory	0	0	2	1	25	25	50	-
7.	INT254	Facilities Planning	3	0	0	3	40	60	100	3
8.	INT255	Object Oriented Programming Methods	2	0	0	2	40	60	100	3
9.	INP255	Object Oriented Programming Methods Lab	0	0	2	1	25	25	50	-
10.	IDT252	Biology	2	0	0	2	25	25	50	2
11.	INP256	Industrial Visit	0	0	2	0	SF/USF Grade			-
12.	HUP258	Personality Development Lab	0	0	2	1	25	25	50	-
		Total	**16**	**0**	**12**	**21**	**330**	**420**	**750**	**16**

Semester IV

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	MAT261	Introduction to Statistics &Probability - II	3	0	0	3	40	60	100	3
2.	INT261	Principles of Mechanical Engineering - II	2	0	0	2	20	30	50	3
3.	INP261	Principles of Mechanical Engineering - II Lab	0	0	2	1	25	25	50	--
4.	INT262	Manufacturing Engineering - II	3	0	0	3	40	60	100	3
5.	INP262	Manufacturing Engineering - II Lab	0	0	2	1	25	25	50	--
6.	INT263	Work System Design	3	0	0	3	40	60	100	3
7.	INP263	Work System Design Lab	0	0	2	1	25	25	50	1
8.	INT299-	Open Elective - I	3	0	0	3	40	60	100	3
9.	INT265	Instrumentation and Metrology	3	0	0	3	40	60	100	3
10.	INP265	Instrumentation and Metrology Lab	0	0	2	1	25	25	50	--
11.	HUT259	Leadership Skills	2	0	0	2	40	60	100	3
12.	CHT252	Environmental Science	2	0	0	0	SF/USF Grade			-
		Total	**21**	**0**	**8**	**23**	**360**	**490**	**850**	**21**

Open Elective - I		
Sr. No	**Course Code**	**Course Name**
1	INT299-1	Organizational Behavior Development
2	INT299-2	Decision Modeling
3	INT299-3	Six Sigma

Scheme of Teaching & Examination of Bachelor of Engineering (Industrial Engineering)

Semester V

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total	
1.	INT351	Operations Research - I	3	0	0	3	40	60	100	3
2.	INP351	Operations Research - I Laboratory	0	0	2	1	25	25	50	-
3.	INT352	Production Planning and Control	3	0	0	3	40	60	100	3
4.	INT353	Work Measurement and Value Engineering	3	0	0	3	40	60	100	3
5.	INT354	Relational DBMS	3	0	0	3	40	60	100	3
6.	INP354	Relational DBMS Laboratory	0	0	2	1	25	25	50	-
7.	INT355	Modeling and Simulation	3	0	0	3	40	60	100	3
8.	INP355	Modeling and Simulation Laboratory	0	0	2	1	25	25	50	-
9.	INT398 - x	Open Elective - II	3	0	0	3	40	60	100	3
10.	HUT353	Indian Traditional Knowledge	2	0	0	0	SF/USF Grade			-
		Total	**20**	**0**	**6**	**21**	**315**	**435**	**750**	**18**

Open Elective - II		
Sr. No	**Course Code**	**Course Name**
1	INT398-1	Data Science
2	INT398-2	Maintenance and Troubleshooting
3	INT398-3	Safety Engineering
4	INT398-4	Industrial Psychology
5	INT398-5	Theories of Engineering Experimentation
6	INT398-6	Organizational Productivity Improvement

Scheme of Teaching & Examination of Bachelor of Engineering (Industrial Engineering)

Semester VI

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total	
1.	INT361	Operations Research - II	3	0	0	3	40	60	100	3
2.	INP361	Operations Research Lab	0	0	2	1	25	25	50	-
3.	INT362	Supply Chain Management	3	0	0	3	40	60	100	3
4.	INT363	Quality Engineering	3	0	0	3	40	60	100	3
5.	INP363	Quality Engineering Lab	0	0	2	1	25	25	50	-
6.	INT364	Elective - I	3	0	0	3	40	60	100	3
7.	INT365	Elective - II	3	0	0	3	40	60	100	3
8.	INT399	Open Elective - III	3	0	0	3	40	60	100	3
9.	INP367	Mini Project	0	0	4	2	25	25	50	-
10.	INP368	Comprehensive Viva	0	0	2	1	25	25	50	-
		Total	**18**	**0**	**10**	**23**	**340**	**460**	**800**	**18**

Elective - I		
Sr. No	**Course Code**	**Course Name**
1	INT 364-1	Marketing Management
2	INT 364-2	Industrial Robotics
3	INT 364-3	Data Analytics and Machine Learning
4	INT 364-4	Sustainability and Green Manufacturing

Elective - II		
Sr. No	**Course Code**	**Course Name**
1	INT365-1	Entrepreneurship Development
2	INT365-2	Project Management
3	INT365-3	Industrial Drives and Design
4	INT365-4	Material Management and Inventory Control
5	INT365-5	Lean Production System

Open Elective - III		
Sr. No	**Course Code**	**Course Name**
1	INT 399-1	Supply Chain Analytics
2	INT 399-2	Research Methodology

Scheme of Teaching & Examination of Bachelor of Engineering (Industrial Engineering)

Semester VII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	INT451	Industrial Automation	3	0	0	3	40	60	100	3
2.	INP451	Industrial Automation Lab	0	0	2	1	25	25	50	-
3.	INT452	Engineering Economy and Cost Control	3	0	0	3	40	60	100	3
4.	INT453	Human Factors Engineering	3	0	0	3	40	60	100	3
5.	INP453	Human Factors Engineering Lab	0	0	2	1	25	25	50	-
6.	INT454	Elective - III	3	0	0	3	40	60	100	3
7.	INT455	Elective - IV	3	0	0	3	40	60	100	3
8.	INT498	Open Elective - IV	3	0	0	3	40	60	100	3
9.	INP457	Major Project Seminar	0	0	4	2	25	25	50	-
10.	INP458	Industry Internship (6-8 Weeks)	0	0	2	0	SF/ USF Grade			
		Total	**18**	**0**	**10**	**22**	**315**	**435**	**750**	**18**

Elective - III		
Sr. No	**Course Code**	**Course Name**
1	INT454-1	Non-Linear Optimization Technique
2	INT454-2	Human Resource Management
3	INT454-3	Enterprise Resource Planning
4	INT454-4	Advanced Instrumentation and Measurement Techniques

Elective - IV		
Sr. No	**Course Code**	**Course Name**
1	INT455-1	Tool Design
2	INT455-2	Flexible Manufacturing Systems
3	INT455-3	Internet of Things

Open Elective - IV		
Sr. No	**Course Code**	**Course Name**
1	INT498-1	Computer Integrated Manufacturing
2	INT498-2	Project Planning and Management

Semester VIII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	INT461	Elective - V	3	0	0	3	40	60	100	3
2.	INT462	Elective - VI	3	0	0	3	40	60	100	3
3.	INP463	Project	0	0	12	6	100	100	200	-
		OR								
1.	INP464	Full Semester Internship	-	-	24	12	100	100	200	-
		Total	**6**	**0**	**12**	**12**	**180**	**220**	**400**	**6**

Open Elective - V		
Sr. No	**Course Code**	**Course Name**
1	INT461-1	Reliability Engineering
2	INT461-2	Industrial Energy, Management

Elective - VI		
Sr. No	**Course Code**	**Course Name**
1	INT462-1	Quality for Service
2	INT462-2	Additive Manufacturing Technique
3	INT462-3	Data Visualization Tools
4	INT462-4	Behavioral Science

Honor Scheme

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	INTH41	Industry 4.0	4	0	0	4	40	60	100	3
2.	INTH51	Soft Computing Methods	4	0	0	4	40	60	100	3
3.	INTH61	Taguchi Methods for Experimentation	4	0	0	4	40	60	100	3
4.	INTH71	Supply Chain Optimization	4	0	0	4	40	60	100	3
5.	INTH81-1	Business Analysis	4	0	0	4	40	60	100	3
6.	INTH81-2	Strategic Information Management Systems	4	0	0	4	40	60	100	3
		Total	**24**	**0**	**0**	**24**	**240**	**360**	**600**	**18**

Minor Scheme

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	INTM41	Methods Engineering	4	0	0	4	40	60	100	3
2.	INTM51-1	Materials Management	4	0	0	4	40	60	100	3
3.	INTM51-2	Production Planning and Control	4	0	0	4	40	60	100	3
4.	INTM61	Operations Research	4	0	0	4	40	60	100	3
5.	INTM71	Quality Engineering and Management	4	0	0	4	40	60	100	3
6.	INTM81	Project Management and Engineering	4	0	0	4	40	60	100	3
		Total	**24**	**0**	**0**	**24**	**240**	**360**	**600**	**18**

Syllabus for Semester BE I / II
Department of Industrial Engineering, Civil Engineering

Course Code : PHT158 **Course : Mechanics, Optics and Acoustics (Theory)**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 4**

Course Objectives

1. To build a strong conceptual foundation of mechanics, optics and acoustics
2. To enhance the ability to use the mathematical techniques in its applications

Course Outcomes

After successful completion of the course students will be

1. able to apply concepts of kinematics , dynamics and oscillatory motion in solving engineering problems
2. able to understand how to describe and solve simple general rigid body motions.
3. able to recognize and analyze phenomena of interference, diffraction and polarization of light waves
4. able to understand broad principles of acoustics and ultrasonics

Module 1: Newton's Laws and Applications

Forces in Nature, fundamental and derived forces; Newton's Laws of Motion, First law (law of inertia), Inertial and Non-inertial Systems; Second law, concept of force; Third law, Simple applications of Newton's laws, friction, Examples and problems including friction and constraints.

Module 2: Oscillations

Particle Dynamics in One Dimension: Velocity Dependent Force, Position Dependent Force,

One-dimensional harmonic oscillator, damped oscillator, over, critical and under damping; Forced oscillator, undammed and damped cases; Examples, resonance and Q factor;

Module 3: Conservation Laws Rigid Body Dynamics

System of Particles and Centre of Mass, Conservation of Linear and Angular Momentum, Angular momentum of a particle, torque of force; L of a system of particles, torque of external forces, Definition of a rigid body, rotation in a plane, angular momentum about a point of rigid body in planar motion about a fixed axis, Kinematics, concept of moment of inertia, Dynamics of pure rotation about an axis.

Module 4: Interference, DiffractionLight as an electromagnetic wave, Superposition of waves, Coherence, Interference in thin films, Newton's ring, Applications of thin films.

Diffraction, Diffraction at a single slit, double slit, grating, Resolving power, Bragg's law of crystal diffraction.

Module 5 : Polarization

Unpolarized and polarized light, Different types of polarization of light, Malus' law, Optically anisotropic materials, double refraction, wave-plates and compensators, production and analysis of polarized light, Applications of polarizing devices , Applications of birefringence.

Module 6 : Acoustics and Ultrasonics

Fundamentals of vibrations, Sound waves and their characteristics, Sound intensity level-Decibel, Reverberation time , Sound absorption , Reverberation theory, Determination of sound absorption coefficients , Factors affecting acoustics of building and their remedies, acoustic design of hall.

Ultrasonics : Pizoelectric effect, types of ultrasonic waves, Determination of velocity of ultrasonic waves, Industrial and medical applications of ultrasonic waves.

Text Books

1. An introduction to Mechanics, Daniel Kleppner, Robert J. Kolenkow, 2nd Edition (Cambridge University Press)
2. Engineering Physics by Sanjay Jain and Girish Sahasrabudhe , Universities Press

Reference Books

1. The Physics of vibrations and waves by H.J. Pain Sixth edition , John wiley and Sons, Ltd
2. Engineering Physics by M.N. Avadhanulu and Kshirsagar S. Chand Publication

Syllabus for Semester BE I / II
Department of Industrial Engineering, Civil Engineering

Course Code : PHP158 **Course : Mechanics, Optics and Acoustics (Theory) Lab**

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits : 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following lists as specific to Program:

1. Ohm's law verification, error analysis and graph plotting using linear least square fit
2. Newton's law of cooling
3. Radius of curvature of a convex lens using spherometer
4. Measurement of Magnetic flux by bar magnet
5. Study of simple pendulum
6. Young's modulus by bending of beam
7. Moment of Inertia of a Flywheel
8. Modulus of rigidity of wire using torsional pendulum
9. Moment of inertia of a rigid body of irregular shape
10. Searle's dynamical method
11. Determination of wavelength of light using Newton's experiment
12. Dispersive power of prism
13. Resolving power of grating

14. Malus law
15. Data analysis using Mathematica

Suggested References

1. Physics Lab Manual written by the Teaching Faculty of Physics Department, RCOEM.

A minimum of 8 experiments are to be performed from the above list of experiments.

Syllabus for B.E. Semester I / II

Department of Industrial Engineering

Course Code: MAT151 **Course : Calculus**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 04**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Calculus and multivariate analysis. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The fallouts of Mean Valve Theorems that is fundamental to application of analysis to Engineering problems, to deal with functions of several variables that are essential in most branches of engineering.
2. Basics of improper integrals, Beta and Gamma functions, Curve Tracing, tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. Multivariable Integral Calculus and Vector Calculus and their applications to Engineering problems.

Syllabus

Module 1 : Differential Calculus: (12hours)

Taylor's and Maclaurin's series expansions; radius of curvature (Cartesian form), evolutes and involutes, Limit and continuity of functions of several variables and their partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 2 : Integral Calculus: (6 hours)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Tracing of curves (Cartesian form)

Module 4 : Sequences and series: (7 hours)

Convergence of sequence and series, tests for convergence, power series, Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 5: Multiple Integrals (10 hours)

Multiple Integration: Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area, mass and volume by double integration, Center of mass and Gravity (basic concepts).

Module 6 : Vector Calculus (10 hours)

Vector Differentiation, Directional derivatives, total derivative, Gradient, Curl and Divergence. Vector integration , Theorems of Green, Gauss and Stokes and their applications.

Topics for self learning

Rolle's theorem, Mean value theorems, Indeterminate forms , Maxima and minima for function of one variable, Geometrical interpretation of Partial Differentiation(Tangent plane and Normal line) , Applications of definite integrals to evaluate perimeter, area, surface areas and volumes of revolutions.

Textbooks/References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).

Syllabus BE Semester - I / II

Department of Industrial Engineering

Course Code : MAT152 **Course : Differential Equations, Linear Algebra, Statistics & Probability**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Ordinary differential equation, statistics, probability and Matrices.

It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
2. The essential tool of matrices in a comprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and the basic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus

Module 1:First order ordinary differential equations(7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree : equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3:Basic Statistics: (7 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation.

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Topics for Self Learning

Application of Differential Equations.

Textbooks / References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory and Problems of probability and statistics : 2nded :J. R. Spiegal ,Schaum series.
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Syllabus of Mathematics Computational Lab for Semester I/II, B.E. (2018-19)

Course Code : MAP151 **Course : Computational Mathematics Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 1**

Course Outcomes

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in mathematics and compare the results obtained with theoretical calculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.

The Lab turns will be utilized for performing the experiments based on the following list:

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Suggested References

1. Computational Mathematics Lab Manual written by the Teaching Faculty of Mathematics Department, RCOEM.

A minimum of 8 experiments to be performed based on the above list.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EET151 **Course : Basic Electrical Engineering**

Course Outcomes

At the end of this course, students will demonstrate the ability

- CO1: Understand and analyze basic ac and dc electric circuits and magnetic circuits
- CO2: Understand working principles of electrical machines: Transformer, Induction motor, DC machines
- CO3: Apply the knowledge of power converter for suitable applications
- CO4: Introduce and identify the components of power systems and low-voltage electrical Installations.

Module 1: Introduction to Power system (2 hours) - C04:

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind, and Solar) with block schematic presentation only. Single line diagram for Generation, Transmission & Distribution through different voltage levels.

Module 2 : DC Circuits & Magnetic Circuits(8 hours) - COI:

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation, Time-domain analysis of first order RL and RC circuits, Magnetic materials, BH characteristics, Basics of Magnetic circuits.

Module 3: Single Phase AC Circuits (6 hours) - COI:

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.

Module 4: Three Phase AC Circuits (4 hours) - COI:

Three phase Ac generation, Three phase balanced circuits, voltage, and current relations in star and delta connections. Power factor improvement.

Module 5: Transformers (6 hours) - C02:

Ideal and practical transformer, Equivalent circuit, losses in transformers, regulation, and efficiency. Auto transformer and three-phase transformer connections.

Module 6: Electrical Machines (8 hours) - C02:

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components, efficiency, starting of induction motor. Single phase induction motor. Construction, working, torque-speed characteristic, and speed control of separately excited dc motor.

Module 7: Power Converters (4 hours) - C03:

Block schematic introduction to power converters and its practical applications (DC-DC, DC-AC, AC-DC, AC-AC), Types of Batteries, Important Characteristics for Batteries and battery backup.

Module 8: Electrical I nstallations (4 hours) - C04:

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption, energy tariff.

Text/References

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", TataMcGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
6. Electrical Technology: B. L. Thereja, S. Chand Publications.
7. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Syllabus of Group 1 - Semester I and Group 2 - Semester II
Bachelor of Engineering Course

Code : EEP151 **Course : Basic Electrical Engineering Lab.**

Course Outcomes

Upon completion of this course, the students shall be able to,

CO1: Co-relate, analyze and apply the fundamental principles of science and engineering to understand the laboratory experimental work.

CO2: Connect the electric circuit, perform the experiment, analyze the observed data and make valid conclusion.

CO3: Write report based on the performed experiments (journal) with effective presentation of diagrams and characteristics/graphs.

CO4: Carry out survey of electrical energy consumption at home and calculate monthly energy bill as per the tariff of power Distribution Company.

List of Experiments

1. To verify Kirchhoff's laws for D.C. Circuits
2. Verification of Kirchhoff's laws to AC circuit(RLC series)
3. Verification of Kirchhoff's laws to AC circuit (RLC parallel).
4. To study speed control of D.C. shunts motor by:
   a) Armature voltage Control method.
   b) Field current/flux control method.
5. To study the balanced Three phase system for star and delta connected balanced load.
6. Improvement of power factor by using static capacitors
7. To determine regulation and efficiency of a single phase transformer by open circuit (o.c) and short circuit (s.c.) tests.
8. To determine regulation and efficiency of a single phase transformer by direct loading test

Demonstration/ Study experiment

9. To study B-H curve for different magnetic material
10. To study Buck converter
11. To study Boost converter

Demonstration of cut out sections of machines:

i. DC Machine
ii. Three phase squirrel cage induction motor
iii. Synchronous machine

Syllabus of Department of Mechanical Engineering

Course Code : MET151 **Course : Engineering Graphics and Design**

L:1 Hr., T:OHrsv P:0 Hrs., Per week **Total Credits : 01**

Course Outcomes

The expected learning outcome is that, the students shall be able to

1. Draw and interpret technical drawing
2. Convert 2-D to 3-D drawing and vice versa.
3. Represent the various positions of planes and solids in different orientations.
4. Develop the solid surface for sheet metal working.

UNIT 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of drawing instruments, Lettering and dimensioning.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions : Projections of Points and lines (line inclined to both planes) Projections of planes (inclined to both the planes), Introduction to Auxiliary Planes;

UNIT 3: Projections of Solids

Inclined to both the Planes - Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UN IT 4: Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid Cone-Auxiliary Views; Development of surface of Right Regular solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT5 : Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; Conversion of Orthographic views to Isometric Views/Projection.

Suggested Text / Reference Books:

i) Bhatt N. D. Panchal V.M. & Ingle P.R., (2014) Engineering Drawing, Charotar Publishing House.

ii) Jolhe D. A. (2016) Engineering Drawing with an Introduction to Auto CAD", Tata McGraw- Hill Publishing Co. Ltd., New Delhi.

iii) Narayana K. L. & P. Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

iv) Shah M. B. & Rana B. C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.

v) Agrawal B & Agrawal C. M. (2012), Engineering Graphic, TMH Publication.

vi) Corresponding set of CAD Software Theory and User Manuals.

Syllabus of Department of Mechanical Engineering

Course Code : MEP151 **Course : Engineering Graphics & Design Lab**

L:0 Hr., T:0Hrs., P:4 Hrs., Per week **Total Credits : 02**

Course Outcomes

Students are prepared for actual work situations through practical training in a new state of the art computer designed CAD laboratory using engineering software. The student will learn to :

1. Draw and interpret technical drawing
2. Plan the sheet layout for the given drawing
3. Convert 2-D to 3-D drawing and vice versa
4. Represent the various positions of planes and solids in different orientations.
5. Develop the solid surface for sheet metal working
6. Use & demonstrate drafting package.

UNIT 1: Introduction to Engineering Drawing

Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and involutes; Introduction to Scales.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions - Projections of Points and lines inclined to both planes; Projections of planes- Auxiliary Planes.

UNIT 3: Projections of Solids

Inclined to both the Planes Auxiliary Views; Draw simple annotation, dimensioning and scale, Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

U N IT 4: Sections and Sectional Views of Right Angular Solids

Prism Cylinder, Pyramid, Cone - Auxilary Views; Development of surfaces of Right Regular Solids Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT5: Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; conversion of Orthographic views to Isometric views/Projection

UNIT 6: Overview of Computer Graphics

Demonstrating knowledge of the theory of CAD software such as (the Menu System Toolbars Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, crosshairs, Coordinate Systems), Dialog boxes and windows, Shortcut menus (Button Bars), The command Line

(wherever applicable), The Status Bar, Different methods of zoom as used in CAD, select and erase objects; Isometric Views of lines, Planes, Simple and compound solids);

UN IT 7: Customization & CAD Drawing

Setting up drawing page and the printer, including scale settings, Setting up of units and Drawing limits; ISO and ANSI standards for coordinate dimensioning; Orthographic constraints, map to objects, manually and automatically, Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT 8: Annotations Layering & Other Functions

Applying dimensions to objects, applying annotations to drawings; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques.

UNIT 9: Demonstration of a simple team design project that illustrates

Geometry and Topology of Engineered Components Creation of Engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed top logies for engineering, Introduction to Building Information Modeling (BIM), Drafting and Design Package, 3D Printing.

List of sheets

1. Curves (ellipse, Parabola, hyperbola, Cycloid, involute)
2. Line, Planes, Solids
3. Application of Section and development of solids
4. Orthographic Projection
5. Isometric
6. Auto CAD practice sheet 1
7. AutoCAD practice sheet 2
8. Blueprint sheet

Suggested Text/ Reference Books

i) Bhatt N.D, Panchal V.M. & Ingle P.R., (2014), Engineering drawing, Charotar Publiishing house

ii) Jolhe D.A., (2016) Engineering drawing with an Introduction to AutoCAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

iii) Shah M.B. & Rana B.C. (2008), Engineering drawing and Computer Graphic, Pearson Education.

iv) Agarwal B & Agarwal C.M. (2012), Engineering Graphics, TMH PUBLICATION

v) Narayana, K.L & P Kannaiah (2008), Text Book on Engineering Drawing, Scitech Publishers.

vi) (Concesponding set of) CAD Software Theory and USER Manuals.

Syllabus for B.E. Semester I Department of Humanities

Course Code : HUT152 **Course : Constitution of India**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 0**

Course Outcome

1. Students will understand the role of constitution in democratic India
2. Students wil I be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course Content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salientfeatures and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy - Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India-The constitution powers and status of the President of India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy & social justice
11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government-Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Book

Durga Das Basu "An Introduction to Constitution of India" 22nd Edition, LexisNexis

Syllabus for B.E. Semester I Department of Physical Education

Course Code : PEP151 **Course : Yoga / Sports**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 0**

Course Outcome

On successful completion of the course, students will be able to:

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

Brief Objectives of Sports/Yoga Practical Classes:

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

- **Sports:**

1. Introduction to sports, offered by the department.
2. Health and safety issues related to sports; knowledge, recognition and ability to deal with injuries and illness associated with sports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

- **Yoga :** Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.
- **Physical Efficiency Tests :** This includes 6 health related physical fitness tests.

Components	Name of Tests
Speed	50 mts Dash
Agility	Shuttle run
Cardiovascular Endurance	8 mins Run/Walk
Test Flexibility	Sit and Reach Test
Abdominal Strength (M)/Shoulder strength (F)	Bent Knee Sit-ups (M)/Modified Pull-ups (F)
Yogic exercises	Suryanamaskars

Syllabus for B.E. Semester I / II
Department of Industrial Engineering

Course Code : CHT151 **Course : Chemistry**

L: 3 Hrs, T: 1 Hr, P : 0 Hr., Per week **Total Credits : 4**

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10 + 2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand different phenomena; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Explain the differences in the behavior of engineering materials based upon bond type, structure, composition, and processing.
- Analyse microscopic chemistry in terms of atomic and molecular orbitals and to apply this knowledge for understanding the band structure of different types of solids.
- Understand different types of molecular interactions, rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- List major chemical reactions that are used in the synthesis of molecules and to understand structural aspect of organic compounds.
- Analyse impurities present in the water and suggest the methodology for its removal.

Chemistry (Concepts in Chemistry for Engineering)

(1) Engineering Materials (8 Lectures)

Polymeric Materials : Introduction, polymer composites, fibre reinforced composites, Biopolymers (Polylactic acid etc.). Engineering applications of polymers (optical media, data storage, devices, electronics and medical sector).

Nanomaterials : Definition of Nano, Top down bottom up approach, carbon age-new form of carbon (CNT to Graphene), One dimensional, Two dimensional and Three dimensional nanostructured materials, mechanical-physical-chemical, optical properties.Applications of Nanomaterials.

Cement : Raw materials, manufacturing of cement, properties (settling and hardening, heat of hydration, soundness), Types of cement, Rapid hardening, Pozzolonic cement, white cement, High Alumina Cement.

(2) Atomic and molecular structure (8 lectures)

Schroedinger equation. Particle in box solutions, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Equations for atomic and molecular orbitals. Molecular Orbital Theory and Molecular orbital diagrams of different homo-nuclear and hetero-nuclear diatomic molecules. Pi- molecular orbital diagram of butadiene benzeneand hexatriene.

Crystal field theory and the energy level diagrams for octahedral and tetrahedral complexes of transition metal ions and their magnetic properties.

Band structure of solids and the role of doping on band structures.

(3) Spectroscopic techniques and applications (8 lectures)

Electromagnetic Spectrum, Principles of spectroscopy.

Electronic spectroscopy – Basic Principles, Lambert-Beer's Law, Woodward-Fisher Rule for conjugated dienes.

Fluorescence and its applications in medicine.

Nuclear magnetic resonance – Basic Principles, Chemical Shift, Spectral interpretation of some simple compounds.

(4) Chemical Thermodynamics and Corrosion Science(6 lectures)

Thermodynamic functions: energy, work, entropy, ethalpy and free energy and numerical based on these thermodynamic functions.

Corrosion – Basic principle, mechanism of corrosion, overview of types of corrosion and preventive measures.

(5) Stereochemistry and Organic Reactions (8 lectures)

Stereoisomers, configurations and symmetry & chirality, enantiomers, diastereomers, optical activity.

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction. Synthesis of a commonly used drug molecule such as Ibuprofen, Aspirin,Paracetamol, Chloroquine/doxycyclineetc.

(6) Water Technology (6 lectures)

Impurities in natural water, hardness and alkalinity, Disadvantages of hardness i. e. sludge and scale formation, softening of water using lime-soda, zeolite and ion- exchange method, advantages and limitations of these water softening processes, Desalination of water using Reverse Osmosisand electrodialysis.

Suggested Text Books

1. A Textbook of Engineering Chemistry by Dr. Rajshree Khare, S. K. Kataria and Son's Publisher.
2. Selected topics in Inorganic Chemistry by W. U. Malik, R. D. Madan &G. D. Tuli, S. Chand Publications.
3. Engineering Chemistry by A. Pahari, B. Chauhan, Firewall Media, Infinity Science Press LLC.
4. A Textbook of Engineering Chemistry by S. S. Dara, S. Chand Publications.
5. Applied Chemistry by V. K. Walekar, A. V. Bharati, Tech-Max Publications.
6. Organic Chemistry by R. L. Madan, Mc-Graw Hill Publications.
7. Elementary Organic Spectroscopy, Revised Edition by Y. R. Sharma, S. Chand Publications.
8. Organic Chemistry – Reactions and Reagents by O. P. Agrawal, Goel Publishing House Publications.
9. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

Reference Books:

1. Physical Chemistry, by Robert G. Mortimer, Elsevier Academic Press Publications.
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, Mc-Graw Hill Publications.

Syllabus for B.E. Semester I / II
Department of Industrial Engineering

Course Code : CHP151 **Course : Chemistry Lab**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits : 1.5**

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

- Estimate the amount of different impurities in water/waste water samples.
- Estimate rate constants of reactions and order of the reaction from concentration of reactants/products as a function of time and to validate adsorption isotherms.
- Measure molecular/system properties such as surface tension, viscosity of aqueous or other industrially important liquids/mixtures etc.
- Synthesize a polymer or drug molecule or nano-material.

List of Experiments for Chemistry Lab

1. Determination of Surface tension of a given liquid/mixture.
2. Determination of Viscosity of a given liquid/mixture.
3. Estimation of total, temporary and permanent hardness present in a given water sample.
4. Estimation of type and extent of alkalinities present in a given water sample.
5. Estimation of Cu and Zn in a brass sample.
6. Study of chemical oscillations or iodine clock reaction and determination of rate constant of the reaction.
7. Estimation of acid value of oil.
8. Estimation of saponification value of oil.
9. Ion Exchange column for removal of hardness.
10. Study of adsorption of acetic acid by charcoal.
11. Synthesis a polymer / drug molecule / nano-material.

Suggested Books / Reference Books

(1) A Textbook on Experiments and Calculations in Engineering Chemistry by S. S. Dara, S. Chand Publications.

(2) Advanced Practical Physical Chemistry by J. B. Yadav, Krishna's Prakashan Media (P) Limited.

(3) Collection of Interesting General Chemistry Experiments, A by A. J. Elias, Universities Press Publications.

(4) College Practical Chemistry by V. K. Ahluwalia, S. Dhingra and A. Gulati, Universities Press Publications.

(5) Advanced Practical Medicinal Chemistry by Ashutosh Kar, New Age International Publisher.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : CST151 **Course : Programming for Problem Solving**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 4**

Course Outcomes

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays to solve various matrix operation searching, Sorting and Pointers, Structures for the formulation of algorithms and programs.
4. To understand basics of file operation and to apply various I/O operations for file handling programming.

UNIT-1: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm : Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UN IT-Ill: Arrays and Basic Algorithms

Arrays: 1 -D, 2-D, Character arrays and Strings.

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using f flush ( ).

Text Books

1. Programming in ANSI C: E. Balguruswami McGraw Hill
2. MasteringC: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : CSP151 **Course : Programming for Problem Solving Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 1**

Course Outcomes

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C programming.
3. Understand pointers, structures, unions and apply them todevelop programs.
4. Implement file Operations in C programming for a given application.

Syllabus for B.E. Semester I

Creativity Innovation and Design Thinking Course Syllabus

Course Code : IDT151 **Credits : 1**

L:1HrsvT:OHrsv P:OHrsv Per week

Course Outcomes

C1: Be familiar with processes and methods of creative problem solving C2:

Enhance their creative and innovative thinking skills C3: Practice thinking creatively and innovative design and development Detailed Topics

UNIT I. Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT 2. Pattern Breaking: Thinking differently, Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking, Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: TheTRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats, Ethical considerations

UNIT 5. Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property: Introduction to intellectual property: Patents, Copyrights®, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Book

1. Creative Problem Solving for Managers-Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching creativity and Problem Solving - By Arthur BVangundy- Pfeiffer
3. H. S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,
5. J. Goldenbergand D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002. Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)

- TRIZ, a systematic ideation method, reading (individual)
- Bookreadings and discussions (small teams)
- Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie/game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

BE Semester I / II
Department of Industrial Engineering

Course Code : INT151 **Course : Workshop / Manufacturing Practices (Theory)**

L:1Hrs., T:0Hrs., P:0Hrs., Per week **Total Credits : 1**

Course Outcomes

1. Identify the different manufacturing process commonly employed in Industry along with prevailing safety practices.
2. Identify the various tools and equipments to carry out different manufacturing processes accompanied by the inspection of the work part.

Syllabus

Unit-1 Fundamentals of metal cutting, single point cutting tool, fundamental mechanics of metal cutting, fitting operations, and associated measuring and marking tools

Unit-2 Introduction to pattern making for metal casting, different types of carpentry tools, measuring tools and markingtools, holding devices, different types of carpentry joints.

Unit-3 Smithy and Forging, Forging tools like chisels, hammers, types of furnaces, types of coal, Forming operations, Hot working and Cold working of metals.

Unit-4 Metal joining Process, mechanics of welding, types of welding, soldering and brazing, types of joints

Unit- 5 Introduction to foundries, Metal Casting, types of sand, Introduction to Molding tools & casting process.

Unit-6

Introduction to Plastic Injection Molding

Suggested Text Book

1. "Elements of Workshop Technology" HajraS.K, Choudhury A. K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd. Mumbai.

Reference Books

1. Kalpakjian S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture"4,h Edition, Prentice Hall India 1998.

BE Semester I / II

Department of Industrial Engineering

Course Code : INP151 **Course : Workshop/Manufacturing Practices Lab (Practical)**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits : 1**

Laboratory Outcomes

On the completion of the course the students shall be able to;

1. Recognize the different manufacturing process commonly employed in the Industry
2. Make the components using required manufacturing process, inspection methods while practicing the requisite safety precautions

Contents

1. Fitting Practice
2. Welding and Soldering Practice
3. Pattern Making Practice
4. Metal Casting Practice
5. Smithy and Forging Practice
6. Machining Practice
7. Plastic Molding Process
8. Glass Cutting

Suggested Text Book

1. "Elements of Workshop Technology'" HajraS.K, Choudhury A.K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd Mumbai.

Reference Books

1. Kalpakjain S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture", Prentice hall India 1998.

Syllabus for B.E. Semester I / II
Dept of Humanities

Course Code : HUT151 **Course : English**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 2**

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as well as communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in an interview and group discussion

SYLLABUS

1. Vocabulary Building

1.1. The concept of Word Formation

1.2. Root words from foreign languages and their use in English

1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives

1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Creating coherence

2.5 Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

3.3 Misplaced modifiers

3.4 Articles

3.5 Redundancies

3.6 Cliches

4. Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

5. Writing Practices

5.1 Comprehension

5.2 Precis Writing

5.3 EssayWriting

5.4 Letter Writing

5.5 Email Writing

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Books

1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyonsand Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Syllabus for B.E. Semester I
Department of Humanities

Course Code : HUP151 **Course : English Lab**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 1**

Course objective

1. To enhance competency of communication in English among learners.

Course outcomes

1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills - listening, speaking, reading and writing

List of Practical (2 hours each for each batch) based on unit 6 (oral communication).

1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation, Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations: Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion-Orientation
8. Communication at Workplace: Practice Session

III Semester
Department of Industrial Engineering

Course Code: MAT258 **Course : Introduction to Statistics & Probability-1**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of this course is to expose student to understand the basic concepts of Probability Distribution, Sampling Distributions and Testing of Hypothesis. It also focuses on Inferences Concerning Variances.

Course Outcomes

On Successful completion of the course, Student shall be able to

1. To create competence in critically evaluating research results, and carrying out good quality empirical work.
2. The students will be able to demonstrate the principles of hypothesis testing and thorough knowledge of statistical distribution their properties and uses.
3. The students will be able to conduct a quantitative study on versatile research area.

Syllabus

Module - I : Sampling and sampling Distributions

Introduction to sampling, random sampling, sampling with and without replacement, introduction to sampling distributions, sampling distribution of means, sampling distribution of proportion, an operational consideration in sampling: the relationship between sample size & standard errors.

Practice and Analysis with data analytic tools / software.

Module - II : Estimation

Introduction, point estimates, interval estimates: basic concepts, interval estimates & confidence intervals, calculating interval estimates of the mean from large samples, calculating interval estimates of the proportions from large samples, interval estimates using the t distribution, determine the sample size the estimation.

Practice and Analysis with data analytic tools / software

Module - III : Testing Hypothesis

One sample Introduction, concepts basic to the Hypothesis - Testing procedure, Testing Hypothesis, Hypothesis testing of means when the population standard deviation is known, measuring the power of Hypothesis tests, Hypothesis testing of means when the population standard deviation is not known.

Practice and Analysis with data analytic tools / software.

Module - IV : Testing Hypothesis Two Sample

Hypothesis testing for differences between means & proportions, tests for differences between means: large sample size & small sample sizes, testing differences between means with dependent sample, test for differences between proportions : large sample sizes.

Practice and Analysis with data analytic tools / software.

Module - V : Inferences Concerning Variances

The estimation of variances, Hypothesis concerning one variance, Hypothesis concerning two variances.

Practice and Analysis with data analytic tools / software.

Text Books

1. Statistics for management 7 Edition : R. I. Levin & D. S. Rubin (P. H. I.)
2. Theory & Problems of Probability & Statistics : M. R. Spiegal (McGraw Hill) Schau, Seriesth.
3. Probability & Statistics for Engineers 6 Edition : Miller Freund & Johnson.

Reference Books

1. Basic Statistics for Business & Economy : E. K. Bowen, M. K. Starr (McGraw Hill)
2. Statistics for Business & Economics : R. P. Hooda (Mc. Millan pub)

Tools / Software : R, Scilab, Python, Matlab

III Semester
Department of Industrial Engineering

Course Code : INT251 **Course : Principles of Mechanical Engineering - I**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of this course is to prepare students:

1. To understand the universal principle of work and heat interaction for different thermodynamic systems
2. To learn about working principles of different hydraulic machines

Course outcomes:

The students shall able to: -

1. Understand the basic laws of thermodynamics and their relation to various processes.
2. Apply the thermodynamic concepts to various thermal applications.
3. Understand basic properties of fluid and measurement of flow and pressure.
4. Know the principle of operation and working of various hydraulic machines.

Unit I : Introduction to thermodynamics : Basic laws of thermodynamics, property, state, process, cycles, thermodynamic-equilibrium, temperature, concept of enthalpy and entropy, heat engine, heat pump and refrigerator (analytical treatment is expected).

Unit-II : Applications of thermodynamics : Introduction to boilers, cooling towers, condensers and Internal Combustion engines. Thermodynamics process pertaining to refrigeration and air conditioning, Different methods of refrigeration, classification and environmental impact of refrigerants, household refrigeration system, vapor compression refrigeration cycle, vapor absorption refrigeration system. Introduction to comfort industrial air conditioning (analytical treatment on refrigeration system is expected). Brief introduction to non- conventional power generation: wind, tidal, solar, and geothermal power plant.

Unit- III : Introduction to fluid power : Properties of fluid, Newton's law of viscosity, classification of fluid based on rheological chart. Pressure at a point and pressure head measurement using manometer. Application of Bernoulli's theorem. Dimensional analysis: dimensional homogeneity Rayleigh and Buckingham's method of dimensional analysis. Dimension less number, laminar flow, turbulent flow and use of Reynolds's apparatus.

UNIT-IV : Applications of fluid power : Elements of hydroelectric power plant, Impulse and reaction turbines, pumps and draft-tube. Industrial hydraulics-hydraulic press, hydraulic accumulator, hydraulic intensifiers, hydraulic ram, hydraulic lift and hydraulic crane.

Text books

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw-Hill Publication.
2. Thermal Engineering, P. L. Ballani, Khanna Publication.
3. Refrigeration and Air conditioning, C.P. Arora, Tata McGraw Hill Publication.
4. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, S Chand Publication.

Reference books

1. Thermodynamics and Engineering approach, Yunus A.Cengel and Michael A. Boles, Tata McGraw - Hill Publication.
2. Modern Engineering Thermo dynamics, Robert Balmer, Publisher-AcademicPress.
3. Refrigeration and Air-conditioning, Wilbert F. Stocker, Mc-Graw Hill Publication.
4. Fluid Mechanics, JohnF. Douglas, Pearson publication.

III Semester
Department of Industrial Engineering

Course Code : INP251 **Course : Principles of Mechanical Engineering - I Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of this course is to prepare students:

1. To understand the performance of different thermodynamic machinery and turbo machinery.

Course Outcomes

The students shall able to:

1. Analyze the performance characteristics of IC engine.
2. Understand the various elements of refrigeration and air conditioning systems.
3. Apply the concept of thermodynamics and fluid power to various applications.
4. Study the performance of hydraulic machines.

List of Experiments

1. Study boilers, cooling towers, condensers and Internal Combustion (IC) engine.
2. Study and demonstrate the performance of computerized single cylinder petrol engine test rig.
3. Study and demonstrate the performance of computerized single cylinder diesel engine test rig.
4. Determine coefficient of performance (COP) of vapor compression refrigeration test rig.
5. Study various types of air conditioning systems.
6. Study of non-conventional power generation plant with visit report.
7. Study of dimensional analysis and its applications.
8. Study and performance evaluation of hydraulic pumps (Centrifugal and Reciprocating pumps)
9. Study and performance evaluation of hydraulic turbines (Pelton wheel turbine and Francis turbine)
10. Study of hydraulic systems like accumulator, intensifier, press, lift and crane.

III Semester
Department of Industrial Engineering

Course Code : INT252 **Course : Manufacturing Engineering - I**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of this course is to prepare students:

1. Learning and becoming aware about the different components of manufacturing cycle from raw material to finished product
2. Learn about different chip less manufacturing methods that shape the component by applying heat and pressure

Course Outcomes

The students shall able to:

1. Identify the types, structure, properties and applications of different engineering materials.
2. Apply methods of various melting and heat treatment processes.
3. Select & apply appropriate methodology for designing and producing component by casting processes.
4. Select and apply advance casting methods for intricate castings.
5. Select and apply appropriate hot and cold metal working methods for designing and manufacturing metal components.
6. Select and apply appropriate welding methods for fabrication of various components.

Syllabus

UNIT I

Engineering Materials : Classification, Crystal Structures, Properties of Engineering materials. Classification of Engineering materials: Ferrous and Non-Ferrous materials. Use and application. Classification Steels & Cast Irons, their processing and application. Bearing Materials, Thermoplastic & Thermosetting plastics, Rubber, Ceramics, Heat Insulating Materials.

UNIT II

Melting Practices of Ferrous & Non-Ferrous Metals : Types of Metal Melting Furnaces, Melt treatment, Degassing, Ladles, Heat Treatment of Ferrous & Nonferrous Alloys: Iron- carbon equilibrium diagram Objective & principles of heat treatment, TTT curve, Allotropic forms of iron, Heat treatment of steels, transformation curves, Classification of Heat Treatment Processes, Process Parameters & Application. Heat Treatment Furnaces,

UNIT III

Metal Casting Process : Advantages, limitations & applicability, Product Design for Sand Casting, Pattern Design & Types of Pattern, Methoding of Casting: Gating and Riser Design, Solidification of casting. Core, Chills & Chaplets. Casting terms: Process requirements of Sand mould Properties molding materials, Sand preparation, Methods for Mould & Mould Material analysis. Casting Defects. Foundry Mechanization.

UNIT IV

Special Casting Processes : Carbon di-oxide molding, Shell Molding, Precision Investment Casting, Permanent mould casting, Die Casting, Centrifugal Casting, Continuous Casting. Squeeze Casting, Slush Casting. Introduction of Rapid Prototyping in Casting.

UNIT V

Nature of Plastic Deformation, Product Design for Metal Working. Hot & Cold Working of metals: Rolling, Forging, Extrusion. Wire, Rod &Tube Drawing, Swaging. Introduction to Sheet Metal working, Press tool operations, shearing, drawing.

UNIT VI

Fabrication process : Classification of Metal Joining Processes, Gas welding, Electric Arc: MMA, TIG & MIG Welding, Resistance Welding, Thermit welding, Other Fusion welding processes, Brazing, Soldering.

Text Books

1. Production Engineering by Dr. R.K. Jain , Khanna Publications, 2001
2. Manufacturing Science by A. Ghosh and J. Mallik (East West Publications)

Reference Books

1. Workshop Technology - I (Tata McGraw Hill)- H.S. Bawa
2. Workshop Technology Parts - I & II- B. S. Raghuvanshi; Hajra-Choudhary
3. Manufacturing Technology Vol-1 by Dr. P. N. Rao (TataMc Graw Hill Publication)
4. Manufacturing Engineering by SeropeKalpakjainTataMcgraw Hill Publication
5. ASME Handbook of Metal Casting
6. ASME Handbook of Welding

III Semester
Department of Industrial Engineering

Course Code : INP252 **Course : Manufacturing Engineering-1 Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of this course is to prepare students:

1. Learn and practice about different chip less manufacturing process
2. Learn and practice about joining methods

Course Outcomes

The students shall able to:

1. The students should be able to identify specific types of pattern required to make mould for casting a particular component.
2. The students should be able to select the appropriate metal melting methods an equipment according to the requirement.
3. The students should be able to identify the various products manufactured by hot an cold working methods and understand their applications.
4. The students should be able to distinguish and apply appropriate welding methods for specific application.

The list of experiments shall be based on the theory course INT 252

III Semester
Department of Industrial Engineering

Course Code : INP253 **Course : Machine Drawing Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 1**

The objective of this course is to prepare students:

1. Understand about expressing the design details through drawings for producing components

Course outcomes

The students shall be able to:

1. Understand the significance and its use of standard machine components.
2. Convert 3D object to its 2D representation.
3. Read the Industrial drawing to understand the mechanical system.
4. Use of drafting package i.e. AutoCAD.

Syllabus

Unit-I Introduction to machine drawing, Classification of machine drawing, Principles of drawing, Orthographic projections, Interpretation of views & Sectioning, Conventional representation of machine components, Thread terminology, Types of threads, Thread designation, types of screws, bolts and nuts, Nut locking arrangements using pins, washers & screws.

Unit-II Assembly drawing: Introduction, Drawings of stuffing box, steam engine cross head, air valve, Fuel injector, square tool post, spring loaded safety valve, knuckle joint, protected flanged coupling, crane hook, screw-jack, Feed check valve, Hartnell governor, Porter governor &Compound slide

Unit-III Parts drawing: Introduction, Milling machine tail stock, Machine vice, Drill jig, Non return valve, Lever safety valve socket & spigot joint, Universal coupling, Pipe vice, Spark plug, Feed check valve, Hartnell governor, Porter governor & Compound slide.

Unit IV Blue print reading: Introduction, Gear box cover, pump housing, steam stop valve, connector, adopter, square tool-post, drill jig, chuck body, etc

Unit V : AutoCAD Drawing: use of various AutoCAD commands, preparation of 2-D drawings using AutoCAD.

Text Books

1. Machine Drawing (4thEdition) by K .L .Narayan, R Kannaiah, K. V. Reddy-New AgeInt. Publications.

2. Machine Drawing by N. Sidheshswar, P. Kannaiah, V V S Sastry- Tata Mcgraw Hill Publications.

Reference Books

1. Machine drawing (48thEdition) by N.D. Bhat- Charotar Publications.

2. Machine drawing by R. K. Dhawan- S. Chand Publications

III Semester
Department of Industrial Engineering

Course Code : INT254 **Course : Facilities Planning**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of this course is to prepare students:

1. Learn about designing and effective plant layout taking into consideration all the important design aspects
2. Learn about different techniques used for design of and effective plant layout

Course Outcome

The students shall able to :

1. Design a new manufacturing facility.
2. Select and specify the equipment required for a manufacturing facility.
3. Calculate the space requirements for a manufacturing facility.
4. Select the appropriate material handling equipment for a facility.
5. Design alternate layouts for the departments within a facility.
6. Apply facility design software to generate and analyze optimized layouts

Syllabus

Unit-I Plant Location: Factors affecting site selection, concepts, location Economics, Rural V/s urban Plant site Factory building, Types of factory building, Building construction, Facilities Management Function, Organization and Administration, Facilities Manager - Role and Responsibility. Facilities Planning & Design Management

UNIT II : Types of layout, layout procedures, systematic layout planning, Flow Analysis approaches and Activity relationship analysis, relationship diagram, purpose, premise and proximity, graph based process, relationship diagramming process. Space requirements and availability, production rate determination, equipment requirements, employee requirements, space determination, Designing the space relationship diagram, the BLOCPLAN, flexible layouts, designing material handling system, presenting the layout design

UNIT III : Techniques for Quantitative Analysis of Layouts, computerized layout evaluation, adjacency- based scoring, distance based scoring, and distance weighted adjacency based scoring, more complex scoring models. Computerized Layout generations: Construction algorithms and improvement algorithms CRAFT, COFAD, PLANET, CORELAP and ALDEP.

UNIT IV : Storage systems layout, dedicated storage location policy, space requirements, sizing on the basis service levels and costs, comparison with dedicated storage, class based dedicated storage location policy, shared storage location policy, space requirements, throughput performance, continuous warehouse layout, storage region configuration, computing the expected distance traveled.

UNIT V : Elements of materials Handling, Importance, principles of material handling, and analysis of materials handling problems. Selection of Mechanical Handling Equipment, Selection of handling system, Cost data & economic analysis, classification of drives, specifications for selection.

UNIT VI : Bulk handling Devices; conveyers: Belt, Chain, Pneumatic, Hydraulic, screw. Unit handling Devices; Hoist, conveying materials, Elevator, conveyer cable ways, ropeways, draggling roller conveyers, escalators, tractors, Robotic handling.

Text books

1. James A. Tompkins, John A. White, Facilities Planning, J. Wiley & Sons, Inc., 3rd Edition, New York.

Reference Books

1. Francis, R. L. and J. A. White, Facility Layout and Location: an Analytical Approach, Prentice-Hall, 2nd Edition.
2. James M Apple, Plant Layout and Material handling, 2nd Edition, John Wiley and Sail.
3. Production and Operations Management, Panneerselvam R, Publisher: PHI
4. Buffa, Modern Production/Operations Management, Wiley Eastern Ltd.
5. Plant layout & Material Handling – by Prof. G.K. Agrawal
6. Sunderesh S .Heragu, Facilities Design, PWS Publishing Company.
7. James M. Moore, Plant Layout Design, Mc Millan Publishing Company.
8. Lee J Karjewski and larry P Ritzman, Operations management Strategy and Analysis, Pearson Education Asia.

III Semester
Department of Industrial Engineering

Course Code : INT255 **Course : Object Oriented Programming Methods**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 2**

Course Objectives

The objective of this course is to prepare students:

1. Develop programming skills of the students by making them aware about different techniques

Course Outcomes

The students shall able to :

1. Understand the principles of object-oriented programming create classes, invoke methods and access data.
2. Understand C + + classes and data abstraction.
3. Use principles of inheritance and polymorphism in programming.
4. Implement different templates, Exception handling techniques in programming.

Syllabus

UNIT I

Concept of a class, Object, Features of Object Oriented Programming viz. data encapsulation, inheritance and polymorphism, Need for OOP, Access control of members of a class, constructors, Destructor, Friend Function.

UNIT II

C + + Classes And Data Abstraction: Static class members, Constant member functions, Dynamic creation and destruction of objects, Dynamic memory allocation and de-allocation operators-new and delete

UNIT III

Polymorphism: Static and Dynamic bindings, Function overloading, Operator overloading, Virtual functions, Concept of Inheritance, forms of inheritance.

UNIT IV

Function templates and class templates. Exception Handling: types of exception, throwing an exception, use of try catch block, user defined exceptions, Re-throwing an exception, Design issues in exception handling, Benefits of exception handling.

Text Books

1. Object Oriented Programming Using C++: E. Balaguruswamy, 4th edition. Tata Mcgraw Hill Companies
2. The C++ Programming Language: B. Stroustrup, 4th edition, Addison Wesley. Reading Mass. USA. May 2013
3. Mastering C++: K Venugopal, Raj Buyya, T ravishankar, 2nd edition, McGraw Hill Education

Reference Books

1. The Complete Reference: Herbert Schildt, 4th Edition, Tata McGraw Hill
2. Object oriented Programming in C++, 4th Edition, Robert Lafore by Sams Publishing

III Semester
Department of Industrial Engineering

Course Code : INP255 **Course : Object Oriented Programming Methods Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of this course is to prepare students:

1. Develop programming logic of the students by making them write the codes for different conditions

Course Outcome

The students shall able to :

1. Create classes, invoke methods and access data using OOP principles.
2. Dynamically create objects, allocate and de-allocate memory.
3. Use principles of inheritance and polymorphism in programming.
4. Implement different templates, Exception handling techniques in programming.

The experiments shall be based on the syllabus of theory course

III Semester
Department of Industrial Engineering

Course Code : IDT252 **Course : Biology**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 2**

Course Objectives

The objective of this course is to prepare students:

1. For Understanding evolutionary aspects of the Biological world for solving engineering problems.

Course Outcomes

The students shall able to:

1. Differentiate between science and engineering with help of some surrounding examples.
2. Realize the universality of basic building blocks in the living world and use current techniques necessary for Computational Biology
3. Appreciate Physics of living being to understand role of man in the Man-Machine system

Syllabus

Unit 1: Why Study Biology in Industrial Engineering. Distinction between Science and Engineering, eye and camera, Hand and Manipulator, Bipedalism in Man and Humanoids. Evolution and artificial selection. Effects on society due to it.

Unit 2: Cell Biology and Genetics. Universality of living things. Cell as the basic building block of all living beings. Proteins as building blocks and information carriers. Genemapping, Gene interaction,. Passing of genetic material to next generation. Single gene disorders in humans. Introduction to sequences, alignment and dynamic programming. Mathematical Biology, Biostatistics, Computational Biology, Databases, types of databases, Algorithms/ Data Structures.

Unit 3: Mechanics and Mechanical Properties of Human Body:- Terminology, "Standard Human" and Scaling. Statics of body, standing, walking, running and swimming.Effect on body elements like bones, muscles and tendons. Biology of safety devices in work place.Fluid pressure and Fluid flow in the body, Biological comfort zone for Humans. Energy cost considerations for human activities during work. Energy, Heat, work and Power of the body. Cause of fatigue and recovery by resting.

Textbooks

1. Physics of Human Body, Irwing P. Herman, First ed. (2007), Springer
2. Applied Cell and Molecular Biology for Engineers, G. N. Waite, L. R. Waite (2007), McGraw-Hill

Reference Books

1. Human Physiology, VOL-I & II, C. C. Chatterjee, Twelfth ed. (2018), CBS Publishers & Distributors P. Ltd., N. Delhi
2. Campbell Biology, 10th ed., (2015), Pearson

III Semester
Department of Industrial Engineering

Course Code : INP256 **Course Name : Industrial Visit**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 0**

Course Objectives

The objective of this course is to prepare students:

1. Understand about working of Industry and get a first hand information about how industry works

Course Outcomes

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

1. Understand and witness the working of industry

Methodology

1. A visit to nearby industries of MIDC Nagpur is organized. The students are informed well in advance along with a schedule.
2. After the completion of visit they are required to submit a report. The VIVA is conducted for the students based on the report and evaluation is done accordingly

III Semester
Department of Industrial Engineering

Course Code : HUP258 **Course : Personality Development**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of this course is to develop abilities and skills of the students to interact and work effectively in a group and as a person.

Course Outcomes

CO 1 : Students will learn to interact effectively in society and work efficiently in groups.

CO 2 : Students will learn strategies to communicate effectively.

CO 3 : Students will learn generic skills for a better personality.

CO 4 : Students will learn the basics of motivation and attitude.

Syllabus (List of Practical)

1. SWOT analysis (pre and post) and RBS Technique
2. Interpersonal relations and group dynamics
3. Time management
4. Negotiation skills
5. Critical thinking and Problem Solving
6. Role of motivation and attitude formation
7. Verbal Communication and barriers
8. Body Language

Reference Books and Material

1. Barun K. Mitra, "Personality Development and Soft Skills", 2012, Oxford.
2. Dr. K. Alex, "Soft Skills: Known Yourself & Know the World". 2009, S. Chand.
3. E. N. McGrath, "Basic Managerial Skills for all", 2009, PHI Learning.
4. Harvard Business Review - https://hbr.org/2005/01/how-to-play-to-your-strenghts
5. Meenakshi Raman and Sangeeta Sharma, "Thechnical Communication: Principles and Practice", 2015, Oxford University Press.

IV Semester
Department of Industrial Engineering

Course Code : MAT261 **Course : Introduction to Statistics &Probability - II**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The Objective of this course is to expose student to understand the important concepts of Probability Distributions, Regression Analysis and Nonparametric methods. It also focuses on Time series and Forecasting, Index numbers and Decision theory

Course Outcomes

On successful completion of the course, student shall be able to

1. The students will have a reliable base for making decisions.
2. They will also be able to make decision for having appropriateness of a distribution in population.
3. They will also be able to make proper modeling techniques.

Syllabus

Module - I :

Chi-Square and analysis of Variance:

Chi-square as a test of independence. Chi-square as a test of goodness of fit: testing the appropriateness of a distribution, Analysis of variance.

Practice and Analysis with data analytic tools/software

Module - II

Nonparametric Methods :

Introduction to non parametric statistics, the sign test for paired data, rank sum Test: the Mann–Whitney U test and the Krustal-Wallis test. Tests of Randomness.

Practice and Analysis with data analytic tools/software

Module - III

Times Series Methods and Forecasting :

Introduction, variation in time series, trend analysis, cyclical variation, seasonal variation, irregular variation, a problem involving all four components of a time series, time series analysis in forecasting.

Practice and Analysis with data analytic tools/software

Module - IV

Index Numbers :

Defining an index no., un-weighted aggregates index,weighted aggregates index, average of relatives methods, quantity and value indices, issues in constructing using index numbers.

Practice and Analysis with data analytic tools/software

Module - V

Decision Theory :

The decision environment, expected profit under uncertainly, assigning probability values, using continues distributions: marginal analysis, utility as a decision criterion, helping decision makers supply the right probabilities, decision-tree analysis. Simple concept and designing a questionnaire.

Practice and Analysis with data analytic tools/software.

Text Books

1. Statisticformanagement7thed:R.I.LevinandD.S.Rubin(P.H.I.)
2. Theory and Problems of Probability and Statistics - M. R. Spiegal (McGraw Hill) Schaum Series.
3. Probability and Statistics for Engineers 6th Ed.-Miller, Freund and Johnson.(P.H.I.)

Reference Books:

1. Basic Statistics for Business and Economics E. K. Bowen, M. K. Starr (McGraw Hill).
2. Statistics for Business & Economics : R. P. Hooda (Mc.Millan Publication)

Tools/Software – R, Scilab, Python, Matlab

IV Semester
Department of Industrial Engineering

Course Code : INT261 **Course : Principles of Mechanical Engineering - II**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 2**

Course Objective

The objective of this course is to prepare students:

1. Understand and apply design of machines and mechanisms and other mechanical components used for manufacture from time to time

Course Outcome

The students shall able to :

1. Understand the basics of synthesizing the mechanisms and to determine the velocities of linkages.
2. Synthesis the cam for different motions of follower and to understand the problems of balancing and vibrations to avoid the failure of machine elements.
3. Understand the mechanism and significance of mechanical drives
4. Understand the fundamentals of designing the machine elements and its optimization.
5. Select the fasteners, flat belts, V-belts, bearings, etc.

Syllabus

Unit I : [A] Theory of Machines:- Introduction to mechanism, machine and structure, Kinematic Link, Kinematic pair, Types of Pairs and its Classification, Kinematic Chain, Degree of freedom, Kutzback's criterion. Grashof's law, Inversion of mechanisms –four bar chain & slider crank mechanism. Determination of velocities of links of mechanisms and concept of acceleration of moving links – Relative motion method (simple mechanisms are expected).

Unit II : Cam, Balancing and Vibrations Introduction, Types of Cams and follower and itsapplications, Displacement, velocity and acceleration of follower and construction of cam profiles for – uniform acceleration and retardation and simple harmonic motion of followers. Balancing of rotary masses-static balancing and concept of dynamic balancing. Vibrations – Mechanism of vibration, terminology, types of vibrations, determination of frequency of vibration (only by equilibrium method), vibration isolation and critical speed of shaft (Analytical treatment is not expected).

Unit III : Drives Introduction to drives, Types of drives, Terminology of drives. Gear drive- forms of teeth (Cycloidal and Involute profiles), gear trains. Belt drive – Types of belt drives, Types of flat belt drives, Velocity ratio of belt drive, sleep of belt, Power transmitted by belt. Chain drive – Classification of chains. Advantages and disadvantages of drives over one another.

Unit IV : [B] Machine Design:- Introduction to machine design and its features, Basic procedure of machine design, Basic requirements of machine elements, Stress-strain diagram, Classification and Selection of engineering material, Types of stresses in machine member, Factor of safety, Use of data book, Design of shaft and key. Optimization in design (Single method is expected).

Unit V : Design of elements Design of threaded fasteners, Design of flat belts, selection of V-belt, Selection of rolling contact bearings.

Text Books

1. S.S. Ratan; Theory of Machines, Tata McGraw Hill Publication.
2. R.S. Khurami, J.K. Gupta; Theory of Machines, S. Chand Co.
3. Sadhu Singh; Theory of Machines, Khanna Publisher.
4. B.D. Shiwalkar; Design of Machine Elements, Denett& Co.
5. V.B. Bhandari; Design of Machine Elements, Tata McGraw Hill.
6. P. Kannaiah; Machine Design, Scitech Publications.

Reference Books

1. J. Uicker, Jr. G. Pennock, Joseph Shigley; Theory of Machines and Mechanisms, Oxford University Press
2. Thomas Bevan; Theory of Machines, Pearson Education Ltd.
3. Joseph Shigley; Design of Machine Elements,Tata McGraw Hill Publication.
4. R.S. Khurami, J.K. Gupta; Machine Design, S. Chand Co.
5. Design Data; B.D. Shiwalkar, Denett& Co.
6. PSG Design data Book

IV Semester
Department of Industrial Engineering

Course Code : INP261 **Course : Principles of Mechanical Engineering - II Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The objective of this course is to prepare students:

1. Understand and apply to motion of different mechanical elements

Course Outcome

The students shall able to :

1. Get practical knowledge of configuring the mechanisms and cams.
2. Obtain hands on experience of balancing and vibrations.
3. Understand the design process of mechanical system.

List of Experiments

1. Draw configuration of mechanisms (Any two) and determine number of links and its type, types of pairs,
2. Degree of freedom and find out the change in type of system by adding or removing one link.
3. Graphical solution of problems on velocity and acceleration in mechanisms by relative velocity and acceleration method.
4. To draw displacement diagram of cam profile.
5. Balancing of rotary masses.
6. Demonstration of whirling of shaft.
7. Determine the natural frequency of spring mass system.
8. To verify the effect of factor of safety on sizes of mechanical component with the help of stress-strain diagram.
9. Design of basic mechanical system.

IV Semester
Department of Industrial Engineering

Course Code : INT262 | **Course : Manufacturing Engineering-II**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week | **Total Credit : 3**

Course Objective

The objective of this course is to prepare students:

1. Understand metal cutting operation and apply different non conventional metal removal techniques for economical machining

Course Outcome

The students shall able to :

1. Understand different types of tools used in machining operations and the theory of metal cutting.
2. Understand in detail the types, construction and working principle of various production machines.
3. Understand the different types of operations to be performed on machines and its proper selection for product to manufacture.
4. Select different machines for mass production, special purpose machines, CNC machines, etc.
5. Understand different accessories, methods of holding and locating the tools and work piece on various machines.
6. Understand & and Select different unconventional machines for specific product.

Syllabus

UNIT I: Theory of metal cutting, Orthogonal and Oblique Cutting, Tool Materials, Nomenclature & Signature. Chip formation & its Types, Chip control & Chip Breakers, Force and Velocity relationship, Influence & effect of various parameters on Tool Life & Machinability. Cutting fluids, Lathe, Centre Lathe: Construction and Operations, Introduction to Capstan & Turret Lathe, Automatic Lathe. CNC and other special purpose machines,

UNIT II : Hole Making Machines & Operations: Introduction, Drilling, Reaming, Boring, Tapping & Others Hole Making Operations. General purpose, mass production and special purpose hole making machines, Reciprocating Machine Tools: Introduction, Shapers, Planning Machine (Planers), Slotting Machine (Slotters), Broaching, Sawing and Comparison of Reciprocating Machine Tools.

UNIT III : Milling machine – Introduction to Milling Machine &Types, Operations performed on Milling Machine, Types of milling cutter, dividing & Indexing heads. Milling Mechanics, Machines for gear production and screw thread production

UNIT IV : Abrasive Processes: Introduction, Grinding Wheel: Designation and Selection, Types of Grinding Machines, Grinding Process, Grinding-Process Parameters, Creep-Feed Grinding, Honing, Lapping, Other Finishing Processes. Machines for Super Finishing Processes

UNIT V : Jigs and fixtures: Introduction, different elements, types, general design principles, drill jigs, milling fixtures. Principle of location, locating devices, clamping devices, Designing for Machining: Introduction, General Guidelines for Design for Machining (DFM), Design for Turning, Design for Hole- Making Operations, Computer Integrated Manufacturing – NC, CNC, DNC, Simple CNC Programming.

UNIT VI : Unconventional machining processes: Need For Unconventional Processes, Electric-Discharge Machining, Electro-chemical Machining, Ultrasonic Machining, Laser-Beam Machining, Electron-Beam Machining, Plasma-Arc Machining, Abrasive Jet Machining, Abrasive Water-Jet Machining. Introduction to High Energy Rate Forming Processes, Types and Application

Text Books

1. Production Engineering by Dr. R.K. Jain (Khanna Publications)

Reference Books

1. Manufacturing Technology Vol-2 by Dr. P. N. Rao (TataMc Graw Hill Publication)
2. Manufacturing Science by A. Ghosh and J. Mallik (East West Publications)
3. Workshop Technology - I (Tata McGraw Hill) - H.S. Bawa
4. Workshop Technology Parts - I & II - B. S. Raghuvanshi; Hajra-Choudhary

IV Semester
Department of Industrial Engineering

Course Code : INP262 **Course : Manufacturing Engineering-II Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The objective of this course is to prepare students:

1. Understand the working of different machines and able to perform different machining operations on them

Course Outcome

The students shall able to :

1. Understand the working principles of different machines.
2. Make different jobs on Lathe, Shaper, Milling and drilling machine.
3. Understand the working principle of unconventional machine such as electric discharge machine.
4. Work on CNC lathe and CNC milling machine.

The list of experiments will be based on the theory course INT 262

IV Semester
Department of Industrial Engineering

Course Code : INT263 **Course : Work System Design**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The objective of this course is to prepare students:

1. Understand and apply various recording techniques to the given process or activity of Methods Study.

Course Outcome

The students shall able to :

1. Study and identify the factors affecting productivity
2. Carry out systematic investigation and improvement of existing way of doing work using appropriate recording technique.
3. Study principles of motion economy and fundamental hand motions
4. Establish standard time for a specific activity using time study

Syllabus

Unit: 1 Productivity : Introduction and Concept of Productivity, Concept of work content, excess work content and ineffective time, Techniques for productivity improvement, Productivity Measures.

Unit: 2 Work study : Introduction and definition of work study, Basic procedure, human factor in the application of work study, the influence of working conditions on work study. Concept and definition of Method Study, objectives of method study, basic Procedure of methods study.

Unit 3: Recording Techniques : Recording Techniques, process Charts symbols, outlines process chart, flow process charts, multiple activity chart, Quantitative Techniques for man machine relationships, two hand process chart, travel chart, Flow diagram, string diagram, Critical evaluation Phase, Develop, Define and install the improved method.

Unit 4 : Micro motion Study Introduction, micro motion study equipment, making motion pictures, Film analysis, the use of fundamental hand motions, SIMO Chart, principles of motion economy-related to the use of human body, work place and the design of tools and equipment.

Unit 5 : Work Measurement time Study Objective of work measurement, work measurement techniques, objectives and uses of Time study, time study equipment, Basic steps in time study. Selecting the Job for time study, choosing the operator, breaking the job into elements, determination of sample size

Unit 6 : Time Study- Rating & Allowances Definition of rating, performance rating, the concept of normal performance, Factors affecting the rate of working, systems of rating, rating scale. Concept of allowance, Types of allowances, Calculation of standard time, Concept of Wage incentive plan.

Text Books

1. International Labor organization, "Introduction to work-study", Universal Publishing Company. ISBN 81-850270
2. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
3. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education, 2000.

Reference Book

1. Maynard H. B., "Industrial Engineering Handbook", 3rd edition, McGraw Hill Book Company. ISBN 0-07-041084-4

IV Semester
Department of Industrial Engineering

Course Code : INP263 **Course : Work System Design Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The objective of this course is to prepare students:

1. Understand about tools used for work measurement and recording the data used for motion study.

Course Outcome

The students shall able to :

1. Use the suitable recording technique to record information in a systematic way of a given activity.
2. Identify the fundamental hand motions involved in the process in order to eliminate unnecessary motions.
3. Identify the principles of motion economy for given workstation.
4. Understand the concept of performance rating.
5. Determine the standard time of a job using time study.

List of Experiments will be based on the syllabus in theory course INT 263

IV Semester
Department of Industrial Engineering

Course Code : INT299-1 **Course : Organizational Behavior Development**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The objective of this course is to prepare students:

1. Understand about components of individual and organizational behaviour

Course Outcome

At the end of this course the students shall be able to

1. Conceptualize the components of individual Behavior
2. Understand Personality and its importance for Organization
3. Apply Perception techniques in organizations
4. Improve on learning ability
5. Understand the practicability of communication
6. Understand attitudes and values

Syllabus

Unit 1: Introduction To Organizational Behavior - Emerging Challenges of OB- Managing Diversity, Changing Demographics of work force, Globalization & Technology, Foundation Of Individual Behavior – Personal & Environmental factors, models of Individual Behavior

Unit 2: Personality - Types – Personality Theories, Freudian Stage, Determinants of Personality, Personality Traits, Personality Tests, Personality &OB

Unit 3: Perception & Attribution - Importance - Factors Influencing Perception - Interpersonal Perception Types, Perceptual Process, Process of Interpreting, Attribution theory, When perception fails, Perception & OB

Unit 4: Learning- Types Of Learning Styles - The Learning Process - Learning Theories – Learning Curve, Learning & OB

Unit 5: Communication- Significance of Inter Personal Communication, Types of Communication, Barriers for effective communication, factors influencing organizational communication, Transaction Analysis, Johari Window

Unit 6: Attitudes & Values- components of attitudes, ABC model, foundation of attitude, changing attitudes, Job satisfaction, Values, merging personal and organizational values, attitudes values & OB

Text Books

1. Aswathapa, Organizational Behavior, PHI Publications.

Reference books

1. Stephen Robbins, Organizational Behavior, Prentice Hall Of India, 9th Edition, 2001.
2. Fred Luthans, Organizational Behavior, Mcgraw Hill Book Co, 1998.

IV Semester
Department of Industrial Engineering

Course Code : INT299-2 **Course : Decision Modeling**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

1. Understand about the mathematical models that can aid in decision making process within the organization

Course Outcome

At the end of this course the students shall be able to

1. Develop mathematical models that can be used to improve decision making within an organization.
2. Sharpen their ability to structure problems and to perform logical analyses.
3. Practice translating descriptions of decision problems into formal models, and investigate those models in an organized fashion.
4. Identify settings in which models can be used effectively and apply modeling concepts in practical situations.
5. Strengthen their computer skills, focusing on how to use the computer to support decision-making

Syllabus

UNIT I : Decision making, Formulation of situation as LPP, Solution of LPP by graphical, simplex, Degeneracy and techniques to resolve degeneracy in simplex method, forming the dual, Duality concepts, complementary slackness condition, dual simplex methods, Sensitivity Analysis

UNIT II : Transportation Models, Caterer problem, Transshipment Model, Sequencing Models, Traveling salesman Problem

UNIT III : Assignment Models, Linear integer Programming, Zero-One (binary programming)

UNIT IV : Concept of simulation, simulation involving distributions like Step, Uniform, Normal , Poisson, Exponential Distribution, Simulation of complex and dynamic situation in industry and business. Use of computers in simulation

UNIT V : Introduction to management project, CPM and PERT analysis of projects, Concept of crashing, Resources leveling and smoothing

UNIT VI: Dynamic programming, Concept of Multistage Programming Recursive relation approach, forward and backward recursions, Application of technique in discrete decision making problems

Text Books

1. Principles of Operation Research- Wagner- Prentice Hall

Reference Books

1. Operation Research - An Introduction- Hamdy A Taha, PHI Publication - New Delhi
2. Introduction to Operations Research- Hillier, Lieberman-Tata McGraw Hill Publishers
3. Operation Research Principles & Practice- Ravindran. Philips, Solberg, John Wiley & Sons

IV Semester
Department of Industrial Engineering

Course Code : INT299-3 **Course : Six Sigma**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The objective of this course is to prepare students:

1. Understand about the quality management and its application to different problems

Course Outcome

At the end of this course the students shall be able to

1. Develop understanding of Quality Management terminology
2. Develop understanding of six sigma concepts for any improvement in a process.
3. Have knowledge of methodology of implementation of six sigma in any industry.
4. Apply statistical quality control tools and techniques.

Syllabus

Unit 1: The history of quality management, from mere 'inspection' to Total Quality Management, and its modern 'branded interpretations such as 'Six Sigma', Processes, ideas, theories and tools : central to organizational development, change management, and the performance improvements.

Unit 2: Six Sigma: Definitions and success stories, six sigma framework, DMAIC – the six sigma improvement process, statistics and six sigma, difference between six sigma and TQM.

Unit 3: Preparing for Deployment: Elements of successful deployment, personal requirements – developing training plan, training need analysis, champions, black belts, and green belts, and focusing on deployment – customer focus, project selection, and QFD.

Unit 4: Six Sigma Tools: Exploratory tools and Analysis tools – Charts, diagrams, Data collection and monitoring tools – primary and secondary data and SPC.

Unit 5: Six Sigma Methodology (DMAIC): Define – objectives, process thinking, process mapping, balanced scorecard, project selection and tracking, Measure –objectives, measurements (discrete vs continuous), measurement as a process, baseline estimation, performance metrics, and measurement system analysis, Analysis – objectives, value stream analysis, analyzing sources of variations, and determining process drivers, Improve – objectives, defining new process, benchmarking, prioritizing and selecting a solution, and corrective action matrix, Control – objectives, more on SPC, visual control, best practices and lessons learned, and documenting process changes.

Unit 6: Six sigma Methodology (DMADV) .Case studies: Selective cases with hands on exercises.

Textbooks

1. "Six Sigma Demystified"- Keller, P. (2005). Tata McGraw-Hill, New Delhi.
2. "Simplified Six Sigma "- N.Gopalkrishnan (2012) , ,PHI,New Delhi.

Reference Book

1. "Quality Planning and analysis" - JuranJata, McGraw Hill.
2. "Statistical Quality Control" - Eugene L Grant, McGraw-Hill

IV Semester
Department of Industrial Engineering

Course Code : INT265 **Course : Instrumentation and Metrology**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to understand

1. Apply the use the different measurement instruments and indentify their functional elements

Course Outcome

The students shall able to :

1. Understand the various elements of generalized measurement system and identify functional elements of instruments.
2. Make the industrial use of various transducers and sensors.
3. Understand linear and angular measuring instruments. Design the gauges based on type of fit required.
4. Understand the conventional and advanced techniques in measurement.

UNIT I : Introduction to measurement systems, significance of measurement, methods of measurement, elements of generalized measurement system and errors in measurement, Performance characteristics of measuring devices

UNIT II : Different types of transducers and their applications in measurement of force, pressure, flow, temperature, speed and sound. Industrial use of sensors

UNIT III : Introduction to metrology, standards of measurement, simple gauging instruments for linear and angular measurements. Mechanical, electrical and pneumatic comparators, Limits, fits and tolerances. Design of limit gauges, process planning sheet and tolerance chart preparation

UNIT IV : Measurement of straightness and flatness, Use of optical flat, Measurement of screw thread parameters, Measurement of surface roughness, Introduction to advanced measurements

Text Books

1. Mechanical Measurement and Control, D. S. Kumar, Metropolitan Book Company.
2. Instrument Measurement and Analysis, Nakra and Chaoudhary, McGraw Hill Education.
3. Mechanical Measurements and Instrumentation (Including Metrology and Control Systems), R. K. Rajput, Publisher- S. K. Kataria and Sons.

4. A Textbook of Engineering Metrology, I. C. Gupta, Dhanpat Rai Publications.

Reference Books

1. Handbook of Optical Metrology: Principles and Applications, Toru Yoshizawa, Publisher- CRC Press.
2. Mechanical Measurements, S.P. Venkateshan, Publisher- CRC Press.
3. Design Data for Machine Elements, B. D. Shiwalkar, Denett and company

IV Semester
Department of Industrial Engineering

Course Code : INP265 **Course : Instrumentation and Metrology Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to understand

1. Apply the use the different measurement instruments and indentify their functional elements

Course Outcomes

The students shall be able to :

1. Identify functional elements of measuring instruments.
2. Analyze the industrial use of linear and angular dimensions measuring instruments.
3. Design the gauges based on type of fit required.
4. Make the industrial use of various transducers.

List of Experiments

1. Study of generalized measurement system and identify functional elements of the measuring devices.
2. To perform measurement of linear and angular dimensions using precision instruments.
3. To determine taper angle of a conical shape work-piece using sine centre.
4. To perform measurement of straightness and flatness using auto-collimator and optical flat.
5. Study and measurement of screw parameters using Toolmaker's microscope and Profile projector.
6. Design of limit gauges (GO and NO-GO): a report on the study of limit, fits and design of gauges.
7. To perform measurement of effective diameter using floating carriage micrometer.
8. Study and demonstration of coordinate measuring machine.
9. Measurement of speed of motor shaft using magnetic and photo electric pickup.
10. Study and measurement of temperature using contact and non-contact type transducers.

IV Semester
Department of Industrial Engineering

Course Code : HUT259 **Course : Leadership Skills**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 2**

Course Objective

1. The objective of the course is to make students aware about various aspects of effective leadership in the contemporary set-up and the skills required to lead a team

Course Outcome

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

1. Get acquainted with the basic concepts of leadership.
2. Learn to work effectively in team as leaders and members.
3. Have effective awareness about linkages between leadership and culture.
4. Understand the concept and role of digital leadership in contemporary society.
5. Understand transformation of society by effective leadership.
6. Learn the value of contributing to community development.

Syllabus

Unit - I

Introduction to Leadership : Definition, classification, features, approaches, traits, Distinguishing Leadership and Management

Unit - II

Leading the Team Steps for formation of team : Team Purpose, Power of purpose, creating the team for purpose, Delegation: why people resist delegation of work, how to delegate successfully.

Unit - III

Culture and Leadership Understanding global leadership : Cultures differences in leadership, Cultural Intelligence, women in leadership.

Unit - IV

Digital leadership Influence Building : Influencing and Persuasion Techniques, Influence and Organizational Politics, Connect and Influence, Influencing Others as a Leader.

Unit - V

Transformational Leadership Overview of transformational leadership: Case study: Mohandas Gandhi, Adolf Hitler, Nelson Mandela, Martin Luther King junior, Dhirubhai Ambani, Henry Ford and Narayana Murthy, Applying leadership theory to all of the above.

Unit - VI

Community Leadership : Community Leadership: Importance, need, role of leadership in CSR, case studies (Ratan Tata, Keshub Mahindra, etc).

Reference Books

1. Christopher F. Achua and Robert N. Lussier"Effective Leadership by CourseMate"Cengage India Private Limited; Fifth edition (1 March 2017)
2. Northouse P, (2015)"Leadership: Theory and Practice", Kindle Edition, 8th Edition, Sage Publishing Inc. Califonia.
3. Lencioni. P, (2005)"Overcoming the Five Dysfunctions of a Team: A Field Guide for Leaders, Managers, and Facilitators", Jossey-Bass Publishing house, Francisco.
4. Moran T. R, et al, (2007) "Managing Cultural Differences: Global Leadership Strategies for the 21st Century", 7th edition, Butterworth Heinemann Elsevier Inc.
5. Sheninger C. E, (2014) "Digital Leadership: Changing Paradigms for Changing Times" 1st Edition, Corwin a Sage company.
6. Seth M., Asudani. V. (2018) "Indian Spiritual Masters and Management Principles", Narendra Publication, Nagpur.
7. Blaine H, (2017) "Principles of transformational Leadership", Career Press. Inc, New Jersey
8. Krile F.J, (2006) "The Community Leadership Handbook: Framing Ideas, Building Relationships, and Mobilizing Resources", Paperback, Amazon.

IV Semester
Department of Industrial Engineering

Course Code : CHT252 **Course : Environmental Science**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 0**

Course Objective

The students should be able to understand

1. The waste management techniques and different types of pollutions along with the damage caused to environment.

Course Outcome

On successful completion of the course, the students:

1. Will get sufficient knowledge regarding different types of environmental pollutions, their causes, detrimental effects on environment and effective control measures.
2. Will realize the need to change an individual's outlook, so as to perceive our environmental issues correctly, using practical approach based on observations and self-learning.
3. Will become conversant with recent waste management techniques such as E-wastes, its recycling and management.
4. Will gain knowledge about the modes for sustainable development, importance of green energy and processes.
5. Will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be adopted, to protect the environment from getting polluted.

Syllabus

Unit I : Air pollution and its control techniques:(4 lectures)

Principle of contaminant behaviour and recent trends in environmental pollution control Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution Natural pathways for degradation: Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle. Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs). Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

Unit II : Noise pollution and its control techniques: (2 lectures)

Introduction to noise pollution and its causes Noise pollution control: Recent advances in noise pollution control and benefits.

Unit III : Soil pollution and its control techniques: (5 lectures)

Soil pollution: Soil around us, Soil water characteristics, soil pollution.Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment, bioremediation technologies, conventional techniques (land farming, constructed wetlands), and phytoremediation.Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals

Unit IV : Water pollution and its control techniques: (8 lectures)

Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics Techniques to control water pollution: Conventional waste water treatment-types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal.Case studies:Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills

Unit V : E-wastes (2 lectures)

Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

Unit VI : Environmental Sustainability: Role of Green technology (5 lectures)

Concept of green technologies, categories, goals and significance, sustainability Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation

VII : Different government initiatives (2 lectures)

National ambient air quality standard 2009, Swacch bharat abhiyan, National forestation program and Act- 2016, National river conservation plan and National Ganga river basin authority, Formation of National Green Tribunal

Books Suggested

1. Benny Joseph, Environmental Studies, Mc Graw Hill Education (India) Private Limited
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P AarneVesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth-Heinemann
4. D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd. Sultan Chand & Company
5. Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6. P.T. Anastas& J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press
7. P. Thangavel& Sridevi, Environemental Sustainability: Role of Green technologies, Springer publications

V Semester
Department of Industrial Engineering

Course Code : INT351 | **Course : Operations Research - I**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week | **Total Credit : 3**

Course Objective

The students should be able to understand

1. Formulation and solving of LPP for assignment, transportation, sequencing problems etc.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Formulate given situation as LLP and solve the LLP by graphical & simplex method.
2. Solve problem through counterparts and competitors perspective & solve problem by dual simplex method, also enhance capabilities for carrying out sensitivity analysis.
3. Solve transportation problem and also in using transportation problem for solving trans shipment and cater problem.
4. Form and solve assignment (optional pairing) problem, also student should be able to sequence the operations activities for completing the tasks in least possible time.
5. Find strategies of playing for players in competitive situation.
6. Find specification for designing queuing system.

Syllabus

UNIT I : Nature and development of operation research, Decision making, general methodology of OR. application of OR. in industrial problems. Formulation of situation as LPP, Solution by graphical method, simplex, alternate optima, infeasible solution, unbounded solution, indications in simplex method, Degeneracy and techniques to resolve degeneracy in simplex method

UNIT II : Forming Dual, Duality Concept, Complementary Slackness Condition, Dual Simplex Methods, Sensitivity Analysis

UNIT III : Transportation Models, Degeneracy in Transportation Problems, Caterer Problem, Trans shipment Model

UNIT IV : Assignment Models, Hungarian Method, Travelling Salesman Problem, Sequencing Models

UNIT V : Introduction to Game Theory, Two Person Zero Sum Games. Dominance Principle, Saddle Point, Nx2, 2xm Games. Solution of Game by Algebraic Method, Arithmetic Method, Method Of Sub Game, Graphical Method, Oddment Method. Simplex Method, Iterative Method

UNIT VI : Queuing System and Concepts, Classification of Queuing Situations, Solution Of Queuing Problems, Single Channel, Single Stale, Finite And Infinite Queues With Poisson's Arrival And Exponential Service, Application To Industrial Problems. Emphasis Only On (M/M/I): (FCFS/Infinity /Infinity) and (M/M/I): (FCFS/N/Infinity) Optimum Service Rate

Text Books

1. Introduction to Operations Research by Frederick S. Hillier and Gerald J. Lieberman Ninth Edition.
2. Operations Research : An Introduction by Hamdy Taha 9th Ed. Person India.
3. Operations Research by R. Panneerselvana, 2nd Ed., PHI Publications.

Reference Books

1. Principles of Operation Research with applications to Managerial Decision (Prentice-Hall international series in management) - January 16, 1970 by Harvey M. Wagner (Author)
2. Introduction to Operations Research : A Computer Oriented Algorithmic Approach by Billy E. Gillett Tara McGraw Hill, Edition.

V Semester
Department of Industrial Engineering

Course Code : INP351 **Course : Operations Research-I Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to understand

1. The different types of LPP and formulate LPP from the data given

Course Objective

At the end of this course students will demonstrate the ability to

1. Formulate real world problems into LPP and solve it.
2. Carry out sensitivity analysis of a LPP.
3. Make optimal allocation in case of transportation of assignment problems.
4. Determine optimal strategy in Game like situation.
5. Determine waiting line system specifications
6. Determine optimal production sequence

The experiments shall be based on theory course and syllabus mentioned in theory.

List of Experiments

1. Formulation of Linear Programming Problem.
2. Solving Linear Programming Problem by Graphical Method.
3. Solving Linear Programming Problem by Simplex and Dual Simplex Method.
4. Sensitivity Analysis of LPP.
5. Solving Games.
6. Solving Transportation Problems.
7. Assignment Problems
8. Handling Queuing Problems.

V Semester
Department of Industrial Engineering

Course Code : INT352 **Course : Production Planning and Control**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to understand

1. The production planning, demand forecasting, capacity planning and production control as well as different modern theories employed for control of production within the shop floor

Course Outcome

At the end of this course the student shall be able to

1. Understand the various important features and functions of PPC.
2. Apply demand forecasting and its models
3. Understand capacity planning and aggregate planning.
4. Understand inventory control and material requirement planning
5. Apply scheduling and sequencing in production

Syllabus

UNIT I: Production Planning : Introduction to Production Planning and Control (PPC), Functions and Objectives of PPC, Production procedure, Information requirement of PPC, Manufacturing Methods and PPC, Types of production systems, Product Life Cycle, Product design.

UNIT II: Demand Forecasting: Forecasting and Prediction, Long-term and short-term forecasting, Time series analysis, least square method, exponential smoothing method, Moving Average forecasting.

UNIT III: Capacity and Process Planning: Introduction, Measurement and measures of capacity, factors influencing effective capacity, factors favouring over capacity and under capacity, aggregate planning, linear programming approach to aggregate planning, Process Planning – Machine, Manpower Planning, line balancing.

UNIT IV: Inventory Control: Introduction, Types of inventories, reasons for keeping inventories, inventory control, benefits of inventory control, cost associated with inventory, inventory cost relationships, safety stock, inventory models, deterministic models, inventory control system.

UNIT V : MRP: Introduction, Objectives of MRP, MRP-I System, MRP-II system, Lot sizing consideration,

UNIT VI: Production Control: Introduction, loading, sequencing, priority sequencing, scheduling; single machine, flow shop, job shop scheduling, etc. Dispatching and progressing.

Text Books

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand, New Delhi (2009)

Refrence Books

1. Buffa, “Modern Production operations Management”, Wiley Eastern, New York (1999)
2. Panneer Selvan R, “Production and Operations Management”, Prentice Hall India, New Delhi (2002)

V Semester
Department of Industrial Engineering

Course Code : INT353 **Course : Work Measurement and Value Engineering**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to understand

1. Work sampling methods and apply modern techniques for work measurement and motion time study

Course Outcome

At the end of this course the student shall be able to

1. Apply the concept of work sampling
2. Determine the standard time using PMTS
3. Understand and apply MOST to given process or operations.
4. Apply about standard Data technique.
5. Understand the concept of value engineering

Syllabus

Unit 1: Work Sampling Definition, The need for work sampling, Establishing confidence level, determination of sample size, making random observations, control charts, Procedure for making work sampling study, determining time standards.

Unit 2: Predetermined Time Systems Definition, Concept of PTS, Predetermined time systems- Work factor, Methods Time Measurement (MTM), Application of PTS systems.

Unit 3: Basic MOST Introductions, General Move Sequence model, controlled move sequence model, tool use sequence model. Application of Basic MOST

Unit 4: Standard Data Introduction, developing the standard data, uses of predetermined time standards systems to develop standard data. Application of standard data

Unit-5: Value Engineering Definition, Value Engineering Function: Approach of Function, Evaluation of Function, Determining Function, Classifying Function, Evaluation of costs, Evaluation of Worth, Determining Worth, Evaluation of Value, Value Engineering Job Plan.

Text Books

1. International Labour organization, "Introduction to work-study", Universal Publishing Corporation, Geneva (Indian Reprint) Tenth Edition 2012.

Reference Book

1. Maynard H. B., "Industrial Engineering Handbook", 3rd edition, McGraw Hill Book Company. ISBN 0-07-041084-4.
2. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", John Wiley, UK (Indian Reprint Delhi) Seventh Edition, 2011.
3. S. S. Iyer, "Value Engineering A how to Manual", New age International Publishing

V Semester
Department of Industrial Engineering

Course Code : INT354 **Course : Relational DBMS**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to understand

1. Building, operating and maintaining a standard database, operations performed and querying a database.

Course Outcome

At the end of this course the student should have ability to

1. Realize the importance of having relational database for a given information system.
2. Organize the raw data such that there is no loss of data from the system and yet the data of different entities is integrated.
3. Make the data entity set such that data does not become redundant over a period of time.
4. Design the SQL to retrieve the data from the system.
5. Use the RDBMS to capture the data from the various Business Processes and integrate it in a system.
6. Ensure the data integrity, robustness and error handling features in the software that will be designed for any Business System

Syllabus

UNIT I : Introduction: Purpose of Database Systems, Views of data, Data Models, Database language, Transaction Management, Storage Management, Database Administrator, Database Users, Overall System Structure, Different types of Database Systems E-R Model: Basic Concepts, Design Issues, Mapping Constraints, Keys, E-R Diagram, Weak Entity set, Extended E-R features, Design Of an E-R Database Schema, Reduction of an E-R schemes of Tables.

UNIT II : Relational Model: Structure of Relational Database, The Relational Algebra, The tuple relational calculus, The Domain Relational Calculus, Views SQL- Background, Basic Structure, SET operations, Aggregate functions, Null Values, Nested Sub queries, Derived Relations, Views, Modification of Database, Joined Relations, DDL, Other SQL features

UNIT III : Transaction : Transaction Concepts, State, Implementations of Atomicity and durability, Concurrent Executions, Serializability, Recoverability, Transaction Definition in SQL.

UNIT IV: Concurrency Control: Lock based protocol, Timestamp based protocol, Validation based protocol, Multiple Granularity, Multi version Schemes, Deadlock Handing, Insert and Delete operations, Concurrency in index structure Query Optimization.

UNIT V : Relational Database Design: Pitfalls in Relational-Database Design, Decomposition, Normalization Using Functional Dependencies, and Normalization Using Multi valued Dependencies, Normalization Using Join Dependencies, Domain-Key Normal Form and AlternativeApproachestoDatabaseDesignOtherRelevantAdvanceTopicsandApplications

UNIT VI : Object Oriented Database: Decision-Support Systems, Data Analysis, Data Mining, Data Warehousing, Spatial and Geographic Databases, Multimedia Databases Mobility and Personal Databases, Information- Retrieval Systems, Distributed Information Systems, The World Wide Web

Text Book

1. Database System Concepts by Siberschatz Korth and Sudarshan 6thEdition.

Reference Books

1. Business Analytics: The science of Data Driven Decision Making by U Dinesh Kumar 6th Edition

V Semester
Department of Industrial Engineering

Course Code : INP354 **Course : Relational DBMS Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to understand

1. Standard query language and programming for querying a database

Course Outcome

At the end of this course the student should have ability to

1. Create and alter the database objects.
2. Normalize the raw data such that there is no loss of data from the system.
3. Make the data entity set such that data does not become redundant over a period of time.
4. Ensure the data integrity, robustness and error handling features

The experiments for the above course shall be based on topics covered in theory class

V Semester
Department of Industrial Engineering

Course Code : INT355 **Course : Modeling and Simulation**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to understand

1. The elements of system modeling and simulation, framework for modeling , discrete event simulation

Course Outcome

At the end of this course the student should have ability to

1. Define basic concepts in modeling and simulation(M&S)
2. Classify various simulation models and give practical examples for each category
3. Construct a model for a given set of data
4. Generate and test simulation models
5. Analyze output data produced by a model and test validity of the model

Syllabus

UNIT I: Introduction to System Modeling Concepts: System Specification Formalisms, Levels of System Knowledge, Introduction of Hierarchy of Systems Specification, The Specification Levels Informally Presented, System Specification Morphisms

UNIT II: Framework for Modeling and Simulation: The Entities of the Framework, Primary Relations Among Entities, Other Important Relations, Time.

UNIT III: Modeling Formalisms and their Simulators: Introduction, Discrete Time Models and their Simulators, Differential Equations Models and their Simulators, Discrete Event Models and their Simulators.

UNIT IV: Introduction to Discrete Event System Specifications (DEVS): Introduction, Classic DEVS System Specifications, Parallel DEVS System Specification, Hierarchical Models, And Object-Oriented Implementations of DEVS.

UNIT V: Parallel and Distributed Discrete Event Simulation: Problem Characterization of Parallel Discrete Event Simulation, Conservative Parallel Discrete Event Simulation

UNIT VI: Optimistic Parallel Discrete Event Simulation, Parallel DEVS Simulator

Text Books

1. Theory of Modeling and Simulation: Integrating Discrete Event and Continuous Dynamic Systems by Bernard P. Zeigler, Herbert Praehofer and Tag Gon Kim

Reference Books

1. Modeling and Simulation by Hartmut Bossel
2. Principles of Modeling and Simulation: A Multi-disciplinary Approach by John A. Sokolowski and Catherine M. Banks

V Semester
Department of Industrial Engineering

Course Code : INP355 **Course : Modeling and Simulation Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to understand

1. Construct and simulate a model from the given data or dataset

Course Outcome

At the end of this course students will demonstrate the ability to

1. Define basic concepts in modeling and simulation(M&S)
2. Classify various simulation models and give practical examples for each category
3. Construct a model for a given set of data
4. Generate and test simulation models
5. Analyze output data produced by a model and test validity of the model

The experiments shall be based on theory course and syllabus mentioned in theory

V Semester
Department of Industrial Engineering

Course Code : INT398 - 1 **Course : Data Science**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. The course is designed with the objective of developing, implementing and demonstrating various concept of Data Science to the students. The methods to analyze data and draw out inferences from it will be taught in this course.

Course Outcome

The students shall able to:

1. Capture basic features of the data
2. Draw out extra feature of data for better understanding and visualization and also find out best describing probability distribution
3. Draw out inferences based on samples drawn from population and also test the hypothesis
4. Establish various forms of linear and nonlinear relationship in entities of data.
5. Implement Decision Tree training and prediction
6. Train and implement ANN for various applications

Syllabus

Course will make use of Python (and R) for developing, implementing and demonstrating various concept of Data Science. Necessary ingredients of Python will be taught during the coverage of course.

Unit 1 : Descriptive Statistics: Data exploration (histograms, bar chart, box plot, line graph, scatter plot), Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Other Measures: Quartile and Percentile, Interquartile Range

Unit 2 : Statistical Analysis Initial Data Analysis: Relationship between attributes: Covariance, Correlation Coefficient, Chi Square; Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs, Probability (Joint, marginal and conditional probabilities), Probability distributions (Continuous and Discrete), Density Functions and Cumulative functions

Unit 3 : Sampling and Inferential Statistics: Sample versus population, Sample techniques (simple, stratified, clustered, random), Sampling Distributions, Parameter Estimation, Inferential Statistics, develop an intuition how to understand the data, attributes, distributions, Procedure for statistical testing, etc., Test of Hypothesis, T test, z-test, F-test,ANOVA

Unit 4 : Regression: Linear, Multiple Linear, Non-Linear, Forecasting Models

Unit 5 : Decision Tree: Information Theory primer, Entropy, Information Gain, under-fitting, over-fitting

Unit6 : Artificial Neural Networks, Topology, Sigmoidal function, Neuron Bias, Feed-forward Back-propagation training of neural networks.

Text Books

1. Mastering Python for Data science- Samir Madhavan; PACKT publishing

Reference Books

1. Python Data Science Handbook- Jake Wander Plas; O Rielly Publications

V Semester
Department of Industrial Engineering

Course Code : INT398 - 2 **Course : Maintenance and Troubleshooting**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. It is a unique course designed to aid engineers of all branches to understand the various elements of industrial systems to ensure the performance and safety of the workers. This course will help to understand the concept of maintenance and remedial troubleshooting to get the system back to normal.

Course Outcome

Students shall able to

1. Understand concepts and terminology in reliability.
2. Understand the applications of constant failure model and estimation of system reliability.
3. Should be in position to perform failure analysis and construct fault tree diagram.
4. Understand different maintenance strategies along with recent trends.
5. Should understand planning and scheduling in maintenance and maintenance effectiveness

Syllabus

UNIT I : Introduction to reliability, analysis of downtime, concept of availability, random versus deterministic failure phenomena, terms and definitions in reliability, application areas, reliability function, MTTF, Hazard rate function, bath tub curve, conditional reliability.

UNIT II : Constant Failure Rate (CFR) model- Failure modes with CFR model, two parameter exponential distribution, Poisson process, relevant applications. Reliability of systems – Series configuration, parallel configuration, combined series parallel, redundancy, K out of N redundancy.

UNIT III : Design for reliability –Failure analysis, identification of failure mode, determination of cause, assessment of effect, classification of severity, system safety and fault tree analysis.

UNIT IV : Maintenance concept – Functions, objectives, purpose, system approach to maintenance function. Maintenance planning and scheduling – Steps in job planning, planning technique, job manual, scheduling, Gantt chart and bar chart, PERT/CPM and CPA network.

UNIT V : Maintenance strategies – Basis of selecting maintenance strategies, types of maintenance, breakdown or Emergency maintenance, preventive, predictive, condition-based maintenance, risk-based maintenance, Design out maintenance, comparison of maintenance strategies, total maintenance management.

UNIT VI : Maintenance effectiveness – Overall equipment effectiveness, maintenance effectiveness assessment /survey, Key performance indicators (KPI), maintenance performance measuring indices, maintainability index. Recent trends in maintenance - Reliability centered maintenance, Total productive maintenance.

Text Books

1. Reliability and Maintainability Engineering – Charles E. Ebeling, Tata McGraw Hill
2. Maintenance Engineering – Er. Sushilkumar Srivastava, S chand.

Reference Books

1. Reliability Engineering- L. S. Srinath affiliated East- west Press PrivateLimited
2. Reliability Engineering – E. Balagurusamy Tata McGrawHill
3. Maintenance planning and control – AntonyKelly

V Semester
Department of Industrial Engineering

Course Code : INT398 - 3 **Course : Safety Engineering**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

1. The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings.

Course Outcomes

The students will be able to

1. Apply the concepts of industrial safety
2. Apply the concepts of accidents, accident record and reporting to real life problems
3. Evaluate the safety performance of an organization
4. Apply hazards and hazard assessment tools and methods.
5. Apply industrial safety management Syllabus:

UNIT-I : Concept of Safety : Definition and measurement of risk, reliability and hazard potential; elements of risk assessment; – risk analysis techniques – risk reduction resources – industrial safety and risk assessment. - Concepts of disaster control, job safety analysis, safety survey and safety inspection, Basic understanding of Industrial safety: environmental, electrical, dock, transport and nuclear safety; safety in hazardous industries like chemical, mining, construction etc.

UNIT-II : Accident Investigation and Reporting: Concept of an accident, unsafe act and condition – domino sequence, type of accidents: reportable and non-reportable accidents, serious and fatal accidents, reporting to statutory authorities; principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, and concept of Zero Accident Potential (ZAP) and cost of accident.

UNIT-III : Measurement of Safety Efficiency : Safety audit methods; safety records management. Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, and safety "t" score, safety activity rate – problems. Safety audit, checklist analysis, what- if analysis, safety review, safety warning systems

UNIT-IV : Hazards And Hazard Assessment : Definition and types of Hazards, difference between Risk and Hazard, Hazard assessment, procedure, methodology; preliminary hazard analysis (PHA), human error analysis, hazard operability studies (HAZOP), Tools for Hazard Identification, Evaluating Hazards.

UNIT V : Safety Management Systems : Safety management systems in Indian industry; engineering aspects of safety management, Safety legislations, implementation and monitoring of safety programs. Recent Trends of development of safety engineering approaches, Safety training, Introduction to OSHA, ILO standards and guidelines

Text Books

1. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, Third Edition, CRC Press, ISBN 9781138749573 - CAT# K32753 201

Reference Books

1. Benjamin O. ALLI, Fundamental Principles of Occupational Health And Safety, Second Edition, ISBN -9221204545, International Labour Office, 2008
2. D. S. S. Ganguly, C. S. Changeriya, Safety Engineering, Chetan Publication; ISBN-13: 978-8193452264, 2016
3. R. K. Jain And Prof. Sunil S. Rao, Industrial Safety, Health And Environment Management Systems, Khanna Publishers, ISBN: 978-81-7409-210-6, 2000
4. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
5. Industrial safety management, L M Deshmukh, TATA McGraw Hill, 2010
6. Safety, Reliability and Risk Analysis: Theory, Methods and Applications- Vol 1. Sebastián Martorell, C. Guedes Soares and Julie Barnett, CRC press.

V Semester
Department of Industrial Engineering

Course Code : INT398 - 4 **Course Name : Industrial Psychology**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. The objective of Industrial Psychology is to discover the ideal conditions in which the best mental and physical health of worker/employee can be maintained.

Course Outcome

Students shall able to

1. Apply the motivation concepts
2. Apply Team and group spirit while working
3. Understand leadership theories and politics in work situations
4. Resolve work conflicts
5. Understand and apply the concept of change
6. Manage the stress level at workplace

Syllabus

UNIT I : Motivation - Theories - Importance - Types - Motivation at Work – Designing Motivating Jobs, Theories of Motivation

UNIT II : Team Building and Group Dynamics - Group Behavior - Formation - Types of Groups – Influence, Emergence of Informal Leaders and Working Norms - Group Decision Making, Team issues, Effective team work

UNIT III : Leadership - Meaning - Importance Trait, Behavioural and Contingency Theories-Evolution of Leaders - Leadership Styles - Leaders Vs Managers; Power and Politics -Sources of Power - Power Centers

UNIT IV : Organizational Conflict- Causes, Types, Management of Conflict – Cases, Negotiations and conflict resolution, situational factors favoring negotiations, Beyond conflict solution.

UNIT V : Organizational Change and Development – Nature of change, levels of change, factors affecting change, force field theory of change, Change process, OD interventions.

UNIT VI : Work Stress- Meaning, what is not stress, sources of stress, stressors, outcome, burnout, stress management.

Text Books

1. Aswathapa, Organizational Behavior, PHI Publications

Reference Books

1. Stephen Robbins, Organizational Behavior, Prentice Hall of India, 9th Edition, 2001.
2. Fred Luthans, Organizational Behavior, Mcgraw Hill Book Co, 1998.

V Semester
Department of Industrial Engineering

Course Code : INT398-5 **Course : Theories of Engineering Experimentation**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. It is a unique course designed to aid engineers of all branches in performing experimental design by statistical analysis. Analysis of errors and working relationships between variables are discussed.

Course Outcome

The students shall able to :

1. Understand the concept of experimentation and method of measurements.
2. Understand the challenges in data collection and reduce the experimentation errors.
3. Plan and design the experimentation and the factors related to it.
4. Analyze the experimentation data and draw inferences which can be applied to improve the system.

Syllabus

UNIT I : Introduction to Experimentation and Measurement Systems Experimentation as a Subject for study, The Engineering Experiment, Definitions and Terminology, Nomenclature, The International System of Units, Measurement Systems, Dynamics of Measurements, Laboratory Experimentation, Field Experimentation.

UNIT II : Error and Uncertainty in Experimentation Kinds of Error, Calibration, The Histogram, The Normal Curve of Error, Precision Error and Standard Deviation, The Best Reading from Samples, Precision Error from Samples, The Probability Graph, Estimating the Precision Error of an Instrument The Normal Distribution as an Experimental Result The Effect of Non-normal Error Distributions, The Precision Index of a Product or Quotient, Finding Precision Indexes of a General Function, Application of the General Equation Planning Experiments from an Error Analysis Uncertainty Propagation Using Charts and Curves Linear Propagation and Uncertain Constants Propagation of Non-normally Distributed Errors.

UNIT III : Planning of Experimentation Impedance and Loading Dynamic Response, Response of Zero- Order Instruments, First-Order Instruments, Second-Order Instruments, Higher Order Instruments, The Buckingham Theorem The Pi Theorem, Selection of Groups and Variables, A Stepwise Method, The Choice of Primary Dimensions, Dimensional Analysis and the Differential Equation, Planning for Balance Checks, Spacing of Test Points, Sequence of Experimental Testing, Randomized Blocks: Extraneous Variables, Multifactor Experiments: Classical Plans Multifactor Experiments: Factorial Plans.

UNIT IV : Graphical and Statistical Analysis Graphical Rectification of Test Data Function Discovery, Extrapolation, Graphical Comparison of Data, Rejection of Outlying Points, The Least-Squares Method of Straight-Line Plotting, Correlation, Statistical Terminology: Two Kinds of Inference Error, The Chi-square Test for Significance, The Poisson Distribution, Student's t Test, The Analysis of Variance.

Text Books

1. Theories of Engineering Experimentation, Hilbert Schenk, Roger Hawks, Hemisphere Publishing Corporation, Mc Graw Hill Publication, Third Edition.
2. Design of Experiments by D. Montgomery, Eighth edition John Wiley and Sons.

Reference Books

1. Theory of Design of Experiments; Cox & Reid; Chapman & Hall Publication Third Edition
2. Introduction to Engineering Experimentation; Wheeler& Ganji, Pearson; Third Edition

V Semester
Department of Industrial Engineering

Course Code : INT398 - 6 **Course : Organizational Productivity Improvement**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. The course is designed for the students with a view to make them understand about the concept of productivity in any organization and the various ways to improve the productivity by considering all aspects.

Course Outcome

The students shall able to :

1. Understand the concept of Productivity
2. Know the basic procedure of method study
3. Understand work measurement techniques
4. Understand the concept of ergonomics
5. Know about lean manufacturing tools

Syllabus

Unit II : Productivity Definition, Concept and Importance of productivity, Difference between Production and Productivity, Factors affecting productivity, Techniques to improve productivity.

Unit II : Method Study Definition, Concept, Objectives and Procedure of method study, Process chart symbols, recording techniques, Principles of motion economy.

Unit III : Work Measurement Definition, Concept and Objectives of work measurement, Time study, Rating, Predetermined Motion Time System-PMTS, work sampling, Estimation of standard time.

Unit IV : Ergonomics Introduction, Principles, Work system design, Man-machine system, Human behavior and equipment design, Tools, Techniques and applications, Effect of environment on performance of worker.

Unit V : Lean Manufacturing Introduction, Lean Concept, Principles of lean, Pillars of Lean and Lean Techniques.

Text Books

1. International Labour organization, "Introduction to work-study", UniversalPublishing Corporation, Geneva (Indian Reprint) Tenth Edition 2012.

Reference Books

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lonnie Wilson. How to implement Lean Manufacturing, Mc. Graw Hill, 2010.
3. Human Factors in Engineering and Design by Sander's McCormick, Seventh edition.

V Semester
Department of Industrial Engineering

Course Code : HUT353 **Course : Indian Traditional Knowledge**

L: 2Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 0**

Course Objective

The course is designed with the objective of developing, understanding of the students about the essence of Indian traditional knowledge in terms of its scientific approach, legality, role in natural resource protection, as well as its contribution to philosophy and art.

Course Outcome

Students will have increased ability to understand the importance and application of:

CO 1 : Indian Knowledge system and its scientific approach

CO 2 : Traditional knowledge and protection of nature

CO 3 : The legality and its importance for the protection of Indian traditional knowledge

CO 4 : Indian philosophical tradition

CO 5 : Indian artistic tradition

Syllabus

1. **Basic Structure of Indian Traditional Knowledge :** Vedas, Upavedas, Vedang, Upadang, scientific approach
2. **Ecology and Indian Traditional Knowledge :** Meaning, role, case studies
3. **Intellectual Property Rights and Indian traditional Knowledge :** Meaning, role in protection of Indian traditional knowledge, cases studies
4. **Indian Philosophical traditions :** Nyay, Sankaya, Yog, Mimansa, Jainism, Buddhism, Sikhism, and other approaches
5. **Indian Artistic Traditions :** Chitrakala, Murtikala, Vastukala, Sangeet, Sthpatya, Nrityaevam Sahitya, case studies
6. **Knowledge of traditional Indian Science and Technology**

Reference Material

1. Amit Jha (2009), Traditional Knowledge System in India, Atlantic Publishers and Distributors.
2. RR Gaur, Rajeev Sangal, GP Bagaria, Human Values and Professional Ethics (Excel Books, New Delhi, 2010).
3. V. Sivaramakrishnan (ed.), Cultural Heritage of India - Course material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
4. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan,
5. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan.
6. S. C. Chatterjee and D. M. Datta, An introduction to Indian Philosophy, University of Calcutta, 1984.
7. Pramod Chandra, Indian Arts, Howard University Press, 1984.
8. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.
9. https://www.researchgate.net/publication/299625768_Traditional_Knowledge_systems_in_India_for_biodiversity_conservation/link

VI Semester
Department of Industrial Engineering

Course Code : INT361 **Course : Operations Research - II**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Analyze project for finding critical activity, determining crashing time, allocating resources, determine optimal replacement time, determine optimal solution for multi objective situation

Course Outcome

At the end of this course students will demonstrate the ability to

1. Analyze any project for finding critical activities, allocating resources.
2. Predict future states for known transition behavior.
3. Determine the optimal replacement policy for the equipment.
4. Find best setting by progressive accumulation of optimal solutions.
5. Determine optimal integer solution and best settings of variables taking binary values.
6. Determine optimal solution in multi-objective situation and in situation when Constants are parameterized

Syllabus

UNIT I : Project Management: Introduction to management of projects, Floats, Slacks, CPM and PERT analysis, Critical Path, Crashing of Network, Resources leveling and smoothing

UNIT II : Markov Chains and their applications: Concept of Brand Switching Mechanism Markov Process Transition matrix regular Transition matrix, steady state condition, absorbing state and decaying state appearing a: Markov chains

UNIT III : Replacement Analysis: Time value of money, Capital assets Single and Multiple Assets. Present worth Concept, Replacement of item A with A, Replacement of item A with similar item B, Replacement of items in anticipation of failure, Group replacement.

UNIT IV : Dynamic Programming: Concept of Multistage Programming, forward and backward recursion, Solution in discrete and continuous case by dynamic programming.

UNIT V : Linear Integer programming, Branch and Bound method, Gomory's cutting Plane Method, Zero-one programming by Implicit Enumeration approach.

UNIT VI : Goal Programming, Parametric Programming.

Text Books

1. Operations Research - An Introduction By Handy A - Tata, PHI Publication - New Delhi 2002, (Seventh Edition)

Reference Books

1. Introduction to R - by Hillier & Lieberman-Tata Mc Graw Hill Publishers
2. Operation Research Principles & Practice, by -Ravindran. Philips & Solberg Sons. New Delhi

VI Semester
Department of Industrial Engineering

Course Code : INP361 **Course : Operations Research - II Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to

1. Formulate and solve problems relating to determining critical activities for project and solve dynamic programming and decision making problems for multi objective optimization.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Determine critical activities in a project and optimize its devotion.
2. Predict composition of states and determining steady state composition.
3. Determine optimal replacement policy.
4. Apply Dynamic programming technique in various field
5. Optimize real life system using appropriate Algorithms.
6. Take decision making in multi objective situation

Syllabus

The experiments are based on the theory topics covered in the class room.

List of Experiments

1. Application of Dynamic Programming.
2. Critical Path Method (CPM) and Project Evaluation and Review Techniques (PERT).
3. Replacement Decision.
4. Markov Chain Analysis.
5. Integer Programming - Gomorys Cut Algorithm.
6. Goal Programming.
7. Zero - One Programming.

VI Semester
Department of Industrial Engineering

Course Code : INT362 **Course : Supply Chain Management**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Understand about the basic components of supply chain and dynamics of transportation and warehousing.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Describe the basic concepts of supply chain and logistics and its role in an organization.
2. Identify the key elements and processes of a supply chain and how they interact.
3. Understand the dynamics of transportation and warehousing.
4. Understand the analytics of inventory.
5. Understand the modeling coordination in supply chain management

Syllabus

Unit-I : Introduction to Logistics & Supply Chain Introduction to Logistics: Producer – Consumer System, Logistics Communication, Costs & Role of modem Technology in Logistics Management. Marketing & Product Distribution - Interdependence & Interaction. Multilevel System & Sensitive Analysis, Logistics Information system: Nature, Purpose & Scope of Information system. Customers Order Cycle & Order Processing. Bar Coding

Unit 2 : Transportation & Warehousing Inventory Management, Material Handling. Storage & Packaging Issues, Transportations: Time Place Utility, Transportation - Logistics Marketing Interface. Different Model of Transportation - Merits, Demerits & Costs, Warehousing: Nature, purpose & Scope of Warehousing, Own Warehouse, Third party warehouse. Economics & warehousing

Unit 3 : Introduction to Modelling and Analytics in Supply Networks: Introduction to Supply Network, Performance Measures for Efficiency and Effectiveness, SCOR model, Strategic Fit and Scope, Types of Distribution Networks, Analytics in Management, Design of Distribution Networks

Unit 4 : Transportation & Warehousing Analytics Transportation models, Route planning, Transhipment, Shipment schedule, Flow path optimization. Warehouse location problem, MILP formulation, Location with foreign exchange risks, space calculation for warehouse, and Nonlinear optimization for warehouse space allocation

Unit 5 : Inventory Analytics: Elementary Concepts related to Inventory Management, Economic Order Quantity (Instantaneous Replenishment), Economic Production Lot Size, Inventory Model with Planned Shortages (Back-Orders), Inventory Management under Uncertainty – Concept of Safety Stock, Continuous Review System, Periodic Review System, Newsvendor Model, Performance Measures: Expected Lost Sales, Expected Sales, Expected Leftover Inventory, Expected Profit, Fill Rate, In-Stock Probability, and Stock-Out Probability

Unit 6 : Modelling Coordination in Supply Chains: Information Distortion in Supply Network and Bull- Whip Effect, Coordination and collaboration modeling in supply networks Mapping the riskiness profile of a country, taxation, Mapping the riskiness profile of possible international routes and Designing the route plan based on riskiness profile

Textbooks

1. Supply Chain Management: Strategy & Analysis, Chopra, Meindl & Kalra, Pearson Education, Asia.
2. Supply Chain Management, Janat Shah, Pearson education, Asia

Reference Books

1. Designing & Managing the Supply Chain, Simchi-Levi, & Kaminsky, McGraw-Hill Publication.

VI Semester
Department of Industrial Engineering

Course Code : INT363 **Course : Quality Engineering**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Understand and apply control charts for interoperation of process control and make use of statistical tools for acceptance sampling process

Course Outcome

At the end of this course students will demonstrate the ability to

1. To develop understanding of quality concepts
2. Develop control charts for interpretation of loss of process control
3. Make use of statistical tools for acceptance sampling process
4. Understand relationship between quality and reliability and estimation of different reliability measures

Syllabus

UNIT : Definition of Quality, Quality Planning, Quality Assurance, Quality of Design and conformance Quality Characteristics. Inspection & Quality Control, TQM. Cost of Quality, Shewhart Experimentation with Normal Bowl. Probability Distributions, Types, Normal, Poisson and Binomial Distribution.

UNIT II : Variation, Causes of Variation in Manufacturing Processes, Histogram application in process control, Concepts of control chart/Attributes and variable control charts, X bar and R Chart Plotting. Patterns Observed in X bar and R chart. Interpretation of patterns, Process capability Calculations Procedures. Importance of process capability.

UNIT III : Attribute Control Charts, Plotting p & np chart. Plotting Procedure, Patterns observed Interpretation. plotting c and u chart, Patterns observed interpretation of c and u Chart, Application. Importance, Comparison with X bar and R Charts.

UNIT IV : Concepts of acceptance Sampling, Comparison with 100% Inspection, Cost of inspection. Sampling Inspection Types, Single Double and multiple Sampling, probability' of Acceptance. Calculations in single sampling & double sampling. Concepts of AQL and Producer's Risk, Concepts of LTPD and consumers Risk, OC Curve

UNIT V : Sequential sampling, Concepts of AOQ & AOQL,ATI , study of standard sampling plan IS-2500 Part I and its application. Dodge roming sampling plan.

UNIT VI : Definition of Reliability. Quality and Reliability. Field Failure Data Analysis, Failure Rate. Failure Density, MTBF. MTTF , Bath Tub Curve., system reliability , , Reliability Allocation, Maintainability & Availability.

Text Books

1. Quality planning and analysis for enterprise quality Frank M Juran 5th edition.
2. Statistical quality control by Eugene L. Grant, Richard S. Leavenworth 7th edition.

Reference Books

1. Quality Engineering Handbook - Thomas Pyzdek, Paul A. Keller, CRC Press.
2. Juran's Quality Handbook - Joseph M. Juran, A. Blanton Godfrey, McGraw Hill.
3. Reliability Engineering Handbook - Dimitri Kececioglu, DEStech Publication

VI Semester
Department of Industrial Engineering

Course Code : INP363 **Course : Quality Engineering Lab**

L: 0Hrs. T: 0Hrs. P: 2 Hrs. Per week **Total Credit : 1**

Course Objective

The students should be able to

1. Calculate statistical terms, plot control charts and determine their statistical interpretation, evaluate system reliability measures.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand and calculate statistical terms like mean standard deviation etc.
2. Understand plotting of control charts and their interpretation
3. Understand sampling trials and plotting of sampling tools
4. Predict and evaluate systems reliability measures

The experiments are as follows

1. Establishment 1. Experiments to be conducted with Shewharts Normal Bowl.
   a) Establishment of relationship between
      1) Universe Mean & Sample Mean.
      2) Universe standard deviation & Standard deviation of means of samples.
   b) 1) To plot a model control chart from the drawings obtained in the previous experiments
2. To make changes in the known Universe & observe their effect on control charts.
3. To study and make use of Histograms as a process control Tool.
4. Demonstration of the fact that sample mean distribution is always normal even if the universe is not normally distributed.
5. Plotting of control chart for variables on the data obtained from a process.
6. Plotting of control chart from np. Fraction rejected and no of rejection.
7. Plotting of control for c & u, defects and defects per unit.
8. Demonstration of the fact :

a) Sampling plan with same percent sample give different quality protection.

b) Fixed sample size tends towards constant quality protection.

c) Acceptance number need not be zero.

9. Plotting of OC curve for double sampling plan.
10. Plotting OC curve multiple sampling plan.
11. Study and application of the MIL- 105 E, for a live problem in a Manufacturing Company.
10. Design of sequential sampling plan based on the given values of AQL & LTPD.
11. Plotting of AOQ with p for a given sampling plan and finding out AOQL .
12. Failure data analysis & estimation of reliability, failure density, failure rate.
13. Estimation of reliability of system :
    d) In parallel
    e) In series
14. Explain Hazard Models
15. Case Study

VI Semester
Department of Industrial Engineering

Course Code : INT364-1 **Course : Marketing Management**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Design a basic marketing research process, analyze buying behavior, carry out product segmentation and positioning.

Course outcome

At the end of this course students will demonstrate the ability to

1. Understanding of basic concepts of marketing.
2. Ability to analyze consumer buying behavior and design marketing research process
3. Knowledge about segmentation targeting and positioning
4. Understanding of product management & pricing strategies

Syllabus

Unit I : Understanding Marketing Management: Core concepts of marketing, nature and concept of marketing, marketing mix, service marketing, steps in the marketing process, nature and contents of marketing plan, scanning the marketing environment.

Unit II : Consumer Behavior: Consumer behavior, buying decision process, organizational buying, customer relationship management, marketing research and demand forecasting.

Unit III : Market Positioning: Market segmentation and targeting, positioning and repositioning; marketing strategies.

Unit IV : Product Management: Meaning of product, product classification, product levels, product policies, product life cycle and new product development, product differentiation. Pricing, Distribution, Pricing objectives, methods and pricing policies; channel design and management, understanding the communication process, managing advertising; sales promotion, public relations and direct marketing

Text Book

1. Marketing Management-A South Asian Perspective: by Philip Kotler, Kevin Lane Keller, Prentice Hall 15th Edition

References Books

1. Marketing Management-Planning, Implementation and Control: by V.S. Ramaswamy and S. Namakumari, McMillan
2. Marketing Management: by Rajan Saxena, Tata McGraw-Hill
3. Introduction to Marketing Management: by Adrian Palmer, Oxford University Press.

Basic Marketing 15th edition: by William D. Perreault, R. Tata McGraw-Hill

VI Semester
Department of Industrial Engineering

Course Code : INT364-2 **Course : Industrial Robotics**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Design a framework for a robotic system for application to a certain task and carry out economic analysis for payback before installing a robotic system.

Course outcome

At the end of this course students will demonstrate the ability to

1. Identify components of robotic system
2. Select combination of sensors and actuators for task
3. Identify and formulate requirement for machine vision
4. Formulate Dh notations and create forward and inverse kinematic matrix
5. Calculate payback period and decide the requirements for installing robot system Syllabus

Unit-1 : Robot Robot anatomy – Co-ordinate systems, work envelope, types and classification Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions – Need for robots – Different applications Pneumatic drives– Hydraulic drives – Mechanical drives – Electrical drives – D.C. servo motors, stepper motor and A.C. servo motors

Unit-II : End effectors – Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers – Two fingered and three fingered grippers – Selection and design considerations Requirements of a sensor, principles and applications – Position sensors – Range sensors – Proximity sensors – Touch sensors Wrist Sensors – Compliance Sensors – Slip Sensors.

Unit-III : Camera, frame grabber, sensing and digitizing image data – Signal conversion – Image Storage – Lighting techniques – Image processing and analysis – Object recognition – Other algorithms – Applications – Inspection, identification, visual serving and navigation. Forward kinematics – Inverse kinematics – Differences: Forward kinematics and Reverse kinematics of manipulators with two and three degrees of freedom (In 2 dimensional), four degrees of freedom (In 3 dimensional) – Deviations and problems

Unit-IV : Teach pendant programming – Lead through programming – Robot programming languages - VAL programming – Motion commands – Sensor commands – End effecter commands – Simple programs. RGV – AGV – Implementation of robots in industries – Various steps - Safety considerations for robot operations

Unit-V : Economic analysis of robots – Pay back method, EUAC method and Rate of return method

Text books

1. Robot motion and control;- K.S. Fu, Tata Mc graw hill publications.5th edition

VI Semester
Department of Industrial Engineering

Course Code : INT364-3 **Course : Data Analytics and Machine Learning**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Apply R language / Python Language to carry out statistical analysis of the data

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand data categorization, data pre-processing, variables
2. Carry out data analysis/statistical analysis using R.
3. Carry out data analysis with R commands / Python Commands
4. Effectively visualize the data
5. Understand, and practice Machine learning approaches and Artificial Intelligence and its application in data analytics

Syllabus

Unit-1 : Data Definitions, variables and overview of Big data Elements, Variables, and Data categorization, Levels of Measurement, Big data overview, data pre-processing, concepts of supervised and unsupervised learning. Introduction to statistical learning and R-Programming.

Unit-II : R / Python for Data Analytics- 1 Introduction to Basics, the basic data types in R and variables, Input and Output Vectors: Analyze data using vectors. Create, name and select elements from vectors. Matrices: work with matrices in R. basic computations of Matrices using R, Factors: categorical data in factors. Create, subset and compare categorical data.

Unit-III : R / Python for Data Analytics- 2 Data Frames: usage of Data frames, create and order Data frames Lists: use of list to store components of different types. Basic Graphics: R's packages graphics and data visualizations. Descriptive Statistics using R: Basic statistics: mean, median, standard deviation, variance, correlation, and covariance, Measures of central tendency, Measures of location of dispersions, Practice and analysis with R

Unit-IV : Data Analysis Techniques and Tools Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Regression analysis, Classification techniques, clustering, Introduction to data analytics tools like TABLEAU, POWERBI, RAPIDMINER, WEKA etc.

Unit V : Machine Learning & AI Basics of Machine Learning & AI, Introduction to Machine Learning with respect to Linear Regression, Logistics regression and neural networks. Brief review of AI history, artificial intelligence and its applications in data sciences

Text Book

1. Seema Acharya, Data Analytics using R, Mc grawhill Education, ISBN -13:978-93-5260- 524-8, 2018

Reference Book

1. Richard I. Levin and David S. Rubin, Statistics for Management, 7th Edition, Pearson, 1998
2. Garrett Grolemund, Hands-on Programming with R, O'Reilly Media, 2014
3. João Moreira, Andre Carvalho, Tomás Horvath, A General Introduction to Data Analytics, Wiley International ISBN: 978-1-119-29626-3; June 2018

VI Semester
Department of Industrial Engineering

Course Code : INT364-4 **Course : Sustainability and Green Manufacturing**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Apply modern approaches for sustainable manufacturing; understand about process parameters for sustainable manufacturing.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand concept of green manufacturing and approaches for sustainable Manufacturing.
2. Understand green manufacturing techniques and Process performance with Industrial case studies.
3. Understand application of productivity measures and techniques for machinability improvement.
4. Understand modern approaches for Sustainable Manufacturing.

Syllabus

Unit-1 : Introduction to sustainable green manufacturing. Introduction of green factory, Sustainability and its relevance. Metrics for green manufacturing. Modern approaches for Sustainable Manufacturing, Toxic substances in industry and need of Renewable sources.

Unit-2 : Difficulties in machining. Importance of cutting fluids, Health hazard and environmental issues using coolants. Coolant selection criteria. Motivations behind the use of green machining. Study of Green manufacturing techniques and Process performance with Industrial and research based case studies

Unit-3 : Systems concept for productivity improvement. Application of productivity measures. Typical measures of affecting productivity. Machinability: Techniques for Machinability improvement. Various Instruments used for Green Machining.

Unit-4 : Modern approaches for Sustainable Manufacturing. Efficiency of Manufacturing Processes. Energy Efficiency characterization of Manufacturing Processes. Energy Efficiency Practices in Manufacturing . Green manufacturing techniques: dry and near-dry machining, edible oil based cutting fluids, cryogenic machining.

Text Books

1. Green Manufacturing: Fundamentals and Applications by David A. Dornfeld, Springer US publisher 2013.

Reference Book

1. Green Manufacturing Process and System by Davim J. Paulo, Springer Verlag Berlin Heidelberg publication 2013
2. Efficiency of Manufacturing Process- Energy and Ecological Perspectives by Li Wen. Springer International Publisher – 2015

VI Semester
Department of Industrial Engineering

Course Code : INT365-1 **Course : Entrepreneurship Development**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Develop and demonstrate ability to execute a business plan, identify entrepreneual opportunities for a start up

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand the evolution of the entrepreneurship and examine the key resources required to exploit an innovative idea.
2. Examine various aspects of needed in Business Plan.
3. Identify the entrepreneurial opportunities in India.
4. Help to take ethical decisions & understand importance of CSR

Syllabus

Unit - I : Basics of Entrepreneurship: Creativity and Innovation, Relationship with the Economic Development, Barriers to Entrepreneurship (Factors affecting Growth of Entrepreneurship), Theory of Achievement Motivation, McClelland's Experiments, Business Idea - Business Idea Generation Process, Evaluation of Business Idea.

Unit - II : Business Plan: The ED Cycle, Building the Business Plan, Venturing an Enterprise, Financial Considerations (Cash Flow Management, Financial Plan, Business Plan). Financial incentives - Backward area benefits, Schemes for educated unemployed, Fiscal incentives, Procurement of industrial equipment, marketing support

Unit - III : Entrepreneurship in India: Family Business, e-Business, Small-Scale Sector in India, Entrepreneurship& Industry, Ancillarization in India, Ancillaries & Industrial Development.

Unit - IV : Ethics & corporate social responsibility - An introduction: Concept of ethics, Moral development pyramid, Beliefs, Religiousness and Law. Corporate Social Responsibility : Business & its stakeholders, Social Responsibility – Concept of CSR, Public Policy approach and role of NGO, Environmental Ethics – concerns, issues & case studies, Corporate Governance : Objectives, issues, features

Text Books

1. Business Ethics: C S V Murthy, Himalaya Publishing House 2. Entrepreneurship: Rajeev Roy, Oxford Publications

Reference Books

1. Business Ethics – Concept & Practice: B. H. Agalgatti& R. P. Banerjee – (Nirali Publication)

VI Semester
Department of Industrial Engineering

Course Code : INT365-2 **Course : Project Management**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Understand about project initiation, planning, organizational structures, performance evaluation of an engineering project

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand basic concept of project management
2. Learn project identification and initiation process
3. Learn the project planning process
4. Learn about project organizational structures
5. Understand project control and performance measurement techniques.
6. Understand application of project management in different industry sectors

Syllabus

Unit 1 : Basics of Project Management: Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Essentials of Project Management Philosophy, Project Management Principles

Unit 2 : Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point

Unit 3 : Project Planning: Introduction, Project Planning, Need of Project Planning, Roles, Responsibility and Team Work, Project Planning Process, Requirement Breakdown Structure (RBS) Work Breakdown Structure (WBS)

Unit 4 : Organizational Structure and Organizational Issues: Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management

Unit 5 : Project Performance Measurement and Evaluation: Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

Unit 6 : Case Studies in Project Management in different sectors like construction, power plants, manufacturing industry, chemical, process industry, IT project management.

Text Book

1. Effective Project Management: Robert K. Wysocki, Rudd McGary, Wiley Publications

Reference Books

1. Project Management: A Managerial Approach, Meredith and Mantel, John Wiley and Sons
1. The New Project Management: J. Davidson Frame, Jossey-Bass
2. Project Management: Harold Kerzner, Van Nostrand Reinhold
3. Project Management: S. Chaudhary, Tata McGrawl Hill
4. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) –Project Management Institute

VI Semester
Department of Industrial Engineering

Course Code : INT365-3 | **Course : Industrial Drives and Design**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week | **Total Credit : 3**

Course Objective

The students should be able to

1. Design, select and apply a specific drive for application and suggest general drives for given torque and speed requirements

Course Outcome

At the end of this course students will demonstrate the ability to

1. Choose appropriate electric motor for the purpose.
2. Pick mechanical drives and its configuration for the purpose.
3. Select gears, belt section and chain to transmit the proposed power in given conditions.
4. Suggest the drives and its general design for given applications

Syllabus

Unit I : Prime movers: Introduction and general types of prime movers, Types of motors, Operation characteristics and selection considerations of various types of motors (Such as AC motors, DC motors, Stepper motors, servo motors).

Unit II : Fundamental of Power transmission and types of drives: Laws of motion, Mechanical advantage, Friction, Uniform and variable torque and speed transmission, Computation of velocity ratio in drive, Various types of mechanical drives such as gear drive, belt drive, chain drive and PIV drive, General considerations for selection and configuration of drives, Advantages and disadvantages of various drives.

Unit III : Selection and design of drives: (a) Gear drive: Types of gears, open and closed systems, parallel, concentric and right angle drives, load factors and selection, Design principles and general design consideration, Backlash adjustment and alignment considerations. (b) Belt drive: Flat belt, V-belt and rope drive, open and cross belt drive, Slip, Creep of belt, Principle of operation and general design for belt selection, Use of idler pulley and automatic belt tensioner. (c) Chain drive: Design principles and general design consideration, selection of chain and sprocket, Silent chain

Unit VI : General design and selection of drives and motors for the applications: Material handling equipments, Stone crusher, Coal handling plant, Rolling mill, Compressor, Industrial blowers, etc.

Text Books:

1. Machine Design by Maleev & Hartman, CBS publishers.
2. Design of Machine Elements by B.D. Shiwalkar. Central Techno publications.
3. A Course in Electrical Power by Soni, Gupta & Bhatanagar

Reference Books

1. Design Data book by B.D. Shiwalkar, Central Techno publications.
2. Design Data Book, PSG.
3. Mechanical Engineering Design by J.E. Shigley, Mc-Graw Hill Education
4. Mechanical power transmission by W.J. Patton, Prentice Hall
5. Design of Machine Elements, V. B. Bhandari., McGraw Hill education
6. Machine design by R.S.Khurami and J.K.Gupta, S. Chand Co.

VI Semester
Department of Industrial Engineering

Course Code : INT365-4 **Course : Material Management and Inventory Control**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Design and inventory model for given conditions and understand different material management strategies employed by different industries

Course Outcome

At the end of this course students will demonstrate the ability to

1. Understand the importance of material management in industries.
2. Understand the purchasing store management aspects of good in industries
3. Understand vendor management and supplier selection methods.
4. Understand inventory management in industries.
5. Understand the application of materials management concept in different industries

Syllabus

UNIT I : Introduction to Material Management of material resource, Importance, Definition, Scope, Objective of materials management, integrated materials management approach, Activities of materials management, materials management and production control, Costs involved in the management of materials.

UNIT II : Purchasing : Importance of good system, its Functions, Organization for purchasing, duties of purchase manager, Method of purchasing, Centralized Vs Decentralized purchasing, make or buy decision, purchasing procedure : steps in purchasing, purchase requisition, placement of purchase order, follow up, receipt of materials, Negotiation in purchasing, Purchasing of Capital equipments. Incoming material Quality Control

UNIT III : Store Management : Objectives of storekeeping, Functions of storekeeper, store location, layout of stores, designing a store building, method of storing, method of achieving First-in-First Out, Bin Cards, return and issue of material, indent on stores, stores accounting.

UNIT IV : Inventory Models: Deterministic models, Inventory models for shortages, inventory models with price breaks, multi-item Deterministic models, stochastic inventory models, Selective inventory models. UNIT V Vendor development and evaluation, Supplier selection, multi criteria decision making (MCDM) technique in supplier selection like Analytic hierarchy process (AHP), Topsis, Promethe

UNTI VI : Material management using KANBAN, Lean materials management, Application of materials management for product like, hazardous, food, chemical, pharmaceutical, engineering product, etc in industry, software used for materials management.

Text Books

1. Materials Management A supply chain perspective A.K. Chitale, R.C. Gupta, PHI Publication, 3rd edition.

Reference Books

1. Introduction to material management, Stephen Chapman, Pearson India
2. Introduction to materials management, J. R. Tony Arnold, Stephen Chapman, Loyd Clive,

VI Semester
Department of Industrial Engineering

Course Code : INT365-5 **Course : Lean Production Systems**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

1. At the end of the semester the students should be have a basic understanding of the lean manufacturing systems and be able to analyze, and optimize such systems.

Course Outcome

At the end of this course the student will demonstrate the ability to

1. Measure production performance and how defects and waste degrade performance.
2. Understand the concept of KANBAN, TPM and OEE System to improve the production system.
3. Apply elements of Lean production including Heijunka, Jidoka, and Poka Yoke.
4. Apply the 5S methodology for establishing and sustaining a production work environment.

Syllabus

Unit - I : Review the history of Lean Production, focusing on Japan's Toyota Production System as an alternative to mass production. Discuss how waste impacts productivity. Just in time production system. JIT Logic - Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops.

Unit - II : The important concepts of cycle time and tact time. Understand the relationship between inventories, Kanban System : Kanban rules, supplier Kanban and sequence schedule used by supplier, Monthly information & daily information. Discuss the concept of Total Productive Maintenance and Overall Equipment Efficiency.

Unit - III : Calculate the impact of setups on capacity when the product variety is increased and understand how batching can improve this, but at the expense of increased inventory. Review the Single Minute Exchange of Die (SMED), and learn why reducing setups and changeovers are critical to Lean manufacturing.

Unit - IV : Understand how Poka Yoke can help fool-proof our processes and learn how to structure and concept of Kaizen for rapid improvement opportunities for problem-solving and process improvements. Understand the elements of Lean production including Heijunka, Jidoka.

Unit - V : Introduction to the concepts of Workplace Visualization and Organization and 5S for improving and maintaining continuous flow in Lean Production. Value Stream Mapping-Understanding the current state and designing the future state managing lean enterprise.

Text Books

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Toyota Production System - An integrated approach to Just in Time - Yasuhiro Monden, - Engineering aild Management Press - Institute of Industrial Engineers - 1983.

Reference Book

1. Rother M. and Shook J, 1999, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA.

VI Semester
Department of Industrial Engineering

Course Code : INT399-1 **Course : Supply Chain Analytics**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Understand about basic performance parameters of a supply chain and how to improve its effectiveness

Course Outcome

At the end of this course students will demonstrate the ability to

1. Describe the basic concepts of supply chain and logistics and its role in an organization.
2. Identify the key elements and processes of a supply chain and how they interact.
3. Understand the dynamics of transportation and warehousing.
4. Understand the analytics of inventory.
5. Understand the modeling coordination in supply chain management Syllabus:

Unit-I : Introduction to Logistics & Supply Chain Introduction to Logistics: Producer – Consumer System, Logistics Communication, Costs & Role of modem Technology in Logistics Management. Marketing & Product Distribution - Interdependence & Interaction. Multilevel System & Sensitive Analysis, Logistics Information system: Nature, Purpose & Scope of Information system. Customers Order Cycle & Order Processing. Bar Coding

Unit 2 : Transportation & Warehousing Inventory Management, Material Handling. Storage & Packaging Issues, Transportations: Time Place Utility, Transportation - Logistics Marketing Interface. Different Model of Transportation - Merits, Demerits & Costs, Warehousing: Nature, purpose & Scope of Warehousing, Own Warehouse, Third party warehouse. Economics & ware housing

Unit 3 : Introduction to Modelling and Analytics in Supply Networks: Introduction to Supply Network, Performance Measures for Efficiency and Effectiveness, SCOR model, Strategic Fit and Scope, Types of Distribution Networks, Analytics in Management, Design of Distribution Networks

Unit 4 : Transportation & Warehousing Analytics Transportation models, Route planning, Transhipment, Shipment schedule, Flow path optimization. Warehouse location problem, MILP formulation, Location with foreign exchange risks, space calculation for warehouse, and Nonlinear optimization for warehouse space allocation

Unit 5 : Inventory Analytics: Elementary Concepts related to Inventory Management, Economic Order Quantity (Instantaneous Replenishment), Economic Production Lot Size, Inventory Model with Planned Shortages (Back-Orders), Inventory Management under Uncertainty – Concept of Safety Stock, Continuous Review System, Periodic Review System, Newsvendor Model, Performance

Measures: Expected Lost Sales, Expected Sales, Expected Leftover Inventory, Expected Profit, Fill Rate, In-Stock Probability, and Stock-Out Probability

Unit 6 : Modeling Coordination in Supply Chains: Information Distortion in Supply Network and Bull-Whip Effect, Coordination and collaboration modeling in supply networks Mapping the riskiness profile of a country, taxation, Mapping the riskiness profile of possible international routes and Designing the route plan based on riskiness profile

Textbooks

1. Supply Chain Management: Strategy & Analysis, Chopra, Meindl & Kalra, Pearson Education, Asia.
2. Supply Chain Management, Janat Shah, Pearson education, Asia

Reference Books

1. Designing & Managing the Supply Chain, Simchi-Levi, & Kaminsky, McGraw-Hill Publication

VI Semester
Department of Industrial Engineering

Course Code : INT399-2 **Course : Research Methodology**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objective

The students should be able to

1. Understand about the basic components of research like formulation of a research problem, data collection, analysis, presentation, designing experiment, taking observations, analysis of results etc.

Course Outcome

At the end of this course students will demonstrate the ability to

1. Gain insights into different aspects of research
2. Understand different data collection methods in research.
3. Learn and understand the basics of data analysis tools and techniques.
4. Understand the role of computers in research.
5. Understand the documentation of research and report writing.

Syllabus

Unit-I : Meaning of Research, Research Methods versus Methodology Objectives of research, Motivation in Research, Types of Research, Research approaches, Significance of Research, Identification of a research problem.

Unit-II : Criteria for selection of the problem, Defining the Research problem, Selecting the Problem, Technique involved in defining a problem, Research Design: Need, features of a good design, research design concepts,

Unit-III : Different research designs, Literature survey and review: Need of review of literature. Data Collection: Meaning and importance of data, Sources of data, Methods of data collection, Collection of Primary Data; Observation Method, Interview Method, Data through Surveys and Questionnaires, Some Other Methods of Data Collection,

Unit-IV : Experimentation, Simulation. Data Analysis: Statistical analysis, Measures of central tendency, Measures of dispersion, Probability distributions: Binomial, Poisson, Uniform, Normal and Exponential, Hypothesis Testing, Procedure for Hypothesis Testing Confidence Interval, Test of Significance, Comparison of Two Proportions, Comparison of Means, Analysis of Variance (ANOVA), Basic principle of ANOVA, One way and two way ANOVA,

UNIT-V : Design of Experiments, Importance of experimental designs. Optimization of Model parameters, Application of optimization theory to modeling, Heuristic and met heuristic approaches like Fuzzy logic, Genetic Algorithm (GA), Simulated Annealing (SA), etc. Unit-VI Role of computers in Research : Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features, Use of MS Excel, Power Point, Use of statistical Analysis software. Report Writing and publication: Planning of Report Writing, Thesis writing, Formats of report writing, Types of Reports, Different steps in writing report, Formats of publications in Research journals

Text book

1. Research Methodology- Methods and Techniques: Kothari C.P. (2004), 2/e, New Age International, New Delhi

Reference Books

1. Design and Analysis of Experiments: Angela Dean and Daniel Voss, Published by Springer-Verlag NewYork,
2. Theories of Engineering Experimentation, 1st ed.: H. SchenckJr.,, Mc-GrawHill.
3. Simulation Modeling and Analysis, 2nd ed.: Law, A. M., and W. D. Kelton, 1991, McGrawHill
4. Discrete event system simulation, 2nd ed.: Banks, J. J., S. Carson, and B. L. Nelson. 1996, Upper saddle river, New Jersey : Prentice-Hall.
5. Design and Analysis of Experiments, 5th ed.: Montgomery, Douglas C. (2007), (Wiley India)
6. Applied Statistics & Probability for Engineers: Montgomery, Douglas C. & Hunger, George C. (2007), 3/e, (Wiley India)

VII Semester
Department of Industrial Engineering

Course Code : INT451 **Course : Industrial Automation**

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

- The objective of this course is to give holistic overview of Industrial Automation applicable to process control and discrete manufacturing control

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Calculate payback period for automation proposals and making decision regarding installation
2. Apply and design transfer mechanisms for the given factory layout and decide about part delivery mechanisms for work stations.
3. Apply type of control system for given process layout and calculate system transfer function, programming of PLC for the given process sequence
4. Design the hydraulic system for given process layout and perform pump sizing for given operating pressure, understand the logic of variable speed motor control.
5. Calculate payback period and sizing for installation of robot system for plant automation and perform forward and inverse kinematics calculation for sizing of the robot arm.

Syllabus

UNIT - I

Introduction to automation Overview of Automation, Types of automation, Mechanization and Automation, Automation strategies, Hard automaton devices. Automated factor, Architecture of Industrial Automation Systems, Difference between Automation and Control, Types of production Systems, Economics of Automation, Evaluation of Automation Proposals, Break-even Analysis, Measurement System Characteristics, Data Acquisition Systems.

UNIT - II

Automated transfer lines, fundamentals of automated production lines, storage buffers and applications. Analysis of transfer lines with internal storage and without storage. Automated assembly systems, fundamentals and quantitative analysis. Parts delivery system at work stations, single station assembly machines, partial automation.

UNIT - III

Signal Conditioning and Transmitters: Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, Introduction to automatic control, PD, PI, PID Control, PID Control Tuning, PLC Hardware Environment PLC: Functions of PLC, Architecture, Selection of PLC, Networking of PLCs, Ladder Programming

UNIT - IV

Industrial Hydraulics, Speed Control of Motors

Industrial Hydraulic Circuits, Flow Control Valves, Hydraulic power plant architecture, control systems in hydraulics Introduction to variable speed drives, Energy savings in variable speed drives, BLDC Motors and their control

UNIT - V

Introduction to Robotics : Components of Robot, Kinematics, DH Notations, Sensors and Actuators, End Effectors, Sizing and Payback period after installation

Text Books

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jayco Publishing House, 2013
2. Programmable Logic controllers and Industrial Automation: Madhuchhanda Mitra, Samarjit Sen Gupta, Penram International Publishing India Pvt. Ltd
3. Automation, Production Systems and Computer Integrated Manufacturing, Groover M P, Prentice Hall

Reference Book

1. Programmable Logic Controllers, Principles and Applications: John W. Webb, Ronold A Reis,5th Edition, Prentice Hall of India Pvt. Ltd.
2. Principles of Automation & Automated Production Process, Malov and Ivanov , Mir Publication
3. Standard Handbook of Industrial Automation - CONSIDINE D M, and CONSIDINE G D, Chapman and Hall, London, 1986.
4. Performance Modeling of Automated Manufacturing Systems - Viswanatham N & Narahari Y, Prentice Hall of India (P) Ltd, 1992.
5. Electric Motor Drives, Modeling, Analysis and Control, R. Krishnan, Prentice Hall India, 2002 Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

VII Semester
Department of Industrial Engineering

Course Code : INP451 **Course : Industrial Automation Lab**

L: 0Hrs. T: 0Hrs. P: 2Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of the course is

1. Learn about different hardware associated with automation such as sensors, circuits and actuators.
2. Develop Automation systems for different real world applications using hardware and software.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand the modeling of electro-mechanical systems for application in automation.
2. Programming and interfacing of microprocessors and microcontrollers
3. Selection and interfacing of sensors and transducers
4. Speed control and interfacing of electrical, pneumatic and Hydraulic actuators

List of experiments will be based on following topics

- ☐ Building Blocks of Automated system
- ☐ Fixed Automation in machining
- ☐ Single Axis position control in machining
- ☐ Multiple axis machining
- ☐ CNC concepts in machining
- ☐ Automation in material movement-trolleys with Mecanum wheels
- ☐ ASRS-Automatic Storage and Retrieval System

VII Semester
Department of Industrial Engineering

Course Code : INT452 **Course : Engineering Economy and Cost Control**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Learn about concepts of economics applied to managing the finances of enterprise.
2. Learn about economic analysis of manufacturing system.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand objectives and operations of enterprises.
2. Develop skills for taking better decisions for selections amongst investment proposals from the enterprise.
3. Analyze and interpret the financial statements
4. Classify different types of costs and costing procedures and apply it for ascertainment of costs of a product or a process.
5. Better decision-making power using proper technique for preparation of budgets and profit analysis

Syllabus

UNIT - I

Definition & Scope of Finance Function. Financing of Engineering Enterprises Ownership & Borrowed Capital. Types of Companies and Company formation, Introduction to Capital market and Stock Markets.

UNIT - II

Engineering Economy, Time value of Money : The nature & purpose of engineering economy, simple interest, compound interest. Discounted cash flow diagram, Present. Future & Annual worth, nominal and effective interest rates ,compounding more than once per year and Gradient Series.

UNIT - III

Evaluating Projects : Determining MARR, Equivalent worth methods, rate of return methods. Payback period methods, Comparison and selections of alternatives. Depreciation and Methods of Depreciation.

UNIT - IV

Elements of Accounting, Preparation and Interpretation of profit and loss accounts and balance sheet. Understanding and analyzing of financial statements, use of ratios.

UNIT - V

Cost Accounting, Costing Systems, Job Costing, Batch Costing. Simple Process costing with normal & abnormal losses & Gains., (Analytical treatment expected on Process costing), Application of costing to decision making like make or buy. Add or drop, operate or shut down etc.

UNIT - VI

Management Accounting, Marginal Costing, Break Even analysis - C.V.P. analysis.. Budget & Budgetary Controls. Concepts of budgeting, advantages & limitations of fixed & Flexible budget. Standard costing & variance analysis, Cost Control/ Management- Steps and Merits.

Text Books

1. Engineering Economics Book -David Bedworth, James L. Riggs, and Sabah U. Randhawa- Tata McGraw-Hill-Fourth Edition
2. Cost Accounting - Jawahar lal and Seema srivastav - Tata McGraw-Hill-Fourth Edition 3.Financial Management-Prasanna Chandra -Tata Mc Graw Hill

Reference Books

1. Engineering economy by Sullivan, W.G., J.A. Bontadelli, and E.M. Wicks (2000)
2. Practice in Accountancy – Shankar liad Basil & Monilal Das –Amit Kumar Biswas

VII Semester
Department of Industrial Engineering

Course Code : INT453 **Course : Human Factor Engineering**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Learn about different ergonomic principles that go into the design of products and process.
2. Learn about different techniques that are used for identifying, preventing and managing work related stress cases.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Describe an expanded view of ergonomics
2. Identify ergonomically related injuries that occur in workplace.
3. Find and assure that the workplace fits the worker
4. Put ergonomic assessments and solutions to practical use in the workplace.

Syllabus

Unit - I

Introduction to Ergonomics : Scope, applications. Productivity Correlation, Human machine System Principles of Ergonomics, Process and application of Ergonomics, Research Design and Evaluation Methods

Unit - II

Engineering Anthropometry and Work Space Design : Structural and functional dimensions, collection of anthropometric principles in application of anthropometric data. Design of workplace, seat design

Unit - III

Cognitive Ergonomics : Concept of information, human information processing model, memory, Problem solving and troubleshooting, Meta Cognition and Effort

Unit - IV

Work Physiology : Metabolism & heat regulation, Muscle Structure, energy cost of work load, physical work capacity, whole body fatigue, stresses and work load

Unit - V

Physical Ergonomics Visual Sensory system, Auditory, Tactile and Vestibular systems, Noise, Illumination, Heat, Design of Displays and Controls

Unit - VI

Biomechanics of Work Musculoskeletal System, Bio Mechanical Models, Low Back Problem, NIOSH, Cumulative Trauma Disorder

Text Books

1. An Introduction to Human Factors Engineering- Christopher D. Wickens, John D. Lee

Reference Books

1. Human factors Engineering & Design - Mark S. Sanders. Ernest J. Me McCormick: McGraw Hill International Edition 30th September 1992 7th Edition
2. Ergonomics: Man, in his working Environment-Murrell, K.Chapman and Hall London1980 1stEdition
3. Human Factors Design Handbook-Wooden Vs. Mc Graw Hill New York 2nd Edition
4. R. S. Bridger, "Introduction to Ergonomics", CRC Press.

VII Semester
Department of Industrial Engineering

Course Code : INP453 **Course : Human Factor Engineering Lab**

L: 0Hrs. T: 0Hrs. P: 2Hrs. Per week **Total Credit : 1**

Course Objectives

The objective of the course is

1. Apply ergonomic principles for identifying work related problems/cases in Industry.
2. Identify Occupational Hazards arising out of improper design.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Design work systems and products using Anthropometric data.
2. Identify poor performance effects due to environmental factors.
3. Understand assignment of work load and its relation with physiological parameters.
4. Investigate Occupational hazards related to improper working condition and design workplace ergonomically.

Syllabus

The experiments would be based on following topics

- Measurement and Interpretation of Illumination
- Measurement and Interpretation of Noise Level
- Estimation of Physical Work Capacity [PWC], Energy Expenditure and Oxygen Consumption Using Bicycle Ergo Meter
- Determination of Physiological Cost of Walking and Physiological Cost Index of walking (PCI) Using Heart Rate
- Experiment On "Spirometry" The Classic Pulmonary Function Test.
- Determination of Body Mass Index (BMI), and Calculations of Basal Metabolic Rate (BMR) and Resting Metabolic Rate (RMR)
- Determination of Speech Transmission Index (STI) as a function of Background noise dB (A)
- Seminar: Presentations on Research Papers from Journals, Relevant to the scope of Scheme

VII Semester
Department of Industrial Engineering

Course Code : INT454-1 **Course : Non Linear Optimization Technique**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Apply different optimization techniques used for arriving at optimal solution
2. Learn about different evolutionary techniques for solving real world optimization problems Course Outcomes: - At the end of this course the student will demonstrate ability to

1. Use classical technique to get optimal solution for NLP
2. Solvenonlinearoptimizationproblemusingdigitaltechniqueorgeometricprograming.
3. Use evolutionary algorithm for solving optimization problems.

Syllabus

UNIT - I : Classical Optimization Techniques : Single and multi-variable Optimization, Lagrangian function, Kuhn–Tucker Conditions.

UNIT - II : Non linear Programming - I : One Dimensional Minimization Methods: Uni-modal Function, Dichotomous Search, Fibonacci Method, Golden Section Method, Quadratic Interpolation Methods, Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods.

UNIT - III : Non linear Programming II : Unconstrained Optimization Techniques: Uni variate Method , Pattern Search ,Method ,Simplex Method, Steepest Descent(Cauchy)Method, Conjugate Gradient(Fletcher Reeves) Method, Newton's Method, Quasi-Newton Methods, Davidson-Fletcher-Powell Method.

UNIT - IV : Geometric Programming : Posynomial, Primal -Dual Relationship and Sufficiency Conditions, Degree of difficulty, orthogonality and normality conditions, 0-and1-degree difficult problem.

UNIT - V : Modern Methods of Optimization : Genetic, Simulated Annealing.

UNIT - VI : Particle Swarm Optimization, Ant Colony Optimization.

Text Books

1. "Engineering Optimization Theory and Practice", Fourth Edition, Singiresu S. Rao, John Wiley & Sons 4thEdition

Reference Books

1. Optimization theory and Methods: Nonlinear Programming - Wenyu Sun, Ya-Xiang Yuan, Springer
2. Linear & Non linear Programming-David G. Luenberger, Yinyu Ye, Springer
3. Non linear Programming-Anthony V. Fiacco, Garth P. Mc Cormick, SIAM

VII Semester
Department of Industrial Engineering

Course Code : INT454-2 **Course : Human Resource Management**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Understand the principles and concepts of Human Resources Management
2. Apply and learn about the practices of Human Resources Management

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand the role of individuals to assist organization in reaching its goal
2. Apply the techniques for ensuring effective utilization of the work force within the organization
3. Apply techniques for moral boosting and motivation amongst employees
4. Identifying and applying techniques for providing well trained and well qualified work force for the organization
5. Understand the techniques for evaluation of job satisfaction and performance rating of employees

Syllabus

UNIT - I

Introduction to Human Resource management : Introduction, Concept of Human Resource Management, Scope of Human Resource Management, History of Human Resource Management, Function of Human Resource Management, Role of HR Executives Human Resource Planning: Process of Human Resource Planning, Need for Human Resource planning, HR Forecasting Techniques ,Successful Human Resource Planning.

UNIT - II

Recruitment and Selection : Concept on Recruitment, Factors Affecting Recruitment, Sources of Recruitment, Recruitment Policy, Selection, Selection Process, Application Forms, Selection Test, Interviews, Evaluation, Placement, Induction. Training and Management Development: Meaning of Training, Methods of training, Concept of Sensitivity Training, Transactional Analysis, Evaluation of Training and Management Development.

UNIT - III

Merit Rating & Job Evaluation : Concept of job Evaluation & Merit Rating, Objectives, Techniques, Advantages and Limitations. Compensation management: Wage and Salary Administration, Managing Wages, Concept of Rewards and Incentives, Managing Benefits in Organization appraisal methods, 360-degreeappraisal, fringe Benefits.

UNIT - IV

Motivation : Need for motivation, effect of motivation on productivity, Maslow Theory of motivation, Mc-Gregors Theory of motivation. Collective Bargaining System: Introduction, Concept, Traditional and Integrative Bargaining, Boulwarism, The process of collective bargaining

UNIT - V

Employee Misconduct and disciplinary procedure : Meaning and objectives of discipline, principles for maintenance of discipline, basic guidelines of a disciplinary policy, disciplinary action - Penalties, Procedure for disciplinary. Grievance and Grievance Procedure: Concept of grievance causes of grievances, forms and effects of grievance, the grievance handling procedure, need for grievance redressal procedure.

UNIT - VI

Communication and counseling : Nature and importance of communication, communication filters, JOHARI window, the communication process, counseling. Employee welfare and working conditions: Concept of employee welfare, welfare measures, types, employee welfare responsibility, the business benefits of employee welfare activities

Text Books

1. Human Resource and Personnel Management. K Ashwatthappa, Tata Mc-Graw Hill Education 2005 4thEdition

Reference Books

1. Business Administration & Management- By Dr. S. C. Saxena- Sahitya Bhawan Publication.
2. Personnel Management-By Edwin B Filippo-McGraw Hills International Edition.

VII Semester
Department of Industrial Engineering

Course Code : INT454-3 | **Course : Enterprise Resource Planning**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week | **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Gain insight about the functioning of the organization
2. Apply tools and techniques for modeling ERP within the organization

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand and gain insight into process views of organizations and tools and techniques used to model both as-is and to-be models
2. Apply the process modeling techniques in one or more modeling environments
3. Know and be able to apply key technical terminology in enterprise information systems as they apply in different ERP products and development methods
4. Understand key differences between the major ERP applications (Such as SAP R/3, and Oracle / People Soft / Sibel optimizer) and issues specific to these applications their configuration and management.
5. Analyze a current architecture and perform an effective analysis before an ERP implementation
6. Understand and be able to articulate the life cycle stages of any ERP implementation

Syllabus

Unit - I

ERP : What is an ERP System? Evolution of ERP, MRP, MRP II to ERP, ERP Systems Components System Benefits and Limitations of an ERP System, Enterprise Systems in Organizations, Information Silos and Systems Integration, How are ERP System Different from Legacy/Traditional Systems.

UNIT - II

Functional Area and Business Process : Information Flow in and out of different department like Marketing and Sales, Accounts and finance, Purchase, Supply Chain Management, Human Resources.

UNIT - II

ERP Planning and Implementation : How to plan ERP project, ERP Implementation Life Cycle, difference between ERP Implementation life cycle and SDLC, Planning of ERP Project, New methodologies in ERP Implementation, Fit Gap Analysis. Strategies in ERP Implementation, Steps involved in ERP Implementation Project Management Approach in ERP

UNIT - IV

Popular ERP System (Vendors) : Study of major ERP applications and key differences between them (such as SAP R/3, and Oracle /PeopleSoft/Sibel) and issues specific to these applications their configuration and management.

UNIT - V

ERP System Architecture : Representation of the complex system interfaces among the ERP application and databases, operating systems, legacy applications networking. Functional and System Components of the Enterprise Systems Architecture

UNIT - VI

Operation and Post Implementation : Go Live, Change management, Post implementation Support. Case studies of ERP implementation, Critical Success factors, why ERP Systems fail?

Text Books

1. Enterprise Resource Planning-Jyotindra Zaveri Nirali Prakashan 2013 3rd Edition

Reference Books

1. Enterprise Resource Planning-Alexis Leon, Tata McGraw Hill,20082ndEdition
2. Enterprise Resource Planning: Concepts & Practice- Vinodkumar Garg, M. K. Venkitakrishnan, Prentice Hall 2008 2nd Edition

VII Semester
Department of Industrial Engineering

Course Code : INT454-4 | **Course : Advanced Instrumentation and Measurement Techniques**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week | **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Understand the modern instrumentation and measurement techniques
2. Select and apply the instruments in various industrial sectors for monitoring and control

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Apply the instrument for the diverse methods of measurement
2. Identify and usage of instrument for the power plant and environmental research
3. Understand the concept of IoT based intelligent instrumentation and usage for industrial research
4. Learn instruments and techniques for aerospace and navigation system

Syllabus

Unit - I

Introduction to Instrumentation : Functional elements of an instrumentation system. Characteristics of instruments. Data acquisition systems. Sensors and transducers. Different methods for measurement: Measurement of speed, vibration, force, and humidity. Measurement of straightness, flatness, and roughness. Non-Destructive Testing. Typical case study: Instrumentation system applied for the measurement in Industrial environment.

Unit - II

Power Plant Instrumentation : Overall plant working, instrumentation in fuel handling, feed water management, drum level control, main steam temperature control, ash handling. Radiation detection with various types of instruments, salient features of instrumentation in nuclear power plants, safety and measures. Piping components and mechanical equipment for thermal plant. Instrument for Environmental Research: Air pollution sources, control methods and equipment. Water pollution sources, control methods and equipment. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement, monitoring and control. Typical case study.

Unit - III

Intelligent Sensor Systems : Intelligent pressure, flow, level, temperature sensors, etc. Intelligent sensor application in process control, biometric sensors, Electron spectroscopy and its applications. SEM with auxiliary equipment. Application of intelligent sensor in biomedical engineering. IoT based

intelligent Instrumentation: Introduction to internet of Things. Sensors for IoT applications. Structure of IoT, IoT Map Device. IoT based Industrial sensors. Description and characteristics of first and advanced generation. Integrated IoT Sensors: Description of Polytronics systems and Sensors' Swarm. IoT generation roadmap. Future scope of intelligent instruments, features and components of intelligent instrumentation system. Block diagram of an intelligent instrumentation system. Typical case study.

Unit - IV

Introduction to Aerospace Instrumentation : Introduction of aviation and space flight. Basic engine instruments, capacitive fuel content, gauges. Standard atmosphere-Altimeters. Aircraft compass, remote indicating magnetic compass. Rate of climb indicator. Air speed indicator. Mach meters. Integrated flight instruments. Introduction to navigation and guidance instrumentation. Typical case study.

Text Books

1. Measurement Systems, Ernest O Doebelin & Dhanesh N Manik, McGraw Hill Education; 6th edition (July 2017)
2. Power Plant Instrumentation, K. Krishnaswamy and M. Ponni Bala, Publisher: PHI, 2nd revised edition
3. M. Bhuyan, Intelligent Instrumentation Principles and Applications, CRC Press 2011
4. Aircraft Systems: Instruments, Communications, Navigation, and Control, Chris Binns, Wiley-Blackwell (28 December 2018)

Reference Book

1. Instrument Engineers Handbook, B. G. Liptak, CRC Press; 4th edition (24 July 2012)
2. Principles of Industrial Instrumentation, D. Patranabis, McGraw Hill Education; 3rd edition (July 2017)
3. Air Pollution Control: Fundamentals and Applications (Fundamentals of Environmental Engineering) Publisher: CRC Press; 1st edition (23 November 2018)
4. Intelligent instruments, Barney, G.C., Hemel Hempsteao: Prentice Hall.
5. Technologies & Sensors for the Internet of Things Businesses & Market Trends, Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier ,Yole Development, 2014

VII Semester
Department of Industrial Engineering

Course Code : INT455-1 **Course : Tool Design**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Understand and apply the design principles for design of cutting tools like single point and multipoint cutting tools and dies
2. Understand and apply the design principles for jigs and fixtures for productivity improvement

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Apply metal cutting theory principles for design of single and multipoint cutting tools
2. Select the material specification for cutting tools
3. Explain the principles of dynamometry and their types.
4. Apply tool design methods for punch and die of various sheet metal operations like
5. Punching, Bending & Drawing and equipment used in it
6. Explain the principles of clamping, jigs and designing fixtures and identify fixtures

Syllabus

Unit - I

Introduction to tool design : Cutting Tool and Machine tool, definition of Tool, Tool materials, Tool wear and machinability, economics of metal machining, types of chips, Requirement of Tool: Tool angles, Importance of each angle tool signature force & velocity relation at chip –tool –work piece interface, Mechanics of metal Cutting: Merchants force Circle diagram, single point cutting tool design

Unit - II

Hole making operations : drilling process. Drills, types of drills, nomenclature of twist drill elements, drill point geometry, chip control in drilling; Design of drill, axial thrust force calculations. Power requirements in drilling, Milling: types of milling cutter, important element s of milling cutter, steps in design of side and face milling cutter.

Unit - III

Dynamometry : basic design principles, types of dynamometers, mechanical, electrical, pneumatic, strain rings and gauges, Jigs and fixtures: types and general design principles.

Unit - IV

Press working : power press types, material handling equipment, introduction to die cutting operations, fundamentals of die cutting operations, press working materials, strip layout. Cutting action in punch and die, clearance, types of die construction, simple, inverted, progressive, compound and combination dies. Punch types, cutting forces in piercing, blanking, types of strippers.

Unit - V

Sheet metal bending : Calculation of blank size, types of bending dies, general design principles, spring back, bend allowance, bending pressure, Forming dies: Types, embossing, coining.

Unit - VI

Drawing Operations, Metal flow during drawing, variables affecting metal flow during drawing, radius on punch and dies, percent reduction and depth of draw, drawing die clearance, design of draw die.

Text Books

1. Tool Design Cyril Donaldson and V.C. Goold Tata McGraw Hill Second Edition

Reference Books

1. Introduction to Jig and Tool design – M H Kempester Butterworth-Heinemann Ltd; 3rd Revised edition edition (1 August 1974)
2. Jigs and Fixtures: Non-Standard Clamping Devices -Hiram Grant McGraw Hill Education Indian Edition 16 July 1971

VII Semester
Department of Industrial Engineering

Course Code : INT455-2 **Course : Flexible Manufacturing Systems**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Gain insights about the implementation of Flexible Manufacturing Systems for Industrial Automation

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand concepts and terminology in Flexible Manufacturing Systems.
2. Perform planning scheduling and control of Flexible Manufacturing System
3. Perform Simulation on Software's use of Group Technology of product classification

Syllabus

UNIT - I : Planning Scheduling and Control of Flexible Manufacturing Systems Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge-based scheduling system

UNIT - II : Computer Control and Software for FMS, Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

UNIT - III : FMS Simulation and Database Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database

Text Books

1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991

Reference Books

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995
3. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, "Toyota Production System: Beyond large-scale Production", Productivity Press (India) Pvt. Ltd. 1992

VII Semester
Department of Industrial Engineering

Course Code : INT455-3 **Course : Internet of Things**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. To get hands-on IoT concepts such as sensing, actuation and communication. It covers the development of Internet of Things (IoT) prototypes—including devices for sensing, actuation, processing, and communication

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand the vision of IoT from a global context.
2. Understand the application of IoT.
3. Determine the Market perspective of IoT.
4. Use of Devices, Gateways and Data Management in IoT.
5. Building state of the art architecture in IoT.
6. Application of IoT in Industrial and Commercial Building Automation and Real-World Design Constraints.

Syllabus

Unit - I

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics

Unit - II

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit - III

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit - IV

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit - V

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data- Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Text Books

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014

Reference Books

1. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, A press Publications, 2013
2. Cuno Pfister, Getting Started with the Internet of Things, O Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

VII Semester
Department of Industrial Engineering

Course Code : INT498-1 **Course : Computer Integrated Manufacturing**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Understand about integration of manufacturing activities with CAD, CAM and CAPP

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.
2. Understand the Computer Applications in Design and Manufacturing [CAD/CAM) leading to Computer integrated systems. Enable them to perform various transformations of entities on display devices.
3. Understand students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.
4. Prepare computer aided process plans, material requirement planning, capacity planning etc.
5. Understand functioning of CNC Machine Tools, CNC part programming, and industrial robots.
6. Understand the concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

Syllabus

Unit - I

CAD and Computer Graphics Software : The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, Computerized Manufacture Planning and Control System, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control.

Unit - II

Flexible Manufacturing Systems : Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture Line Balancing: Line balancing algorithms, methods of line balancing

Unit - III

Additive Manufacturing Systems : Basic principles of additive manufacturing, applications of AM. Recent trends in manufacturing, Hybrid manufacturing Future of Automated Factory: Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.

Text Books

1. Automation, Production Systems and Computer-Integrated Manufacturing, by Mikell P Groover, 4th Edition,2015, Pearson Learning.

Reference Books

1. CAD/CAM Principles and Applications by P N Rao, 3rd Edition, 2015, Tata McGraw-Hill.
2. Principles of Computer Integrated Manufacturing, S.Kant Vajpayee, 1999, Prentice Hall of India, New Delhi.
3. Work Systems And The Methods, Measurement And Management of Work, Groover M. P.,Pearson/Prentice Hall, Upper Saddle River, NJ, 2007.
4. Computer Automation in Manufacturing, Boucher, T. O., Chapman & Hall, London, UK, 1996.
5. Introduction to Robotics: Mechanics And Control, Craig, J. J., 2nd Ed., Addison-Wesley Publishing Company, Readong, MA, 1989.
6. Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition,by Nicolas Windpassinger, Amazon.
7. Internet of Things: A Hands-on Approach, by ArshdeepBahga and Vijay Madisetti (Universities Press)
8. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
9. Understanding Additive Manufacturing, Andreas Gebhardt, Hanser Publishers, 2011
10. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist

VII Semester
Department of Industrial Engineering

Course Code : INT498-2 **Course : Project Planning and Management**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The students should be able to Understand about project initiation, planning, organizational structures, performance evaluation and computerized Techniques of an engineering project

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand basic concept of project management
2. Learn project identification and initiation process
3. Learn the project planning process
4. Learn about project organizational structures
5. Understand project control and performance measurement techniques.
6. Understand application and computerized Techniques of project management in different industry sectors

Syllabus

Unit - I

Basics of Project Management : Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Essentials of Project Management Philosophy, Project Management Principles.

Unit - II

Project Identification and Selection : Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point.

Unit - III

Project Planning : Introduction, Project Planning, Need of Project Planning, Roles, Responsibility and Team Work, Project Planning Process, Requirement Breakdown Structure (RBS) Work Breakdown Structure (WBS).

Unit - IV

Organizational Structure and Organizational Issues : Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management.

Unit - V

Project Performance Measurement and Evaluation : Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects.

Unit - VI

Computerized Techniques for the implementation of the project in making Case Studies in different sectors like construction, power plants, manufacturing industry, chemical, process industry, IT project management.

Text Book

1. Effective Project Management: Robert K. Wysocki, Rudd McGary, Wiley publications.

Reference Books

1. Project Management: A Managerial Approach, Meredith and Mantel, John Wiley and Sons.
2. The New Project Management: J. Davidson Frame, Jossey-Bass.
3. Project Management: Harold Kerzner, Van Nostrand Reinhold.
4. Project Management: S. Chaudhary, Tata McGrawl Hill.
5. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) –Project Management Institute

VII Semester
Department of Industrial Engineering

Course Code : INP457 | **Course : Major Project Seminar**

L: 0Hrs. T: 0Hrs. P: 4Hrs. Per week | **Total Credit : 2**

Course Objectives

The objective of the course is

- To gain experience in practical, effective, efficient and beneficial applications of the knowledge for what the student has been studying different courses so far since first year

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Apply critical thinking in problem solving
2. Demonstrate presentation and communication skills for a particular problem
3. Demonstrate organizational and report writing / documentation skills
4. Applying project management skill
5. Work as an individual while getting support from supervisor for formulating solution to day to day problems by integrating knowledge, and experience gained from the course

VII Semester
Department of Industrial Engineering

Course Code : INP458 | **Course : Industry Internship**

L: 0Hrs. T: 0Hrs. P: 4Hrs. Per week | **Total Credit : 0**

Course Objectives

The objective of the course is

- To enhance students' knowledge in one particular technology which would cultivate student's leadership ability and responsibility to perform or execute the given task by providing hands on practice within a real job situation

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Learn to appreciate work and its function in the economy.
2. Integrate the theory and practical knowledge to give workable solutions.
3. Develop work habits and attitudes necessary for job success.
4. Develop communication, interpersonal and other critical skills in the job interview process.
5. Acquire employment contacts leading directly to a full-time job following graduation from college

VIII Semester
Department of Industrial Engineering

Course Code : INT461-1 **Course : Reliability Engineering**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Understand the important concepts used in system reliability
2. Gain insights about the tools and techniques used for determining system reliability.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand concepts and terminology in reliability.
2. Understand the applications of constant failure model and estimation of system reliability.
3. Perform failure analysis and construct fault tree diagram
4. Understand different maintenance strategies along with recent trends
5. Understand planning and scheduling in maintenance and maintenance effectiveness measurement

Syllabus

UNIT - I

Introduction to reliability, analysis of downtime, concept of availability, random versus deterministic failure phenomena, terms and definitions in reliability, application areas, reliability function, MTTF, Hazard rate function, bath tub curve, conditional reliability.

UNIT - II

Constant Failure Rate (CFR) model- Failure modes with CFR model, two parameter exponential distribution, Poisson process, relevant applications. Reliability of systems – Series configuration, parallel configuration, and combined series parallel, redundancy, K out of N redundancy.

UNIT - III

Design for reliability : Failure analysis, identification of failure mode, determination of cause, assessment of effect, classification of severity, system safety and fault tree analysis.

UNIT - IV

Maintenance concept : Functions, objectives, purpose, system approach to maintenance function maintenance planning and scheduling – Steps in job planning, planning technique, job manual, scheduling, Gantt chart and bar chart, PERT/CPM and CPA network.

UNIT - V

Maintenance strategies : Basis of selecting maintenance strategies, types of maintenance, breakdown or emergency maintenance, preventive, predictive, condition-based maintenance, risk based maintenance, design out maintenance, comparison of maintenance strategies, total maintenance management.

UNIT - VI

Maintenance effectiveness : Overall equipment effectiveness, maintenance effectiveness assessment /survey, Key performance indicators (KPI), maintenance performance measuring indices, maintainability index, Recent trends in maintenance - Reliability centered maintenance, Total productive maintenance.

Text Books

1. Reliability and Maintainability Engineering – Charles E. Ebeling, Tata McGraw Hill Edition.
2. Maintenance Engineering – Er Sushilkumar Srivastava, S Chand Publications 1998.

Reference Books

1. Reliability Engineering- L. S. Srinath affiliated East- west Press Private Limited
2. Reliability Engineering – E. Balagurusamy Tata McGraw Hill Publications

VIII Semester
Department of Industrial Engineering

Course Code : INT461-2 **Course : Industrial Energy Management**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Understand the surging energy demands in industry including its mensuration and management
2. Audit the energy requirements and expenditures of an industry and optimize it for profitability improvement

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand present & future energy scenario, importance of energy conservation & energy efficiency.
2. Analyze various energy conversion processes & their application in energy generation.
3. Establish energy management as a separate function in plant management hierarchy.
4. Conduct energy audit in an organization.
5. Apply the efficient energy management approaches

Syllabus

Unit - I

Introduction, Global Primary Energy Reserves, Indian Energy Scenario, Renewable and Non Renewable Energy, Energy and Environment, Energy Conservation and its Importance, The Energy Conservation Act, 2001 and its Features, Captive power units, demand and supply.

Unit - II

Physical aspects of energy : Classification of energy- Hydel, Thermal, Nuclear, Solar, Wind, Biomass, efficiency and effectiveness of energy utilization in industry. Energy and Energy analysis (Sankey diagram).

Unit - III

Energy Management definition and objective, Energy management skill, strategy Energy action planning: Energy Management as a separate function and its place in plant management hierarchy. Energy Managers responsibilities and duties

Unit - IV

Energy Demand Management : Scope, methodology and modes of Energy Saving, Plant energy and utility system, efficient energy management steps, Financial Management

Unit - V

Energy Audit : Introduction& important of energy audit, uses of energy audit, basic terms of energy audit, types of energy audit, procedure for carrying energy audit, Instrumentation and data analysis, Energy load measurement, system evaluation and simulation, energy saving techniques and guidelines, administrative control, proper measurement and monitoring system.

Unit - VI

Energy efficiency and energy conservation opportunities in different utilities. Fuels and combustion, Boilers, FBC boilers, Steam system, Furnaces, Insulation and Refractory's, Cogeneration, Waste heat recovery

Text Books

1. Wayne C. Turner, Steve Doty, Energy Management Handbook, CRC Press.

Reference Books

1. Thermal Engineering - P. L. Ballaney.
2. A course in Thermal Engineering - Domkundwar.
3. Element of Heat Engines - R.C. Patel & C. J. Karamchandani

VIII Semester
Department of Industrial Engineering

Course Code : INT462-1 **Course : Quality for Services**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. The objective of the course is to understand and apply the tools and techniques for improvement of quality in service sector.

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand the significance of quality in service sector.
2. Analyze and understand various service systems in the service sector.
3. Design and modify a service system with improved quality.
4. Apply various tools and techniques of service quality
5. Understand present & future energy scenario, importance of energy conservation & energy efficiency.

Syllabus

Unit - I : Understanding services, Role of Services in Indian economy, Service Definitions, Sources of service Sector growth.

Unit - II : Nature of Services, Service Classification, Distinctive characteristics of service operations, Methods of service delivery.

Unit - III : New Service development, Service design elements, taxonomy for service process design, Generic approaches to service system design, Technology in Services, Automation in services, Technological innovations in services.

Unit - IV : Service Quality, Defining Service quality, Conceptual models in service quality, The Greenrooms Model Measuring Service Quality, SERVQUAL, QFD in Services, Benchmarking, walk through Audit, Achieving Service Quality, Service process Control, SPC, Application of QC tools in Services, Quality of Service Encounter.

Text Books

1. Service Management, 5th EDITION, James A. Fitzsimmons, Mona J. Fitzsimmons, Tata Mc Graw Hill
2. Juran's Quality planning and analysis for enterprise quality 5th Edition by Frank Gryna, Richard Chua, Joseph Defeo

Reference Books

1. Service marketing, concepts, Applications and Cases, M.K. Rampal, S.L. Gupta

VIII Semester
Department of Industrial Engineering

Course Code : INT462-2 **Course : Additive Manufacturing Techniques**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is

1. Generating a good understanding of Additive Manufacturing, its development and applications.
2. To expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications
2. Gain the knowledge on different types of Rapid Prototyping systems and its applications in various fields
3. Explain direct metal laser sintering, LOM and fusion deposition modeling processes
4. Demonstrate solid ground curing principle and process
5. Discuss LENS, BPM processes; point out the application of RP system in medical field define virtual prototyping and identify simulation components

Syllabus

UNIT - I :

Introduction History : Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP – On demand manufacturing – Direct material deposition – Shape Deposition Manufacturing

UNIT - II

Liquid Based And Solid Based Rapid Prototyping Systems : Classification – Liquid based system – Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling, principle, process, products, advantages, applications and uses – Laminated Object Manufacturing

UNIT - III

Powder Based Rapid Prototyping Systems Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations,

applications and uses. Three-Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development, Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing – Laser Engineered Net Shaping (LENS).

UNIT - IV

Materials For Rapid Prototyping Systems Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder-based materials – case study.

UNIT - V

Reverse engineering and new technologies Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing – types of medical imaging, software for making medical models, medical materials, other applications – Case study.

Text Books

1. Rapid Prototyping-Principles and Applications- C K Chua, K F Leong and C S Lim (NTU, Singapore)-World Scientific
2. Paul F. Jacobs: "Stereo 1ithography and other RP & M Technologies"-SME NY, 1996.

Reference Books

1. Flham D.T & Dinjoy S.S " Rapid Manufacturing"- Verlog London 2001

VIII Semester
Department of Industrial Engineering

Course Code : INT462-3 **Course : Data Visualization Tools**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Understand fundamental concepts of data visualization; information visualization types; design principles of data visualization; tools for static data visualization; tree and network visualizations; big data visualizations

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Present data with visual representations for your target audience, task, and data;
2. Create multiple versions of digital visualizations using various software packages;
3. Identify appropriate data visualization techniques given particular requirements imposed by the data;
4. Apply appropriate design principles in the creation of presentations and visualizations.

Syllabus

Unit - I : Introduction to data visualization Data for data graphics Tableau introduction, Design principles Categorical, time series, and statistical data graphics Data Types Dataset Types Attribute Types Semantics

Unit - II : Storytelling Multivariate displays Geospatial displays Dashboards, interactive and animated displays Why Validate? Four Levels of Design Angles of Attack Threats and Validation Approaches Validation Examples

Unit - III : Tableau : Bar chart ,Geographic map ,Crosstab report ,Scatter plot ,Line chart The Tableau product line Workbook windows , Visual cues

Unit - IV : Live connection, Extract data, Combine data sources, Join tables, Blend data sources, Cross-database join, filtering and sorting data, discretize and continuous data, fiscal dates

UNIT - V : Geographic maps, filled maps, mapping options, difference between heat map and highlight map, Histograms, dashboards and actions, tableau data source, tableau data extract, tableau workbook

Text books

1. "The visual display of quantitative information:- Edward Tufte Second Edition 2nd Edition Graphical Press

Reference Books

1. A practical Introduction- Kierean- Healy-Princeton University Press, 2nd Edition.

VIII Semester
Department of Industrial Engineering

Course Code : INT462-4 **Course : Behavioral Science**

L: 3Hrs. T: 0Hrs. P: 0Hrs. Per week **Total Credit : 3**

Course Objectives

The objective of the course is to

1. Make students understand about human behavior in an organization

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Understand the various work and organizational models
2. Understand Personality, Perception and its importance for organizations
3. Conceptualize the components of individual and group behavior
4. Understand the Leadership concepts
5. Understand the Learning and Motivational theories
6. Understand organizational culture

Syllabus

Unit - I

Introduction To Organizational Behavior : Psychology - Foundation Of Individual Behavior - Definition Need And Importance Of Organizational Behavior - Nature And Scope - Framework Of Organizational Behavior Models, theoretical perspectives

Unit - II

Personality - Types - Factors Affecting Personality Theories - Perception - Importance - Factors Influencing Perception - Interpersonal Perception Types,

Unit - III

Group Dynamics - Group Behavior - Formation - Types Of Groups - Influence - Emergence Of Informal Leaders And Working Norms - Group Decision Making - Interpersonal Relations - Communication - Control

Unit - IV

Leadership - Meaning - Importance Trait, Behavioral And Contingency Theories- Evolution Of Leaders - Leadership Styles - Leaders Vs Managers; Power And Politics - Sources Of Power - Power Centers - Trait And Behavioral Analysis (T.A) Work Stress.

Unit - V

Learning Types Of Learning Styles - The Learning Process - Learning Theories - Ob Modification; Motivation - Theories - Importance - Types - Motivation At Work - Designing Motivating Jobs.

Unit - VI

Organizational Change. Organizational Development - Characteristics - Objectives - Team Building Organizational Effectiveness - Perspectives - Approaches- Organizational Conflict- Causes, Types, Management Of Conflict - Cases.

Text Books

1. Aswathapa, Organizational Behavior, PHI Publications.

Reference Books

1. Stephen Robbins, Organizational Behavior, Prentice Hall Of India, 9th Edition, 2001.
2. Fred Luthans, Organizational Behavior, Mcgraw Hill Book Co, 1998.

VIII Semester
Department of Industrial Engineering

Course Code : INP463 | **Course : Project / Internship**

L: 0Hrs. T: 0Hrs. P: 12Hrs. Per week | **Total Credit : 6**

Course Objectives

The objective of the course is

- To enhance students' knowledge in one particular technology which would cultivate student's leadership ability and responsibility to perform or execute the given task by providing hands on practice within a real job situation

Course Outcomes

At the end of this course the student will demonstrate ability to

1. Demonstrate sound technical knowledge of the selected project topic
2. Undertake problem identification, formulation and solution
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Communicate with engineers and the community at large in written and oral form
5. Demonstrate the knowledge, skills and attitudes of a professional engineer

Honors Program
Syllabus for IV Semester BE

Course Code : INTH41 **Course : Industry 4.0**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students shall be able to

1. Understand about the evolution, future needs and scope of Industry 4.0

Course Outcome

The students should be able to

1. Understand the drivers and enablers of Industry4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Outline the various systems used in a manufacturing plant and the role in an Industry 4.0 world
4. Appreciate the power of Cloud Computing in a networked economy
5. Understand the opportunities, challenges brought about by Industry4.0 and how organizations and individuals should prepare to reap the benefits

Syllabus

Unit I : History Industrialization and Industrial revolutions, Industry1.0, Industry2.0, Industry3.0, Integration of modern technologies with industrial processes. Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory

Unit II : Cyber Physical Systems Introduction, Sensing and Actuation, Communication and Networking, Next Generation Sensors and Collaborative Platform, Introduction to Arduino Raspberry Pi and other IOT development boards, Product Life Cycle Management,

Unit III : Internet Of Things Introduction of Iota, Industrial Iota, Business model with IIoT, APPLICATIONS OF IOT like Digital Manufacturing, Smart Factories, Smart cities, Smart Housing, Smart products and smart services, Smart Logistics, Robotic Automation and Collaborative Robots, Augmented Reality and Virtual Reality.

Unit IV : Data Analytics Introduction, Big Data Analytics and Software Defined Network, Machine Learning and Data Science, Programming for data analytics, Data Center Networks. Inventory management and Quality control.

Unit V : Cloud Computing Introduction, the role of cloud computing in IoT, Fog computing and Cloud computing, Cyber-security, Security in IIoT systems.

Unit VI : Current Scenario Industrial engineering in Industry4.0 paradigm, Industry4.0 Drivers and Industrial Engineer, Shift and change in the responsibilities of IE in smart/connected factories. Case studies on simulation and virtual plant modeling with real time inputs.

Text Books

1. Industry 4.0 : Managing the Digital Transformation: Alp Ustundag, Emre Cevikcan Springer

Reference Book

1. The fourth Industrial Revolution:-Kalus Schwab: Penguin paper back

Honors Program
Syllabus for V Semester BE

Course Code : INTH51 **Course : Soft Computing Methods**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objectives

The students shall be able to

1. Apply the different evolutionary computing techniques to the real time engineering problems and calculations.

Course Outcomes

After completing this course, students will be able to learn:

2. Artificial neural networks and its applications.
3. Fuzzy logic and its applications.
4. Solving optimization problems using GAs and Hybrid algorithms.
5. Applications of Soft computing to solve problems in varieties of application domains.

Syllabus

Unit I : Introduction to Soft Computing Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing; Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.

Unit II : Fundamentals of Neural Networks & Feed Forward Networks Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network: The Perceptron Model, Multilayer Feed Forward Neural Network: Architecture of a Back-Propagation Network (BPN), The Solution, Back propagation Learning, Selection of various Parameters in BPN. Application of Back Propagation Networks in Pattern Recognition & Image Processing

Unit III : Fuzzy logic & Systems Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences; Defuzzification techniques; Fuzzy logic controller design; Some applications of Fuzzy logic.

Unit IV : Genetic Algorithms &Hybrid Systems Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques; Basic GA framework and different GA architectures; GA operators: Encoding, Crossover, Selection, Mutation, etc; Solving single-objective optimization problems using GAs; Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems,Neuro-Genetic Hybrid Systems, Fuzzy- Genetic Hybrid System.

Text Books

1. Introduction to Artificial Neural Systems–J.M.Zurada,JaicoPublishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications–S. Rajasekaran, G.A. Vijayalakshmi Pai,July2011,PHI,NewDelhi.
3. Genetic Algorithms by David E. GoldBerg, Pearson Education India,2006.
4. Neural Networks & Fuzzy Systems- Kosko.B., PHI, Delhi,1994.

Reference Books

1. Artificial Neural Networks–Dr.B.Yagananarayana,1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms–Mitchell Melanie, MIT Press,1998
3. Fuzzy Sets, Uncertainty and Information-Klir G.J.&Folger.T.A.,PHI,Delhi,1993.

Honors Program
Syllabus for VI Semester BE

Course Code : INTH61 **Course : Taguchi Methods for Experimentation**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objectives

The students shall be able to

1. Apply the Taguchi method for design, planning for experimentation.

Course Outcome:-

After completing this course, students will be able to learn:

2. Application of Taguchi methods for experimentation
3. Design of experiments
4. Determining significant variables
5. Determining loss function

Syllabus

Unit I : Introduction to Taguchi's Approach Quality Through Product and Process Optimization, Design of Experiments—The Conventional Approach and The Taguchi Approach, Taguchi Philosophy, Concept of The Loss Function Experiment Design Strategy, Analysis of Results, Areas of Application, Measurement of Quality by Taguchi's Strategy,Taguchi Quality Strategy, Selecting Design, Parameters for Reduced Variation, Common Terminology of Taguchi methods

Unit II : Working Mechanics of the Taguchi Design of Experiments Formulas for Experiment Layout, Basic Methodology, Designing the Experiment, Designing with More Than Three Variables, Designs with Interaction, Designs with Mixed Factor Levels ,Dummy Treatment (Column Degrading), Combination Design, Designing Experiments to Reduce Variability, Robust Design Strategy, S/N Ratio—A Smarter Way to Analyze Multiple Sample Results, Two-Step Optimizations, Robust Designs Against Multiple Noises, Design and Analysis Summary

Unit III : Analysis of Variance (ANOVA) The Role of ANOVA, ANOVA Terms, Notations, And Development, One-Way ANOVA, One Factor Two- Level Experiments (One-Way ANOVA), Two-Way ANOVA, Experiments with Replications, Standard Analysis with Single and Multiple Runs, Application of S/N Ratio

Unit IV : Taguchi's Loss function& Application Derivation of Loss Function, Average Loss Function for Product Population, Application of Loss Function Concepts, Approach for Performance Improvement, Brainstorming—An Integral Part of the Taguchi Philosophy, Taguchi Case Studies.

Text Books

1. "A Primer on The Taguchi Method" by Ranjit K. Roy, Copyright © 2010 Society of Manufacturing Engineers, Michigan, Second edition,ISBN13:978-0-87263-864-8
2. "Applied Design of Experiments and Taguchi Methods", by K. Krishnaiah and P. Shahabudeen, PHI Learning Private Limited, New Delhi.

Reference Books

1. Taguchi's Quality Engineering Handbook-Genichi Taguchi, Subir Chowdhury,Yuin Wu, ISBN:978- 0-471-41334-9

Honors Program
Syllabus for VII Semester BE

Course Code : INTH71 **Course : Supply Chain Optimization**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objectives

The students shall be able to

1. Learn about optimization the supply chain systems for gaining maximum performance.

Course Outcomes

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

1. Understand about the problems and issues within the field of logistics
2. Learn about the critical elements of logistics and Supply Chain Management processes.
3. Gain sufficient knowledge about technical competencies and managerial competencies.
4. Understand about relations of the logistics and supply chain systems to its environment to give knowledge of the management and the operations.
5. Apply advanced qualitative models and methods in logistics and supply chain management and its practical aspects and the latest developments in the field.

Unit - I : Introduction to Logistics and Supply Chain Management, Inventory Management, Inventory aggregation Models, Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and Limit.

Unit - II : Transportation Network Models, Notion of Graphs, Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Multistage Transshipment and Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Algorithms, Advanced Vehicle Routing Problem Heuristics, Scheduling Algorithms-Deficit function Approach and Linking Algorithms.

Unit - III : Inventory Management : Inventory aggregation Models, Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT.

Unit - IV : Risk Analysis in Supply Chain, Measuring transit risk, supply risks, delivering risks, Risk Pooling strategies.

Unit - V : Warehousing Decisions and Facilities Location in a Supply Chain Network.

Unit - VI : Demand Management and Forecasting in a Supply Chain.

Text Book

1. Simulation of Supply Chain Optimization : Caroline Thierry Wiley.

Reference Book

1. Supply Chain Optimization : Joseph Genues, Panos. M. Pardos Springer.

Honors Program
Syllabus for VIII Semester BE

Course Code : INTH81-1 **Course : Business Analytics**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objectives

The students shall be able to

1. Learn about analytical tools for data management in running and enterprise.

Course Outcome

The students at the end of this course will be able to

1. Understand data categorization, data pre-processing, variables
2. Carry out data analysis / Statistical analysis using R.
3. Carry out data analytics with R commands.
4. Effectively visualize the data
5. Understand and practice Machine learning approaches and Artificial Intelligence and its application in data analytics.

Syllabus

Unit - I

Data Definitions, variables and overview of Big data Elements, Variables and Data categorization, Levels of Measurement, Big data overview, data pre-processing, concepts of supervised and unsupervised learning, Introduction to statistical learning and R-Programming.

Unit - II

R for Data Analytics - 1 Introduction to Basics, the basic data types in R and variables, Input and Output Vectors, Analyzed using vectors. Create, name and select elements from vectors. Matrices: work with matrices in R. basic computations of Matrices using R, Factors: categorical data in factors. Create, subset and compare categorical data. R for Data Analytics - 2.

Unit - III

Data Frames: usage of Data frames, create and order Data frames Lists: use of list to store components of different types. Basic Graphics: R's packages graphics and data visualizations. Descriptive Statistics using R: Basic statistics: mean, median, standard deviation, variance, correlation and covariance, Measures of central tendency, Measures of location of dispersions, Practice and analysis with R.

Unit - IV

Data Analysis Techniques and Tools Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Regression analysis, Classification techniques, clustering, Introduction to data analytics tools like TABLEAU, POWERBI, RAPIDMINER, WEKA etc.

Unit - V

Machine Learning & AI Basics of Machine Learning & AI, Introduction to Machine Learning with respect to Linear Regression Logistics regression and neural networks, Brief review of AI history, artificial Intelligence and its applications in data sciences.

Text Books

1. Data Anlytics : Anil Maheswari; MC Graw Hill Publication
2. Data Science and Analytics : V. K. Jain : Khanna Publication

Reference Book

1. Data Mining and Analytics : Daniel T. Larose, Chantal. T. Larose Wiely Eastern.

Honors Program
Syllabus for VIII Semester BE

Course Code : INTH81-2 **Course : Strategic Information Management Systems**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objectives

The students shall be able to

1. Develop robust management information systems for support of organizational excellence.

Course Outcome

The students at the end of this course will be able to

1. Realize the importance of having a Management Information System as a strategic tool a given business enterprise.
2. Leverage the IT infrastructure as a growth carrier for given business model.
3. Develop a Collaborative Commerce and Customer Relationship Management for sustainable competitive advantage.
4. Evolve an effective decision support system (DSS) to guide the decision making and forecast the effect of those decisions.

Syllabus

Unit - I

Introduction to Management Information System for strategic advantage, Contemporary Approaches to Information Systems, Role of Information Systems in Organization.

Unit - II

Different Types of Systems, Relationship of System to one another, Systems from a functional Perspective, Enterprise Systems, Supply Chain Management and Collaborative Commerce, Customer Relationship Management for sustainable competitive advantage. Decision Making in Information Systems, Business-Level Strategy and the Value Chain Model.

Unit - III

Customer Centered Retailing, Business-to-Business Electronic Commerce, Intranet Support Electronic Business, Management Challenges and Opportunities, Ethical and Social Issues.

Unit - IV

Managing Hardware and Software Assets, Database Approach to Data Management, Database Trends, Telecommunication and Networks, Internet.

Unit - V

Organizational Learning and Knowledge Management, Knowledge Work System, Artificial Intelligence, Decision-Support System (DSS), Group Decision-Support System (GDSS), Executive Support in the Enterprise (ES).

Unit - VI

Building Information System : Linking Information Systems to the Business Plan, Systems Development, Establishing Organizational Information Requirement, Business Process Re - engineering and Process Improvement, Change Management ERP. Introduction, ERP Legacy, ERP's element and sub elements, Need of having ERP, ERP Implementation, ERP Vendors.

Text Books

1. Management Information System - Lucey T., Honts, 1987

Reference Books

1. Information Systems for Modern Management - New Delhi, Prentice - Hall India, 1983.

Minor Program
Syllabus for IV Semester BE

Course Code : INTM41 **Course : Methods Engineering**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Understand and apply various recording techniques to the given process or activity of Methods Study.

Course Outcomes

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

1. Carry out systematic investigation of existing way of doing work to effect improvement
2. Select appropriate recording technique for a given activity
3. Design and develop the workplace layout using principles of motion economy and fundamental hand motions
4. Establish standard time for a specific activity using time study

Syllabus

UNIT I : Work Study, Definition and objectives, Basic Procedures, human factor in the application of work study, history of motion and time study, Taylors use of time study and motion study, general problem solving procedure. Method Study Introduction, Definitions and objectives, basic procedure of method study.

UNIT II : Recording Techniques, Recording Techniques, process Charts symbols, outlines process chart, flow process charts, multiple activity chart, two hand process chart, SIMO chart, travel chart, Flow diagram, string diagram. Critical evaluation Phase, Develop, Define and Install Step

UNIT III : Micro motion Study Introduction, micro motion study equipments, making motion pictures, Film analysis, the use of fundamental hand motions, principles of motion economy.

UNIT IV : Work Measurement-Time Study Objective of work measurement, work measurement techniques, time study, time study equipment, Principles steps in conducting time study. Selecting the Job for time study, choosing the operator, breaking the job into elements, determination of sample size UNIT VR a t i n g & Allowances Concept of performance rating, definition, the concept of normal performance, characteristics of sound rating system, Factors affecting the rate of working, Allowances: Types of allowances, standard time estimation

Text Books

1. International Labour organization, "Introduction to work-study", Universal Publishing Company. ISBN 81-850270

Reference Book

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education, 2000.
3. Maynard H. B., "Industrial Engineering Handbook", 3rd edition, McGraw Hill Book Company. ISBN 0-07-041084-4.

Minor Program
Syllabus for V Semester BE

Course Code : INTM51-1 **Course : Materials Management**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Learn about various material management techniques and develop strategies for inventory control for management of materials

Course Outcome

Students shall be able to

1. Describe the concept, functions, objectives and importance of material management function in an organization.
2. Describe the purchasing, store management aspects.
3. Define inventory management in industries.
4. Describe vendor management and supplier selection methods.
5. Apply materials management concepts in different industries

Unit I : Introduction to Materials Management Objectives, scope and functions of Materials Management, Cost involved, integrated materials management approach, Linkages of materials management department, role of material management techniques in material productivity improvement.

Unit II : Materials planning and Purchasing Objectives, Functions, material requirement planning (MRP-I), manufacturing resource planning(MRP-II),Centralized and Decentralized purchasing, make or buy decision, purchase policy and procedures, Negotiation in purchasing, Purchasing of Capital equipment.

Unit III : Store Management Objectives of storekeeping, Functions of storekeeper, store location, layout of stores, Codification, return and issue of material, indent on stores, Material management using KANBAN, stores accounting.

Unit IV : Inventory Models Deterministic models, Inventory models for shortages, inventory models with price breaks, multi-item Deterministic models, Stochastic inventory models, Selective inventory control models.

Unit V : Vendor development and evaluation Supplier selection, Application of multi-criteria decision making (MCDM) techniques in supplier selection like Analytic hierarchy process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) etc

Unit VI : Industrial Application Lean materials management, Various industrial application of materials management, softwares used for materials management, challenges of materials management.

Text Books

1. Production Planning & Control Management: R.K. Garg&V.Sharma.
2. Material Management & Material Handling: S.C. Sharma.
3. Material Management: Menon , Wheeler Publishing

Reference Books:

1. Hand Book of Materials Management - P. Gopalkrishnan, Prentice Hall
2. Materials Management: An Executives Supply chain Guide - Stan C. McDonald, Wiley
3. Materials Management: Procedures, texts & Cases - A. K. Datta, Prentice Hall

Syllabus for V Semester BE

Course Code : INTM51-1 **Course : Materials Management**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Learn about production planning strategies for effective monitoring of the shop floor

Course Outcome

Students shall be able to

1. understand the various important features and functions of PPC
2. understand demand forecasting and its models
3. understand capacity planning and develop different aggregate plans
4. understand material requirement planning and inventory control models
5. understand scheduling and sequencing in production Syllabus:

UNIT I : Production Planning : Introduction, Production Planning and Production Control, Functions and Objectives of PPC, Production procedure, Information requirement of PPC, Manufacturing Methods and PPC, Product Life Cycle, Product design.

UNIT II : Demand Forecasting: Forecasting and Prediction, Long-term and short-term forecasting, Time series analysis, least square method, exponential smoothing method, Moving Average forecasting.

UNIT III : Capacity And Process Planning : Introduction, Measurement and measures of capacity, factors influencing effective capacity, factors favoring over capacity and under capacity, aggregate planning, linear programming approach to aggregate planning, Master Production Schedule, Process Planning – Machine, Manpower Planning, line balancing.

UNIT IV : Inventory Control : Introduction, Types of inventories, reasons for keeping inventories, inventory control, benefits of inventory control, cost associated with inventory, inventory cost relationships, safety stock, inventory models, deterministic models.

UNIT V: MRP: Inventory control system. Introduction, Objectives of MRP, MRP-I System, MRP-II system, Lot sizing consideration,

UNIT VI : Production Control: Introduction, loading, sequencing, priority sequencing, scheduling, dispatching, and progressing.

Text Books

1. Martand Telsang, "Industrial Engineering and Production Management", S. Chand, New Delhi (2009)

Reference Books

1. Buffa, "Modern Production operations Management", Wiley Eastern, New York (1999)
2. Panneer Selvan R, "Production and Operations Management", Prentice Hall India, New Delhi (2002)

Minor Program
Syllabus for VI Semester BE

Course Code : INTM61 **Course : Operations Research**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Learn and apply the different OR techniques for solving different problem and arriving at optimal solution for given constraints

Course Outcome

The expected learning outcome is that the students will be able to:

2. Convert given situation to mathematical form and determine optimal settings.
3. Use sequential optimization approach to find optimal setting in many real life situations.
4. Manage projects for minimum total cost and smooth level of resources.
5. Make decisions related to age of replacement of equipments
6. Develop simulation of real life system to analyze and optimize system concerned.

Syllabus

Unit – I : Introduction to OR & Basic OR Models, Definition Characteristics and limitations of OR linear programming solutions of LPP by graphical methods and simplex method. Sensitivity analysis & formulation of Dual of LPP

Unit – II : Assignment Model, Travelling Salesman Problem by branch and bound method, Transshipment model, Transportation Model

Unit – III : Dynamic programming structure and characteristics of Dynamic programming application of Dynamic programming to resource allocation

Unit – IV : Project Management: Drawing of Network, CPM & PERT, probability of completion of project, cost analysis, Allocation and updating of Networks.

Unit – V : Replacement Models: Concept of equivalence, Interest Rate, Present worth, economic evaluations of Alternatives, Group replacement models.

Unit – VI : Inventory control models, Simulation, concepts and its application in inventory control, and in waiting line situations (queuing situations) and other applications.

Text Books

1. Operation Research, Hamdy Taha, Prentice Hall
2. Operation Research Liberman, McGraw Hill Publications
3. Operation Research by S D Sharma, Kedarnath Ramnath & Co.
4. Operation Research by V K Kapoor, S.Chand Publications

Reference Book

1. Operations Research: Models and Methods by Paul A. Jensen and Jonathan F. Bard, John Wiley and Sons.

Minor Program
Syllabus for VII Semester BE

Course Code : INTM71 **Course : Quality Engineering and Management**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Learn and apply the different statistical techniques for quality of process and monitoring.

Course Outcome

Students shall be able to

1. Understand and identify different parameters related to product and service quality.
2. Make use of quality control tools for process improvement.
3. Make use of different techniques for product quality improvement.
4. Develop skills for applying quality strategy in companies.

Syllabus

Unit - I : Introduction to Quality Management - Evolution of Quality Management, Strategic Quality management, Concepts of Product and Service Quality, Cost of Quality, Quality circles.

Unit - II : Process Quality improvement, Introduction to Process Quality, Graphical and statistical techniques for Process Quality, Improvement Graphical tools for data representation, 7 QC tools.

Unit - III : Sampling, The need for Sampling, Types, sampling distributions, Control charts, types, Control charts for variables and attributes, Process capability.

Unit - IV : Total Quality Management, Lean and JIT Quality Philosophy, Kaizen, Total Productive maintenance, ISO 9001.

Unit - V : Product Quality Improvement, Quality function Deployment, Concept, Applications of QED, Quality Standards and Business Excellence models, Software Quality Management. Six sigma.

Unit - VI : Service Quality Management, Software Quality Management, Quality Strategy for Indian Companies.

Text Books

1. Quality Management, Kanishka Bedi, Oxford Publications.
2. Quality Management, K Shridhara Bhat, Himalaya Publications House.

Reference Book

1. Quality planning analysis - Juran, Tata McGraw Hill.

Minor Program
Syllabus for VIII Semester BE

Course Code : INTM81 **Course : Project Management and Engineering**

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week **Total Credit : 4**

Course Objective

The students will be able to

1. Learn and apply the project management techniques for monitoring and control of large project.

Course Outcome

Students shall be able to

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

1. Make a proper project charter.
2. Plan and schedule a project activity.
3. Demonstrate the ability to understand and use human resources and contracts project team.
4. Evaluate the project performance.
5. Ability to prepare the project audit report.

Introduction and concepts of project management life cycle, Establishing project scope time cost and Performance goals, organizing human resources and contracting, organizing systems and procedures for project implementation, project direction, coordination, control and evaluation. Benefits of project evaluation, limitations of project evaluation, limitations and methods of project evaluation, Project Management Performance, Management Information System, Project Management Tools.

Text Books

1. Project Management : David Cleveland, Lewis Ireland, Tata McGraw-Hill.

Reference Books

1. Project Management : S. Chaudhary Tata McGraw Hill.
2. Guide to Project Management : Harold Kenzer Tata McGraw Hill.
3. Project Management : Jack Gido, James Cleaments : Cengage Learning.

NOTES

NOTES