ACADEMIC CURRICULA 2018 - 2022

BACHELOR'S DEGREE PROGRAMME

B. Tech in

Mechatronics Engineering

Curricula & Syllabi

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

ACADEMIC CURRICULA
2018 - 2022

B. TECH
MECHATRONICS ENGINEERING

Course Structure and Detailed Syllabi
for students admitted in
2018 - 22
Academic Session

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

B. TECH IN MECHATRONICS ENGINEERING

Programme Educational Objectives (PEOs):

The B. Tech programme in Mechatronics Engineering aims to prepare the graduates with the following objectives:

1. Graduates shall be able to provide solutions to mechatronics engineering problems involving design, manufacturing, and operational management issues.
2. Graduates shall be able to perceive the limitation and impact of engineering solutions in social, legal, environmental, economical, and multidisciplinary contexts.
3. Graduates shall demonstrate professional responsibility and thrive to reinforce their knowledge being a part of formal or informal education programmes.

Programme Outcomes (POs):

The programme outcomes are:

a) Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) Design/Development of solutions: Ability to 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.
d) Conduct investigations on complex problems: Ability to 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.
e) Modern tool usage: Ability to 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.
f) The engineer and society: Ability to 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.
g) Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h) Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j) Communication: Ability to 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.
k) Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) Life-long learning: Ability to 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 (PSOs):

The programme specific outcomes are:

m) Join a technical workforce as successful professionals in a wide range of mechatronics engineering and related domains.
n) Pursue advanced degrees in engineering, business, or other professional fields.
o) Continuously advance themselves by expanding their technical and professional skills through formal means as well as through informal self-study.

Abbreviations used in describing the category in all the courses are as follows:

BSC:	Basic Science Course
BSLC:	Basic Science Laboratory Course
ESC:	Engineering Science Course
ESLC:	Engineering Science Laboratory Course
HSMC:	Humanities, Social Science & Management Course
PCC:	Professional Core Course
PCLC:	Professional Core Laboratory Course
PEC:	Professional Elective Course
OEC:	Open Elective Course
PROJ:	Project
IEC:	Industry Elective Course

COURSE STRUCTURE FOR B. TECH IN MECHATRONICS ENGINEERING

SCHEME-I
SEMESTER - I

Theory							
Sl. No	Course	Course Title	L	T	P	Total	Credit:
1.	MA 1003	Mathematics – I	3	1	0	4	4
2.	PH 1007	Physics	3	1	0	4	4
3.	EE 1003	Basic Electrical Engineering	3	0	0	3	3
4.	ME 1003	Engineering Mechanics	3	0	0	3	3
Total of Theory						14	14
Practical							
1.	PH 1097	Physics Lab	0	0	3	3	1.5
2.	EE 1093	Basic Electrical Engineering Lab	0	0	2	2	1
Sessional							
1.	ME 1083	Basic Manufacturing Systems	0	1	2	3	2
2.	CH 1081	Environmental Science	0	0	2	2	1
Total of Practical & Sessional						10	5.5
Semester Total						24	19.5

SCHEME-I
SEMESTER - II

Theory							
Sl. No	Course	Course Title	L	T	P	Total	Credit:
1.	MA 1004	Mathematics – II	3	1	0	4	4
2.	CH 1007	Chemistry	3	0	0	3	3
3.	HS 1005	Professional Communication	2	0	0	2	2
4.	LS 1001	Biology	2	0	0	2	2
Total of Theory						11	11
Practical							
1.	CS 1093	Computer Programming	0	2	4	6	4
2.	CH 1097	Chemistry Lab	0	0	3	3	1.5
Sessional							
1.	HS 1085	Language Lab	0	0	2	2	1
2.	CE 1083	Engg. Graphics	0	1	2	3	2
Total of Practical & Sessional						14	8.5
Semester Total						25	19.5
	EAA- 1	Extra Academic Activity					P/NP

SEMESTER- III

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1	MA 2005	Mathematics-III (Civil & Mechanical)	3	1	0	4	4
2	ME 2023	Thermofluids	3	1	0	4	4
3	ME 2013	Kinematics and Dynamics of Machines	3	1	0	4	4
4	EC 2025	Principles of Electronics Engineering	3	0	0	3	3
5	EE 2011	DC, AC and Special Electrical Machines	3	1	0	4	4
Total of Theory						19	19
Practical							
1	ME 2099	Fluid Mechanics Lab	0	0	2	2	1
2	EE 2095	DC, AC and Special Machines Lab	0	0	2	2	1
3	ME 2093	Machine Kinematics and Dynamics Lab	0	0	2	2	1
Sessional							
1	ME 2083	Machine Drawing and Computer Aided Design	0	0	2	2	1
Total of Practical & Sessional						8	4
Semester Total						27	23

SEMESTER- IV

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1	EI 2008	Introduction to Instrumentation Engineering	3	0	0	3	3
2	ME 2027	Materials Science and Engineering	3	0	0	3	3
3	MH 2002	Principles of Machine Tools	3	0	0	3	3
4	EC 2011	Digital Electronics	3	0	0	3	3
5	ME 2020	Solid Mechanics and Machine Design	3	1	0	4	4
6		HS Elective-I	3	0	0	3	3
Total of Theory						19	19
Practical							
1	EC 2096	Digital and Linear IC Lab	0	0	2	2	1
2	EI 2096	Measurement Lab	0	0	2	2	1
Sessional							
1	ME 2085	Manufacturing Practices	0	1	2	3	2
2	HS 2081	Business Communication	0	0	2	2	1
Total of Practical & Sessional						9	5
Semester Total						28	24

SEMESTER- V

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1	EC 2020	Microprocessors, Microcontrollers and Interfacing	3	1	0	4	4
2	EE 2028	Linear Control System	3	0	0	3	3
3	EI 3007	Sensors and Actuators	3	1	0	4	4
4	EE 3011	Power Electronics and Drives	3	1	0	4	4
5		Department Elective-I	3	0	0	3	3
6		Department Elective-II	3	0	0	3	3
Total of Theory						21	21
Practical							
1	EC 2090	Microprocessor and Microcontroller Lab	0	0	2	2	1
2	EE 3097	Power Electronics and Drives Lab	0	0	2	2	1
3	EI 3097	Sensors and Actuators Lab	0	0	2	2	1
Sessional							
1	ME 3081	Machine Design	0	0	2	2	1
Total of Practical & Sessional						8	4
Semester Total						29	25

SEMESTER VI

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1	MH 3008	Design of Mechatronic systems	3	0	0	3	3
2	MH 3010	Industrial Automation and Robotics	3	1	0	4	4
3		Department Elective-III	3	0	0	3	3
4		Department Elective-IV	3	0	0	3	3
5		Department Elective-V	3	0	0	3	3
6		Open Elective -I / (MI-1)	3	0	0	3	3
Total of Theory						19	19
Practical							
1	MH 3096	PLC and Motion Control Lab	0	0	2	2	1
2	MH 3092	CIM and Robotics Lab	0	0	2	2	1
3	MH 3094	Mechatronics Lab	0	0	2	2	1
Sessional							
1	MH 3082	Minor Project	0	0	4	4	2
Total of Practical & Sessional						10	5
Semester Total						29	24

SEMESTER- VII

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1	HS 4001	Professional Practice, Law & Ethics	2	0	0	2	2
2		Open Elective-II / (MI-2)	3	0	0	3	3
3		(MI-3)	(3)	(0)	(0)	(3)	(3)
(4)		(MI-4)	(3)	(0)	(0)	(3)	(3)
(5)		(HO-1)	(3)	(0)	(0)	(3)	(3)
Total of Theory						05	05
Sessional							
1	MH 4081	Project-I/Internship					3
2	MH 4083	Practical Training	-	-	-	-	2
(3)		(Project – Minor / Lab)	(0)	(0)	(4)	(4)	(2)
Semester Total							10

SEMESTER- VIII

Sl. No	Course	Course Title	L	T	P	Total	Credit:
Theory							
1		HS Elective-II	3	0	0	3	3
(2)		(MI-5)	(3)	(0)	(0)	(3)	(3)
(3)		(MI-6)	(3)	(0)	(0)	(3)	(3)
(4)		(HO-2)	(3)	(0)	(0)	(3)	(3)
(5)		(HO-3)	(3)	(0)	(0)	(3)	(3)
Total of Theory						3	3
Sessional							
1	MH 4082	Project-II / Internship					10
Semester Total							13

MI – Minor HO - Honors

LIST OF HS ELECTIVES

HS Elective – I

Sl. No.	Course	Course Title	Credit
1.	HS 2002	Engineering Economics	3
2.	HS 2008	Economic Environment of India	3
3.	HS 2010	Financial Institutions, Markets and Regulations	3
4.	HS 2012	Development Economics	3

HS Elective – II

1.	HS 3006	Entrepreneurship	3
2.	HS 3008	Management Concepts & Practices	3
3.	HS 3002	Organizational Behaviour	3
4.	HS 3004	Human Resource Management	3

LIST OF DEPARTMENT ELECTIVES

Dept. Elective – I

1.	ME 3020	Advanced Manufacturing Processes	3
2.	EL 3022	Advanced Control Systems	3
3.	MH 3032	Modeling and Simulation of Mechatronic Systems	3
4.	MH 3034	Product Design and Development	3
5.	EC 6108	Digital Image Processing	3

Dept. Elective – II

1.	ME 3069	Total Quality Management	3
2.	MH 3035	Process Planning and Cost Estimation	3
3.	EI 3023	Neural Network & Fuzzy Logic Control	3
4.	MH 3037	Micro and Nano Manufacturing System	3
5.	MH 3039	Artificial Intelligence for Mechatronics Systems	3

Dept. Elective - III

1.	MH 3040	Micro Electro Mechanical Systems	3
2.	ME 3028	Supply Chain Management	3
3.	IT 4027	Software Project Management	3
4.	ME 3055	Additive Manufacturing	3
5.	MH 3042	Mobile and Autonomous Robots	3

Dept. Elective – IV

1.	ME 2024	Industrial Engineering and Operations Research	3
2.	MH 3044	Virtual Reality and Haptics	3
3.	ME 3057	Machine Maintenance and Condition Monitoring	3
4.	ME 3051	Finite Element Analysis	3
5.	AE 3001	Automotive Mechatronics	3

Dept. Elective – V

1.	MH 3046	Intelligent Manufacturing Systems	3
2.	ME 3047	Production and Operations Management	3
3.	E1 3022	Bio-Medical Instrumentation	3
4.	ME 3049	Industrial Safety	3
5.	MH 3048	Internet of Things and Smart Manufacturing	3

HONORS COURSES OFFERED BY MECHATRONICS ENGINEERING

Sl No.	Course	Course Title	Prerequisite/s
1	MH 4001	Robotics, Advanced Concepts and Analysis	Principle of Control Systems (EE 3009), Sensors & Actuators (EI-3007)
2	MH 4003	Introduction to Biomechatronics	Principle of Control Systems (EE 3009), Sensors & Actuators (EI-3007)
3	MH 4005	Computer Vision and Image processing	Digital Signal Processing (EC 3007) & Principle of Digital Signal Processing (EC 3013)
4	MH 4007	Advance control and optimization	Control Systems (EL 3001)
5	MH 4009	Sensors and Signals	Introduction to Instrumentation Engineering (EI 2008)

LIST OF OPEN ELECTIVES OFFERED BY SCHOOL OF MECHANICAL ENGINEERING

Sl. No	Course	Course Title	Prerequisite/s
1	ME 3031	Finite Element Method for Engineers	Mathematics-I (MA1003)
2	ME 3032	Introduction to Fluid Mechanics and Heat Transfer	Mathematics –I (MA1003)
3	ME 3033	Renewable Energy Sources	Nil
4	ME 3034	Applied Thermodynamics	Mathematics –I (MA1003), Engineering Thermodynamics (ME2031)
5	ME 3035	Biomechanics	Nil
6	ME 3036	Strength of Materials	Engineering. Mechanics (ME1003)
7	ME 3037	Quality Engineering and Management	Nil
8	ME 3038	Kinematics and Dynamics of Machinery	Mathematics-I (MA1003), Engineering Mechanics (ME1003)
9	ME 3039	Mechatronic Systems	Principles of Electronics Engineering (EC2025)
10	ME 3040	Engineering Materials	Chemistry (CH1007)
11	ME 3042	Computer Controlled Manufacturing Systems	Nil
12	ME 3044	Robotics	Nil
13	ME 3046	Introduction to Composite Materials	Nil
14	ME 3048	Fundamentals of Computational Fluid Dynamics	Physics (PH1007), Chemistry (CH1007)
15	ME 3050	Automobile Technology	Nil

MINOR IN MECHANICAL ENGINEERING

Sl. No	Course	Course Title	Prerequisite/s
1	ME 2013	Kinematics and Dynamics of Machines	Nil
2	ME 2024	Industrial Engineering and Operations Research	Nil
3	ME 3043	Power Plant Engineering	Nil
4	ME 3062	Thermodynamics and Hydraulic Devices	Nil
5	ME 3041	Mechanical System Design	Nil
6	ME 4070	Manufacturing Processes	Nil
7	ME 2085	Manufacturing Practices	Nil
8	ME 4092	Thermo fluids Lab	Nil
9		Project(Minor)	Nil

MINOR IN MANUFACTURING ENGINEERING

Sl. No	Course	Course Title	Prerequisite/s
1	ME 2007	Materials Science and Engineering	Nil
2	ME 2026	Engineering Metrology	Nil
3	ME 2024	Industrial Engineering and Operations Research	Nil
4	ME 3055	Additive Manufacturing	Nil
5	ME 4070	Manufacturing Processes	Nil
6	ME 4072	Industrial Automation and Robotics	Nil
7	ME 2085	Manufacturing Practices	Nil
8	ME 2099	Metrology and Instrumentation Lab	Nil
9		Project(Minor)	Nil

MINOR IN INDUSTRIAL ENGINEERING AND MANAGEMENT

Sl. No	Course	Course Title	Prerequisite/s
1	ME 3028	Supply Chain Management	Nil
2	ME 3053	Project Management	Nil
3	ME 4061	Operations Research	Nil
4	ME 4074	Quality Engineering	Nil
5	ME 4076	Production, Planning and Control	Nil
6	ME 4078	Work System Design	Nil
7	ME 4092	Work System Design Lab.	Nil
8	ME 4094	Operations Research Lab.	Nil
9		Project(Minor)	Nil

COURSES OF FIRST YEAR

MA 1003 Mathematics-I

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

The laws of nature are expressed as differential equations. The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. This course is designed to familiarize the prospective engineers with techniques in ordinary differential equations, multivariate calculus and solution for ODEs numerically. This course also focuses on Linear algebra that covers system of linear equations and properties of matrices. The objective of the course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

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

CO1: model and formulate differential equation of Physical problems
CO2: apply different methods to solve 1st and 2nd order ODEs
CO3: apply numerical methods to solve ODEs
CO4: study differential calculus in engineering problems
CO5: use the essential tool of matrices and linear algebra
CO6: analyze Eigenvalue problems

Topics:

- Ordinary Differential Equations.
- Linear differential equations of 2^{nd} order.
- Differential calculus and Numerical methods to solve ODEs
- Vector space and system linear of equations
- Matrix-eigenvalue Problems

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, (online) 10^{th} Edition.
2. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand, reprint 2009.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand & Co Ltd, 11^{th} edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & Partial Differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

PH 1007 Physics

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

This course includes the fundamentals of different types of oscillations and its applications; mathematical expression of waves and its physical interpretation; the concept of interference, diffraction and their applications; the principle, construction and working of different Lasers. The course also gives a flavour of Quantum mechanics, which is the founding stone to the state of the art in modern techniques and paves the way towards the world of nano devices. It covers the formulation of Maxwell's electromagnetic equations, and verification of different properties of electromagnetic waves. Mechanical and magnetic properties of different materials and their applications are also covered in this course.
Course Outcomes: At the end of the course, the students will be able to:

CO1: utilize the concept of waves and intensity modulation in day to day life through various applications
CO2: apply the mechanism of LASER technology in different fields
CO3: formulate and solve engineering problems of electricity and magnetism using Maxwell's electromagnetic equations
CO4: apply the principles of quantum mechanics to related problems
CO5: apply the knowledge of magnetic materials in related applications
CO6: analyze the macroscopic behavior of solids and utilize them in future applications

Topics:

- Oscillation and wave
- Interference and diffraction
- LASER
- Quantum mechanics
- Electromagnetism
- Properties of matter (mechanical)
- Magnetism

Textbook (s):

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi

Reference Book(s):

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education
2. Quantum Mechanics, L. I. Schiff, Tata McGraw-Hill Publications
3. Optics, A K Ghatak, Tata McGraw-Hill Publications
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi.

ME 1003 Engineering Mechanics

Credit: 2
Category: ESC
Prerequisite(s): Nil

Course Description:

The course on Engineering Mechanics is a specialized need-based extension of applied physics which is aimed at developing an understanding of the principle of statics and dynamics. The course focuses on learning methodical and logical idealization and subsequent implementation of corresponding procedures for analysis of rigid body, frame and machine under the action of force system which is highly essential for effective design. The course intends to develop the ability of drawing and analyzing the free body diagram of a system when at rest or motion using scalar/vector techniques. Further, the course serves as a prerequisite to fundamental machine design courses such as mechanics of solids and design of machine elements.

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

CO1: draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram
CO2: use scalar analytical techniques for analyzing forces and moments in mechanical systems
CO3: analyzing forces in statically determinate structures such as trusses, frames and problems related to friction
CO4: determine the centroid and second moment of area
CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
CO6: solve real-life problems by using mathematics, physical laws and theorems

Topics:

- Concurrent Forces in a Plane
- Friction
- Parallel Forces in a Plane
- Moment of Inertia
- Force analysis of Plane Trusses
- Principle of Virtual Work
- Kinematics of Rectilinear Motion
- Kinematics of Curvilinear Motion
- Rotation of a rigid body

Textbook(s):

1. Engineering Mechanics (Revised 5th edition), TMH by S. Timoshenko, D.H. Young, J.V Rao and S. Pati.

Reference Book (s):

1. Engineering Mechanics (Statics and Dynamics) - Bear and Johnson, TMH
2. Engineering Mechanics (Statics and Dynamics) by I.H. Shames, Prentice Hall
3. Engineering Mechanics –S.S. Bhavikatti, New Age International
4. Engineering Mechanics (Statics and Dynamics)-S. Rajasekaran & G Sankarasubramanian, Vikas Publishing House.

PH 1097 Physics Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, Screw gauge, vernier calliper, microspope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

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

CO1: calculate appropriate structural members using the fundamental concepts of the elastic behavior of materials
CO2: use the principles of interference and diffraction to find out the wavelength of an unknown monochromatic source of light
CO3: apply the concept of photoelectric emission to calculate the Planck's constant and analyze some aspects of electron-photon interaction through characteristic curves
CO4: explore the efficiency in terms of power output of a green energy source i.e. solar cell
CO5: calculate the acceleration due to gravity 'g' by using the concept of a compound pendulum

Topics:

- Estimation of elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio
- Determination of wavelength of unknown source using Newton's rings and Michelson's interferometer
- Precision length measurement up to the order of 6 A° (distance between sodium D-lines) using Michelson interferometer
- Determination of grating element using a diffraction grating
- Study of photo cell and solar cell by analyzing their characteristic curves
- Determination of acceleration due to gravity using a bar pendulum

EE 1093 Basic Electrical Engineering Laboratory

Credit: 1
Category: ESLC
Prerequisite(s): Nil

Course Description:

Basic Electrical Engineering lab comprises of various equipments and loads i.e voltmeters,ammeters, wattmeters, single phase and three phase transformer, induction motors etc. It is a specialized practical oriented course which intends to develop and understand various principles like Ohm's law and Kirchoff's law. The course focused on learning methodical and logical idealization of various theorems which is highly essential for solving a network. The course intends to make the students familiar with various parts of DC machines and AC machines. The course intends to develop the ability of problem solving by analyzing RL and RLC series circuits. This lab helps the students to understand the principle of operation of a single phase transformer with its no load calculation.

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

CO1: recall the safety practices in the laboratory and the associated work areas
CO2: comprehend the skills for working in a team with common objective
CO3: apply different theorems to find the parameters in DC and AC circuit
CO4: analyse the different parts of DC and AC machines to describe operational features thereof
CO5: apprise the experimental results in systematic manner
CO6: discuss about determination of resistance in incandescent lamp and power factor in fluorescent lamp

Topics:

- measurement of resistance of tungsten filament lamp
- measurement of inductance of a choke coil
- study and use of megger
- study of different parts of dc machine and three phase induction motor
- layout of power system analysis
- determination of voltage ratio of a single phase transformer
- measurement of no load current and core loss of a single phase transformer
- verification of KCL and KVL
- verification of voltage and current ratio of star and delta connection
- study & determine the power factor of the RLC series circuit
- study, connection & determine the power factor of fluorescent tube
- verification of the superposition theorem
- transient analysis of series RL and RC circuit using matlab-simulink with dc excitation

Textbook(s):

1. Basic Electrical Engineering by D.C. Kulshreshtha, Tata Mcgraw publication, 1st Edition 2011.
2. Basic Electrical Engineering, T.K. Nagasarkar and M.S. Sukhija, Oxford University press, 2nd Edition 2011.

Reference Book(s):

1. Basics Electrical Engineering Sanjeev Sharma, I.K. International, New Delhi.(Third Reprint 2010).

ME 1083 Basic Manufacturing Systems

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

This laboratory practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which covers both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC and 3D printing.

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

CO1: practice different operations related to fitting shop
CO2: use different welding tools to prepare a given type of joint
CO3: demonstrate various turning operations including taper turning and knurling using a conventional lathe machine
CO4: design a tray and prepare it using sheet metal equipment involving soldering
CO5: appraise different operations using a CNC machine
CO6: interpret different advanced machines such as 3D printing/additive manufacturing

Topics:

- Turning operations
- Sheet metal operations
- Fitting
- Welding

CH 1081 Environmental Science

Credit: 1
Category: BSLC
Prerequisite(s): Nil

Course Description:

The course is designed to make the students aware of different environmental components and their composition. It will make the students understand different pollutants, their sources and management. It will also help students to apply the principles of Green Chemistry and implement them in synthesis of advanced materials required for engineering applications. It also outlines the basic steps for developing the EIA statements

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

CO1: understand the different components and composition of the environment
CO2: rationalize the different pollutants, their sources, effects and controlling measures
CO3: quantify water quality parameters
CO4: apply the systematic environmental impact assessment (EIA) requirements before setup of any project
CO5: understand and implement the principles of solid waste management
CO6: conceptualize the principles of green chemistry and implement them in synthesis of advanced material, so as to reduce the pollution

Topics:

- Overview on environment
- Environmental pollution: air pollution, water pollution
- Pollution management

Textbook(s):

1. Environmental Chemistry, A. K. De, New Age International Publishers.

Reference Book(s):

1. Environmental Chemistry- S. Chakroborty, D. Dave, S.S. Katewa, Cengage Publishers
2. Environment Science and Engineering, Aloka Debi. Second Edition ;Universities Press
3. Text Book of Environment studies for under graduate courses, Erach Bharucha : 2nd Edition, Universities Press
4. Fundamentals of Environment and Ecology, D. De, D. De; 2013, S. Chand Group
5. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company

MA 1004 Mathematics-II

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is to familiarize the students with series solutions of ODEs, Laplace Transforms, Fourier series, vector calculus, and numerical integration. For the ODEs with variable coefficients, the situation is more complicated to get their solutions in elementary functions. Legendre and Bessel's equations are important ODEs of this kind and their solutions, the Legendre polynomials and Bessel functions play an important role in engineering applications. Laplace transforms can be used as a mathematical toolbox for engineers to solve linear ODEs and related initial value problems. The Fourier series and vector calculus play a very important role in many engineering areas such as solid mechanics, aerodynamics, fluid flow, heat flow, quantum physics. The applied mathematician, engineer, physicist, or scientist must become familiar with the essentials of numerics and its ideas, such as interpolation and numerical integration.

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

CO1: understand application of Power series and solution of ODEs
CO2: use Power series solutions to Legendre and Bessel's equations
CO3: comprehend Laplace transform and IVPs
CO4: study periodic and non-periodic functions and their Fourier series expansion
CO5: develop vector differential and integral calculus and the applications of Green's theorem, Gauss Divergence Theorem & Stokes Theorem
CO6: apply numerical techniques in interpolation and evaluation of the definite integral

Topics:

- Series Solution of Differential Equations
- Laplace Transforms
- Fourier Series
- Vector Differential and Integral Calculus
- Interpolation and Numerical Integration

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10^{th} Edition.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand& Co Ltd, 11^{th}edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & partial differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

CH 1007 Chemistry

Credit: 3
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is designed to enrich the students with basic concepts in Chemistry to strengthen their fundamentals which will support them for pursuing education and research in engineering. It will help them to develop the idea on feasibility and mechanism of different chemical processes, conceptualize alternative sources of energy, give an exposure for handling instrumental techniques to explore structure of organic molecules and an idea of different methods for synthesis of advanced materials.

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

CO1: rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process
CO2: analyze the kinetics of simple and multistep reactions as well as theories of reaction rates
CO3: evaluate some properties such as pH, solubility product etc. by using electrochemical cell and understand the working of modern batteries
CO4: able to understand the mechanism of corrosion and its different controlling measures
CO5: distinguish the different electromagnetic radiations used for exciting different molecular energy levels in various spectroscopic techniques to evaluate the structure of molecules
CO6: get an exposure to different methods used for synthesis of nanostructured materials

Topics:

- Chemical Equilibrium and Thermodynamics
- Chemical Kinetics
- Electrochemistry
- Spectroscopy
- Chemistry of Nano Materials

Textbook(s):

1. Engineering Chemistry: Fundamentals and Applications- Shikha Agarwal, Cambridge University Press, 2016

Reference Book(s):

1. Textbook of Engineering Chemistry: Sashi Chawala, Dhanpat Rai and Co, 2016
2. Principles of Physical Chemistry- B.R. Puri, L.R Sharma, M.S. Pathania; 42nd Edition, Vishal Publishing Co.
3. Spectrometric Identification of Organic compaunds,7th Edition -Robert M. Silverstein, Fransis , Webster, Dravid j. Kiemle; Jhon Wiley& Sons, INC.
4. Nanostructures &Nanomaterials: Synthesis, Properties and Applications- G. Cao and Y. Wang, World Scientific Pvt. Ltd.; 2nd Edition

HS 1005 Professional Communication

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

Professional Communication is more emphasized on enhancing the four LSRW skills like Listening, Speaking, Reading and Writing in order to improve students' professional communication. It is basically designed to enhance speaking skills through pronunciation, stress and tone. This course is prepared to improve reading skills through reading, comprehending and retaining information.This course is basically expected to provide the learner an approach to communicate using all the four skills

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

CO1: understand the communication process and practical implementations in the workplace
CO2: apply verbal and non-verbal modes of communication effectively in practical situations
CO3: apply effective conflict management strategies
CO4: use English grammar correctly and unambiguously in technical writing
CO5: bridge the gap between native language and target language i.e. English
CO6: retain a logical flow while drafting reports and other technical pieces of writing

Topics:

- Communication: Process and Methods of Communication
- Basics of Grammar: Time & Tense, Subject-Verb Agreement, Analogy, Active & Passive Voice, Error Detection in Sentences
- Writing Skills: Paragraph Writing-Techniques & Skills, Use of Punctuation, Business Letter-Enquiry, Claim/ Complaint, Order
- Basic Sounds of English: Hearing & Listening, Introduction to Basic Sounds of IPA, Problem Sounds & MTI

Textbook(s):

1. Technical Communication Principles & Practices. Meenakshi Raman and Sangeeta Sharma OUP. Second Edition-2011

Reference Book(s):

1. A Communicative English Grammar. Geoffrey Leech and Jan Svartvik. Third Edition. Routledge Publication.New York.2013.
2. Effective Technical Communication. MAshraf Rizvi TMH 2005
3. The Oxford Grammar (English) Sidney Greenbaum, Oxford University Press India. 1st Edition. 2005
4. Verbal Ability and Reading Comprehension for the CAT. Arun Sharma and Meenakshi Upadhyay, TMH,New Delhi,2007
5. Better English Pronunciation, Cambridge University Press, J D O'Connor, 2nd Edition (Paper Back) 2013

LS 1001 Biology

Credit: 2
Category: BSC
Prerequisite(s): Nil

Course Description:

Biology is important to everyday life because it allows humans to better understand their bodies, their resources and the potential threats existing in the environment. The engineering undergraduates need to be suitably exposed to the biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

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

CO1: comprehend the typical characteristics which distinguish life forms and analyze life process at cellular level
CO2: apply concepts on structure and function of simple biomolecules in life processes
CO3: comprehend different biological process involved in life and to analyze their effect
CO4: understand different biological phenomenon and then relate it with engineering application domains
CO5: comprehend different physiological functions and then relate it to computer based techniques
CO6: understand biology and its relevance to engineering and technology

Topics:

- The Cellular organization of a living Organism
- The molecular and biochemical basis of an organism
- Enzymes, photosynthesis, metabolism and bioenergetics
- Molecular machines, biosensor and bioremediation
- Nervous system, immune system and cell signaling

Textbook(s):

1. Biology for Engineers. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi, M.K. Jaganathan. McGraw Hill Education (India) Ed., 2012

Reference Book(s):

1. Biology (Indian Edition), P.H. Raven and G.B. Johnson. McGraw Hill Education (India) Private Limited.
2. Concepts of Biology, Eldon D. Enger, Feederick C, Ross and David B. Bailey. TMH Publications.
3. Biology. Neil A. Campbell and Jane B. Recee, Pearson Education.
4. Biology Concepts and Application, Cecie Starr, Thomson Books.

CS 1093 Computer Programming Laboratory

Credit: 4
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

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

CO1: have fundamental knowledge on basics of computers hardware and number systems with concept on basics commands in Linux
CO2: write, compile and debug programs in C language
CO3: design programs involving decision structures, loops, and functions
CO4: understand the dynamics of memory by the use of pointers
CO5: use different data structures and create/update basic data files

Topics:

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

CH 1097 Chemistry Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

The Chemistry laboratory course is designed to develop basic concepts of quantitative analysis by using volumetric as well as instrumental methods. It includes classical titrations to estimate hardness, alkalinity, dissolved oxygen, ferrous ion content, chloride content in water/solution samples. It also gives hands on training to use advanced titration techniques such as potentiometric, pH metric and conductometric titrations which can be used with turbid and colored solutions in incredibly low concentrations. The course also gives an exposure to extensive use of UV-Vis spectroscopy for estimation of different ions in solution phase.

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

CO1: understand the significance of quantitative chemical analysis
CO2: prepare solutions of different concentrations and do their standardization
CO3: get an exposure to different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry
CO4: evaluate the rate constant of pseudo first order reactions
CO5: analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, ferrous iron contents
CO6: rationalize chemical handling and chemical safety in an advanced modern laboratory

Topics:

- Hardness of water sample
- Alkalinity of water
- Estimation of Fe^{2+} iron
- Dissolved Oxygen
- Potentiometric Titration
- Kinetics of Ester Hydrolysis
- Chloride Estimation
- pH metric Titration
- Conductometric Titration
- Concentration of $KMnO_4$ by Visible spectroscopy

HS 1085 Language Laboratory

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

Language Lab is more practical oriented which is designed with an objective to make the learner practice the skills which he/she has learnt in the theory I.e Listening, Speaking, Reading and Writing in order to improve their communication skills. It is basically designed to engage the students to learn to perform group activity or an individual activity. This course is prepared to improve the listening reading, speaking and writing skills . It is expected to orient the students with vocabulary, analogy, sentence completion and sentence correction.

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

CO1: use English grammar correctly and unambiguously in technical writing
CO2: apply verbal and non-verbal modes of communication effectively in practical situations
CO3: have a basic understanding of the communication process and to know the practical implementations in the workplace
CO4: retain a logical flow while drafting reports and other technical pieces of writing
CO5: develop competence in reading and comprehension
CO6: be familiar with English pronunciation and use neutral accent successfully

Topics:

- Reading & Comprehension
- Skit/ Role-Play Practice
- Listening Comprehension
- Time & Tense
- Business Letter
- Business Report
- Subject-Verb Agreement
- Visual Elements in Writing:
- Gadget-Supported Textual Formatting
- Attendance + Lab Record Checking
- Viva Voce

CE 1083 Engineering Graphics

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course of Engineering Graphics comprises of basics of drafting, projection of points & lines, line inclined to both the planes, projection of planes, Computer Aided Drafting, projection of solids and development of surfaces.

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

CO1: use common drafting tools properly
CO2: select, construct and interpret appropriate drawing scale as per the situation
CO3: draw orthographic projections of points, lines and planes
CO4: draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections
CO5: develop the sections of solids for practical situations
CO6: communicate ideas effectively using Computer Aided Drafting

Topics:

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook(s):

1. Engineering Drawing + AutoCAD by K. Venugopal, New Age Publishers, 1st edition, 2011

Reference Book(s):

2. Engineering Drawing with an Introduction to AutoCAD by S. N. Lal, Cengage India Private Limited, 1st edition, 2017

COURSES OF THE PROGRAMME

MH 2002 Principles of Machine Tools

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course will provide a platform to study the different basic machining processes, classification, and working principles of machine tools. It will also provide the design methodology to select and design the machine tool drives, gearbox, machine tool parts, spindles, bearings, guideways, and various control system considering the ergonomic aspects. By studying this course, the learner can be able to select and design the speed gearbox for spindle drive and feed gearbox of machine tools. This course will also create interest among learns to modify the design of existing machine tools in various aspects for industrial applications.

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

CO1: understand the different basic machining processes, machine tools and work-tool holding devices
CO2: understand the general classification, kinematics and layout of machine tools
CO3: demonstrate the design considerations for machine tool drives and machine tool structural parts
CO4: analyse the ergonomic considerations for design the various control members in machine tools
CO5: select and design the machine tool spindles, anti-friction and sliding bearings
CO6: design the speed gear box for spindle drive and feed gear box of machine tools

Topics:

- Basic machining processes
- Classification and kinetics of machine tools
- Machine tool drives
- Design of machine tool structures
- Machine tool spindles and its bearings
- Controlling systems in machine tools

Textbook(s):

1. Machine Tools Design and Numerical Control, N. K. Mehta, TMH.
2. Design of Machine Tools, S. K. Basu, D. K. Pal, OIBH.

Reference Book(s):

1. Principles of Machine Tools, G. C. Sen, Bhattacharya, New Central Book Agency.
2. Metal Cutting Theory and Practice, A. Bhattacharya, New Central Book Agency (P) Ltd.
3. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.

MH 3008 Design of Mechatronic systems

Credit: 3
Category: PCC
Prerequisite(s): Digital Electronics (EC 2018), Principle of Control Systems (EE 3009), Sensors and Actuators (EI 3007), DC AC and Special Electrical Machines (EE 2011)

Course Description:

The course emphasises on the advanced mechatronics deign approaches, system modelling, General Purpose I/O Card and Its Installation, Data Conversion Process, components and design of mechatronics system such as Fuzzy Based Washing Machine, Engine Management System etc. At the end of this course, students will be able to learn and understand the mechatronic system, use of system models in mechatronics, application and design of micro- mechatronics devices and aspects of data acquisition system. Students will get the practical knowledge of Application Software- Lab View Environment and Its Applications, Vim-Sim Environment & Its Applications -Man Machine Interface.

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

CO1: understand the mechatronic systems design and their structure, ergonomic and safety
CO2: design and use of system models in mechatronic system
CO3: analyse theoretical and practical aspects of computer interfacing and real time data acquisition and control
CO4: apply the knowledge to design mechatronics products
CO5: design and implement the micro mechatronic system
CO6: understand the real time interfacing

Topics:
- Mechatronics design process
- System modelling and application model
- Data acquisition and control system
- Different case studies on mechatronics system with example
- System design and application of micro mechatronics system

Textbook(s):
1. Mechatronics System Design", Devdas Shetty, Richard A. Kolk 2nd Edition, Cengage Learning 2011.
2. Mechatronic Systems Modeling and simulation" with HDL's, Georg Pelz, John Wiley and sons Ltd, 2003.

Reference Book(s):
1. Mechatronics Hand book, Bishop, Robert H CRC Press, 2002.
2. Mechatronics Electronics in Products and Processes, Bradley, D. Dawson, N.C. Burd and A.J. Loader CRC Press 1991, First Indian print 2010.
3. Mechatronics A Foundation Course, De Silva Taylor & Francis, Indian Reprint, 2013.

MH 3032 Modeling and Simulation of Mechatronic Systems

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

Modeling and Simulation of Mechatronic Systems course encompassing design of problems within time domain simulation.This course is presented to cover all of these critical aspects including state variables, initialization, time integration, and setting up linear and non-linear algebraic equations in combination with differential equations. Through the course, students will be able to solve linear and non-linear sets of equations, optimization, and parameter identification.

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

CO1: understand the basic concept and principles of modeling and simulation of systems
CO2: understand and apply various modeling techniques to physical systems
CO3: apply various simulation techniques to solve practical problems related to mechatronic systems
CO4: able to design, model and simulate the Mechatronic Systems using softwares
CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
CO6: able to integrate systems across different physical domains and understand the control aspects to achieve desired system behavior

Topics:

- System modelling with structured analysis
- Modelling paradigms for mechatronic system
- Hardware in the loop simulation (HIL)
- Rapid controller prototyping
- Design of identification experiments
- Simulation of systems in software (MATLAB, LabVIEW) environment

Textbook(s):

1. L. Ljung, T. Glad, ―Modeling of Dynamical Systems‖, Prentice Hall Inc. (1994).
2. D.C. Karnopp, D.L. Margolis and R.C. Rosenberg, ―System Dynamics A Unified Approach‖, 2nd Edition, Wiley-Inderscience (1990).
3. G. Gordon, ―System Simulation‖, 2nd Edition, PHI Learning (2009).

Reference Book(s):

1. V. Giurgiutiu and S. E. Lyshevski, ―Micromechatronics, Modeling, Analysis, and Design with MATLAB‖, 2nd Edition, CRC Press (2009).

MH 3034 Product design and development

Credit: 3
Category: PEC
Prerequisite(s): Principles of Machine Tools (MH 2002)

Course Description:

Product design and development (PDD) is an interdisciplinary activity that requires significant cross-disciplinary participation. The course is governed by design thinking and facilitates manpower development for greater coordination of design, manufacturing, and marketing decisions. The course aims to strike a balance between theory and practice by focusing on design-for-X methods. Thus, students get exposure to concurrent engineering practices right from the conceptual stages of product development. The students will be exposed to the use of technology to create concept drawings and designs. They will be urged to give shape to their imagination within the bounds set by the product development software. They will be able to appreciate the use of technology that prevents downstream failures

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

CO1: identify and analyze the product design and development processes in the manufacturing industry
CO2: analyse, evaluate, and apply the methodologies for product design, development, and management
CO3: use the concepts of process planning and its activities
CO4: implement a methodical approach to the management of product development to satisfy customer needs
CO5: carry out the cost and benefit analysis through various cost models
CO6: understand and implement the use of computer-aided technology to support the above

Topics:
- Product development processes and organizations
- Introduction, Concept Generation and Selection
- Concept testing
- Product Architecture
- Industrial Product Design
- Design for Manufacturing and Product Development

Textbook(s):
1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 1999

Reference Book(s):
1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development”, DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal,” Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh,” Tool Design –Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, New York, NY.

MH 3035 Process Planning and Cost Estimation

Credit: 3
Category: PEC
Prerequisite(s): Principles of Machine Tools (MH 2002)

Course Description:

Process Planning and Cost Estimation course encompassing process planning concepts to make cost estimation for various products.This course is presented to cover all of these critical aspects including methods of process planning, developing interpretation, material evaluation, steps in process selection, production equipment and tooling selection.Through the course, students will be able to evaluate the processes and systems for manufacturing a product competitively and economically through extensive and systematic research.

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

CO1: understand the basic concepts of manual and computer aided process planning in industries
CO2: ability to use the concepts of process planning and its activities
CO3: understand and estimate the different elements of cost of production including depreciation
CO4: ability to estimate the cost involved for foundry, forging, welding and sheet metal shops
CO5: ability to estimate the cost involved in machining operations
CO6: ability to evaluate the processes and systems economically

Topics:

- Process Planning
- Introduction to Costing Estimation
- Production Cost Estimation
- Calculation of Machining Times and Costs

Textbook(s):

1. M.S. Adithan and Pabla, “Estimating and Costing,” Konark Publishers Pvt. Ltd, 1989.
2. A.K. Chitale and R.C. Gupta, “Product Design and manufacturing”, Prentice Hall Pvt. Ltd., 1997.
3. Nanua Singh, “System Approach to Computer Integrated Design and Manufacturing”, John Wiley & sons, Inc., 1996.
4. Joseph G. Monks., “Operations Management, Theory and Problems”, McGraw Hill Book Company, 1982.

Reference Book(s):

1. G.B.S. Narang and V. Kumar, “Production and Planning”, Khanna Publishers, 1995.
2. T.R. Banga and S.C. Sharma, “Estimating and Costing”, Khanna publishers, 1986.

MH 3037 Micro and Nano Manufacturing Systems

Credit: 3
Category: PEC
Prerequisite(s): Principles of Machine Tools (MH 2002)

Course Description:

Micro and Nano Manufacturing Systems course encompassing various methods used in micro and nano manufacturing. This course is presented to cover all of these critical aspects including in-depth idea of the conventional and non-conventional micro-nano manufacturing techniques basics.Through the course, students will be able to find best methods to fabricate and design, test, and implement various micro and Nano system through extensive and systematic research.

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

CO1: understand manufacturing considerations at the micro and nano scale
CO2: understand the definition of nanotechnology and increase in nanotechnology awareness
CO3: understand design-and-analysis methods and tools used for micro and nano manufacturing
CO4: able to know the processing and applications of nanoparticles and nanomaterials
CO5: design and select industrially-viable processes, equipment and manufacturing tools for specific industrial products
CO6: understand the application of computers in the area of nano design

Topics:
- Working principles of the micro manufacturing processes
- Microfabrication
- Nano Technology
- Innovative Applications on Present Devices
- Nano Design & CAD
- Acceptability of Nano Workmanship

Textbook(s):

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Sami Franssila, “Introduction to Micro fabrication”, John Wiley & sons Ltd, 2004. ISBN470-85106-6
3. W.R. Fahrner “Nanotechnology and Nanoelectronics”, Springer (India) Private Ltd., 2011.
4. Norio Taniguchi, “Nano Technology”, Oxford University Press, New York, 2003

Reference Book(s):

1. Microfabrication & Nonmanufacturing by Mark J. Jackson 2. ASM handbook on machining
2. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN 8493-9138-5
3. Mark Madou, Fundamentals of Microfabrication, CRC Press, New York, 1997.

MH 3039 Artificial Intelligence for Mechatronics Systems

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

Artificial Intelligence for Mechatronics Systems would encompass a complete study of a variety of topics in computational intelligence. This course is presented to cover all aspects of neural networks, learning methods including unsupervised learning, reinforcement learning and semi-supervised learning, fuzzy systems, evolutionary algorithms and mechatronic applications in broader terms. Through the course, students will be able to apply the capability of artificial intelligence in engineering applications.

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

CO1: understand the concepts of artificial intelligence approaches
CO2: demonstrate awareness of the major challenges facing AI and the complex of typical problems within the field
CO3: exhibit strong familiarity with a number of important AI techniques, including in particular search
CO4: understand the concepts of Neural Networks and various types of learning algorithms
CO5: apply neural networks to pattern classification problems
CO6: evaluate and compare solutions by various soft computing approaches for a given problem

Topics:

- Overview, Foundation, History
- Intelligent Agents
- Solving Problems by Searching
- Knowledge Representation and Reasoning
- Neural Networks
- Recent Advances

Textbook(s):

1. Artificial Intelligence a Modern Approach – Stuart Russel, Peter Norvig, 3rd Edition, Pearson Education, 2009.

Reference Book(s):

1. Artificial Intelligence - Elaine Rich, Kevin Knight and Shivashankar B Nair, 3rd Edition, Tata McGraw Hill, 2008.
2. Artificial Intelligence A new Synthesis – Nils J. Nilsson, 1st Edition, Elsevier, 1997.
3. Introduction to Artificial Intelligence and Expert Systems- Dan W. Patterson 2nd Edition, PHI, 2009.
4. Christopher-M-Bishop," Pattern-Recognition-and-Machine-Learning", Springer.

MH 3040 Micro Electro Mechanical Systems

Credit: 3
Category: PEC
Prerequisite(s): Material Science and Engineering (ME 2007), Digital Electronics (EC 2011) and Sensors & Actuators (EI 3007)

Course Description:

Micro Electro Mechanical Systems encompassing study of microelectromechanical devices including their manufacturing and mechanical behavior. This course is presented to cover all of these critical aspects including material properties, microfabrication technology, mechanical behavior of of microstructures, design, and packaging. Through the course, students will be able to understand physics and design of microsensors, size scale in MEMS materials, micro and nanomanipulation.

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

CO1: understand the basic concepts of micro electromechanical systems
CO2: understand the tools and processes used in micromaching of microelectromechanical systems (MEMS)
CO3: understand the concepts of working of micro-sensors and actuators, to enable selection, design and configuration of Micro-sensors and actuators
CO4: critically analyze microsystems technology for technical feasibility as well as practicality
CO5: understand the knowledge about nano materials and various nano measurements techniques
CO6: choose appropriate material for any microsystem and packaging method for any microsystem

Topics:
- Introduction to Microsystems
- Micro Sensors & Actuators
- Fabrication Process
- Micro System Manufacturing
- Microsystems Design and Packaging

Textbook(s):
1. Mohamed Gad el Hak, ―MEMS Handbook‖, CRC Press, 2002.
2. P. Rai Choudhury ―MEMS and MOEMS Technology and Applications‖, PHI Learning Private Limited, 2009.
3. Sabrie Solomon, ―Sensors Handbook, Mc Graw Hill, 1998.
4. Marc F Madou, ―Fundamentals of Micro Fabrication‖, CRC Press, 2nd Edition, 2002.

Reference Book(s):
1. E.H. Francis, Tay and W.O. Choong, ―Micro fluidics and Bio mems application‖, IEEE Press New York, 1997.
2. S. Trimmer William, Ed., ―Micromechanics and MEMS‖, IEEE Press New York, 1997.

MH 3042 Mobile and Autonomous Robots

Credit: 3
Category: PEC
Prerequisite(s): Principle of Control Systems (EE 3009), Sensors & Actuators (EI 3007), Robotics, Advanced Concepts and Analysis (MH 4001)

Course Description:

Mobile and Autonomous Robots course encompassing basic concepts and algorithms required to develop mobile robots that act autonomously in complex environments.This course is presented to cover all of these critical aspects including mobile robot locomotion and kinematics, environment perception, probabilistic map based localization and mapping, and motion planning.Through the course, students will be able to develop several types of robots such as wheeled robots, legged robots and drones.

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

CO1: define key issues and constraints of locomotion
CO2: interpret different sensor technologies for tracking
CO3: identify robotic platforms and their limitations
CO4: analyze the kinematics of robot
CO5: determination of different parameters of mobile robot by programming
CO6: design of automation solutions using mobile robots

Topics:

- Key issues for locomotion
- Mobile Robot Kinematics
- Sensors for Mobile Robots
- Mobile Robot Localization
- Planning and Navigation

Textbook(s):

1. Howard Choset, et. al. 2005. Principles of Robot Motion Theory, Algorithms, and Implementations, The MIT Press, ISBN-10 0262033275.

Reference book(s):

1. Hexmoor, 2013. Essential Principles for Autonomous Robotics, Morgan and Claypool publishers.

MH 3044 Virtual Reality and Haptics

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

Virtual Reality and Haptics course encompassing hardware and software characteristics of Virtual Reality (VR).This course is presented to cover all of these critical aspects including basics of VR-hardware and history of VR, to different applications of VR and the psychology of Virtual Reality.Through the course, students will be able to evaluate existing VR applications, and design, test, and implement their own VR experiences through extensive and systematic research.

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

CO1: understand the basic concept of virtual reality and haptics in engineering application
CO2: ability to design current generation systems for creating 3D VR environments
CO3: ability to do the geometric modelling and virtual reality programming
CO4: understand the application of VR in various engineering applications
CO5: earn knowledge on haptic architecture
CO6: have the knowledge on various types of haptic devices

Topics:

- Virtual Reality
- 3d User Interface Input Hardware
- Geometry of Virtual Worlds
- 3d Interaction and interface Techniques
- Virtual Reality Applications
- Haptics

Textbook(s):

1. John vince, Essential Virtual Reality Fast (2012), Springer.
2. Matjaz Mihelj, Jonezpodobnik, Haptics for virtual reality and tele operation (2012), Springer

Reference Book(s):

1. Alan B Craig, William R Sherman and Jeffrey D Will, ―Developing Virtual Reality Applications: Foundations of Effective Design‖, Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, ―Designing Virtual Systems: The Structured Approach‖, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, ―3D User Interfaces, Theory and Practice‖, Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, ―Spatial Augmented Reality: Meging Real and Virtual Worlds‖, 2005.
5. Burdea, Grigore C and Philippe Coiffet, ―Virtual Reality Technology‖, Wiley Interscience, India, 2003.
6. Howard Rheingold, ―Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society‖, Simon and Schuster, 1991.
7. William R Sherman and Alan B Craig, ―Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)‖. Morgan Kaufmann Publishers, San Francisco, CA, 2002.

MH 3046 Intelligent Manufacturing Systems

Credit: 3
Category: PEC
Prerequisite(s): Neural network & fuzzy logic control (EI 3023)

Course Description:

Intelligent Manufacturing Systems course encompassing advanced information technology tools for manufacturing industries.This course is presented to cover all of these critical aspects of smart manufacturing including basics of advanced (machine learning, data science and information analytics) and digital technologies.Through the course, students will be able to contribute effectively to operate in the industries of the future through extensive and systematic research.

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

CO1: understand and demonstrate the concepts of machine learning techniques
CO2: understand the concepts of AI and its various applications
CO3: identify various components of knowledge based systems
CO4: apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
CO5: apply various intelligent techniques for manufacturing process optimization
CO6: apply various methods to solve group technology problems and demonstrate the structure for knowledge based system for group technology

Topics:
- Introduction to Machine Learning
- Industrial planning and decision making using intelligent systems
- Intelligent techniques for manufacturing process optimization
- Knowledge Based Group Technology

Textbook(s):
1. Yagna Narayana, “Artificial Neural Networks”, PHI, 2009.
2. Andrew Kussiak, “Intelligent Manufacturing Systems”, Prentice Hall, 1990.
3. A.B. Badiru, “Expert Systems Applications in Engineering and Manufacturing”, Prentice-Hall, New Jersey, 1992.

Reference Book(s):
1. R.V. Rao “Advanced Modeling and Optimization of Manufacturing Processes”, Springer-verlag, London. ISBN 978-0-85729-014-4.
2. Hamid R. Parsaei and Mohammad Jamshidi, “Design and Implementation of Intelligent Manufacturing Systems”, PHI, 2009`.
3. Maluf, Nadim, “An introduction to Micro electro mechanical Systems Engineering”, AR Tech house, Boston 2000.
4. Julian W.Gardner, K. Vijay, Varadan, O. Osama, Awadel Karim, “Micro sensors MEMS and Smart Devices”, John Wiby & sons Ltd.,2001.

MH 3048 Internet of Things and Smart Manufacturing

Credit: 3
Category: PEC
Prerequisite(s): Computer Networks (IT 3001)

Course Description:

Internet of Things (IoT) and Smart Manufacturing encompassing practically all branch of fundamental Engineering-Mechanical, Electronics, Middleware, Analytics, Cloud, Mobile and Firmware.This course is presented to cover all of these critical aspects of IoT Engineering and manufacturing, which includes predictive and preventative maintenance, condition based monitoring of the machines, production optimization, energy optimization, supply-chain optimization and uptime of manufacturing utilities etc.Through the course, students will be able to integrate internet of things (IOT) and manufacturing through extensive and systematic research.

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

CO1: understand the requirements of IOT and apply on the relevant domain
CO2: work and contribute on digital transformation
CO3: apply various IoT enabled techniques for manufacturing processes
CO4: understand the technology behind industry 4.0 manufacturing
CO5: apply the concept of adopting and implementing a smart factory solution
CO6: identify the opportunities for automating operations and use of data analytics

Topics:

- Concept of Internet of Things (IoT)
- Design Principles for Connected Devices
- Internet Principles
- IoT Enabled Manufacturing System
- Smart Factory and Smart Manufacturing

Textbook(s):

1. Yingfeng Zhang, Fei Tao, Optimization of Manufacturing Systems using the Internet of Things, Academic Press- Technology & Engineering, 2016.

Reference Book(s):

1. Jiafu Wan, Iztok Humar, Daqiang Zhang, Industrial IoT Technologies and Applications, Springer, 17-Aug-2016.
2. K. Wang, Y. Wang, J.O. Strandhagen, T. Yu, Advanced Manufacturing and Automation V, WIT Press, 2016.
3. Ovidiu Vermesan and Peter Friess, Internet of Things – From Research and Innovation to Market Deployment, River Publishers, 2014.

MH 3082 Minor Project

Credit: 2
Category: PROJ

Course Description:

Students are required to undertake a minor project either as an individual or in a group in consultation with the project guide which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

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

CO1: perform a background study on certain technical aspect and formulate a project objective
CO2: outline a pathway for the implementation of the project within the time line
CO3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
CO4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
CO6: communicate effectively with a range of audiences and prepare technical reports

MH 3092 CIM and Robotics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This laboratory imparts skill and the basic knowledge on manufacturing, industrial automation, installation, modification, maintenance, and repair. This provides and helps them to integrate and transform the ideas into a high quality and precised products in minimum time and cost. Integration of data in CIM with CAD system to link NC, CAM, Part Programs, Manufacturing process planning and Robotics, with programming. The students can be trained practically to utilize this knowledge in industry.

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

CO1: ability to understand the latest developments and the main elements in computer integrated manufacturing systems
CO2: understand and interpret different controllers used in in industries, machines NC, CNC and DNC systems, ASRS, AGV, VIS, Industrial robots and entire CIM System
CO3: identify and demonstrate manual and APT part programs for 2D complex profiles, automated tool paths and G-s for machining components and test the programs through simulation
CO4: ability to apply modern computational, analytical, simulation tools and techniques to face the challenges in manufacturing
CO5: understand & write programs for Flexible Manufacturing Systems & Robotics
CO6: apply these learnings to automate & improve efficiency of manufacturing process

Topics:

- Introduction to Computer Integrated Manufacturing (CIM) Lab
- Introduction to OPEN CIM Software
- Operating Aristo Robo
- Operating ASRS
- Introduction to CNC and Part Programming
- Operating CNC mill.
- Introduction to CNC Simulator CNC Train
- Programming using Linear and Circular Interpolation, contouring with Left Cutter Diameter Compensation, contouring with Right Cutter Diameter Compensation, Contouring Through Subprogram, MIRRORING, Drilling and Pocketing
- Operating CNC Turn
- Introduction to CNC Simulator CNC Train
- Contouring (Rough Turning), Box Facing, Taper Facing, Multiple Facing,Step, Taper Turning, External box Turning
- Demonstration on entire CIM

MH 3094 Mechatronics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This laboratory imparts skill and knowledge on, how to approach a system by understanding the module, application of components in the system, characteristic and design function in the system. This provides knowledge about synergistic integration of Mechanical engineering, Electronics, Control & Computer through the design process. The practical significance of various parameters those are involved in different modes of mechatronics can be recognized. The knowledge of mechatronics can be applied for different applications in an effective manner. The students can be trained practically to utilize this knowledge in industry.

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

CO1: select and apply the knowledge, techniques, skills and modern tools in mechatronics engineering technology
CO2: apply concepts of circuit analysis, analog and digital electronics, automation and controls, motors, electric drives, power systems, instrumentation, and computers to aid in the design, characterization, analysis, and troubleshooting of mechatronics systems
CO4: apply the different drive systems for actuation of various parts and components of a system, understand the different controllers used in industries, machines and industrial robots
CO5: understand the concept of CNC machining
CO6: develop the G for part programming

Topics:

- Study the working of IR range finder using LabVIEW
- Study the working of Accelerometer using LabVIEW
- Study the working of an ultrasonic sensor using LabVIEW
- myoelectric signal acquisition using LabVIEW
- Controlling of stepper motor using LabVIEW
- Controlling of stepper motor with microcontroller using MATLAB.
- Study of DC Servomotor Position Controller for P and PI Control with microcontroller using MATLAB/SIMULINK
- Detection of smaller objects with one-way light barrier and background suppression
- Development of wireless sensors provide useful information at a distance from the data acquisition system

MH 3096 PLC and Motion Control Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Digital Circuit Laboratory (EE 2094)

Course Description:

PLC Laboratory is to aware the students about the Industrial Automation Techniques. The students will be familiar with different switches, sensors, actuators and measuring instruments which are most frequently used in process control industries. The students will be enabling with the upgraded relevant advanced software based controller utilized in modern industry. PLC laboratory gives the effort for making them efficient to design and construct the hardware part related to desired process control. Students can be able to know the technique and logical programme behind the Industrial process Control.

Course Outcomes: At the end of the course, student will be able to:

CO1: describe typical components of a Programmable Logic Controller
CO2: explain and apply the concept of electrical ladder logic and its relationship to programmed PLC instruction
CO3: explain the concept of basic digital electronics and data manipulation
CO4: use timer, counter, and other intermediate programming functions
CO5: design and program basic PLC circuits for entry-level PLC applications
CO6: design and program automated industrial production line

Topics:

- Introduction to PLC programmable logic controller
- Details of programming language as LAD
- LADDER Programming using NO, NC
- Programming on SPST and SPDT Logic
- Introduction to TIMER and COMPARATOR BLOCK
- Introduction to COUNTER BLOCK

MH 4001 Robotics Advanced Concepts and Analysis

Credit: 3
Category: PEC
Prerequisite(s): Principle of Control Systems (EE 3009), Sensors & Actuators (EI 3007)

Course Description:

This course will help students to understand the basic concept and design of robotics, industrial application and future scope of robotics in industries as well as other applications i.e. space exploration, household applications etc. Through this course, students will be able to learn the basics of kinematics and dynamics of robotic manipulator, velocity and acceleration of robotics joints, and robotic path planning. At the end of this course, students will be able to solve numerical problems related to robotic kinematic, dynamics and trajectory planning.

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

CO1: select kinematic mechanisms for a particular task by robot
CO2: classify different sensors and actuators for body parts of robot
CO3: model the mechanism for position, velocity and acceleration at various points
CO4: analyse the kinematics of robot
CO5: assess different controlling parameters of robot by programming
CO6: design the best robotics applications for overall advantages to industry

Topics:

- Basic concept of robotics and configuration of robot
- Kinematics of Manipulator
- Dynamics of Manipulator
- Trajectory planning and position control
- Industrial application of robots
- Wheeled robot and future of robots

Textbook(s):

1. Robotic Engineering An Integrated Approach- Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice Hall of India

Reference Book(s):

1. M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey, “Industrial Robotics-Technology, Programming and Applications”, McGraw-Hill Book and Company (1986).
2. S. K. Saha, “Introduction to Robotics”, Tata McGraw-Hill Publishing Company Ltd. (2008).
3. S. B. Niku, “Introduction to Robotics–Analysis Systems, Applications”, Pearson Education (2001).
4. A. Ghosal, Robotics “Fundamental Concepts and Analysis”, Oxford University Press (2008).
5. Pires, “Industrial Robot Programming–Building Application for the Factories of the Future”, Springer (2007).
6. Peters, “Image Guided Interventions – Technology and Applications”, Springer (2008).
7. J. J. Craig, “Introduction to Robotics Mechanics and Control”, 2nd edition, Addison-Wesley (1989).

MH 4003 Introduction to Biomechatronics

Credit: 3
Category: PEC
Prerequisite(s): Principle of Control Systems (EE 3009), Sensors & Actuators (EI 3007)

Course Description:

The Biomechatronics course integrate the mechanical, electronics, biomechanics and information system. The course mainly contains introduction and basics of biomechanics, biosensors and actuators, image processing, prosthetics and wearable mechatronics devices. There are various applications of biomechatronics devices in healthcare sector such as Wearable Artificial Kidney, Knee and foot prosthesis, Ligaments cardiovascular biomechanics etc. The students will learn about design and application of biomechtronics devices through this course.

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

CO1: understand both the biomechanical and neuro-scientific principles governing human movement
CO2: work and contribute on sensors and actuators used in biomedical system design
CO3: understand the principle, design and applications of various flow measurement assisted device for the human functional system
CO4: design and develop bio mechatronic devices
CO5: able to design prostheses for amputees
CO6: design and develop wearable mechatronics devices

Topics:

- Musculoskeletal biomechanics and orthopaedics biomechanics
- Fundamental and application of biosensor
- Biomedical Signal and Image Processing
- Sensory Assisted devices
- Active and Passive Prosthetic Limbs
- Wearable mechatronics devices Hours

Textbook(s):

1. Graham M. Brooker, “Introduction to Bio-Mechatronics”, Sci Tech Publishing, 2012.

Reference Book(s):

1. Reddy D C. “Modern Biomedical Signal Processing – Principles and Techniques”, TMH, New Delhi, 2005
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Bio-Medical Instrumentation and Measurements”, II edition, Pearson Education, 2009.
3. Raymond Tong Kaiyu . “Bio-mechatronics in Medicine and Healthcare” Pan Stanford Publishing, CRC Press, 2011.

MH 4005 Computer Vision and Image Processing

Credit: 3
Category: PEC
Prerequisite(s): Digital Signal Processing (EC 3007) & Principle of Digital Signal Processing (EC 3013)

Course Description:

This course covers the concept of image formation and image processing; Applications in Colour/Motion based Image, Segmentation, Background Modelling and Shape Clustering, Machine Learning techniques in Vision and various applications of object recognition and modelling. At the end of this courses students will be able to apply different image transformation techniques, analysis image processing and enhancement techniques.

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

CO1: analyse different image processing technique to retrieve image information
CO2: differentiate between different image transformations techniques
CO3: analyse different image enhancement techniques
CO4: analyse the concept of color image processing
CO5: analyse the concept of image restoration
CO6: differentiate between different image compression and segmentation techniques

Topics:
- Image formation
- Image processing
- Segmentation and its types
- Object tracking and classification
- Object modelling and recognition

Textbook(s):
1. David Forsyth and Jean Ponce, Computer Vision aModern Approach, Prentice Hall India 2004.
2. B. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2008.

Reference Book(s):
1. E.R. Davies, Machine Vision, Theory Algorithms Practicalities, Elsevier 2005
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision. Brooks/Cole / Thomson 1999
3. Basics of some image processing aspects. Texture Chapter 24 (Perception) of Russell and Norvig AI A modern Approach. Prentice Hall 2000.
4. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Compute Vision, Cambridge Univ Press 2000.
5. Richard O. Duda, Peter E. Hart, and David G. Stork, Pattern Classification, 2nd ed., Wiley Asia, 2002

MH 4007 Advance Control and Optimization

Credit: 3
Category: PEC
Prerequisite(s): Control Systems (EL 3001)

Course Description:

This course focuses on the design of robust control system, Lead and Lag compensation design using Bodes plot, PID controllers and its application, Modelling uncertainty, noise and non-linearity, Optimal control using the Linear-Quadratic Regulator (LQR), Introduction to Model-Predictive Control (MPC) and Introduction to optimal control using Linear-Quadratic-Gaussian (LQG) techniques. Knowledge of this course would help students to learn about PID control techniques, estimating robust performance using the v-gap metric, SISO design using the Youla parameter technique, Lead and Lag compensation design using Bode plot and optimal design techniques for linear system.

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

CO1: design cascade and feedback compensation using Bodes Plot
CO2: design PID Controllers
CO3: create theoretical and computer models of multivariable automotive systems
CO4: apply different advanced control techniques to automotive control problems
CO5: able to use MATLAB and Simulink (commercial software packages) to design control algorithms for automotive systems
CO6: design state estimators for multivariable automotive control systems using established techniques

Topics:
- Cascade and feedback compensation
- PID and Robust Control System Design
- Modelling multi-variable systems
- Optimization in multi-variable control
- Multi-variable estimator design using pole-placement techniques
- Neoclassical control and robust control

Textbook(s):
1. Control System Engg, J. Nagrath & M. Gopal 3rd Edition New Age International Publisher
2. Modern Control Engg., By K. Ogata 3rd Edition PHI

Reference Book(s):
1. Discrete Time Control System, K. Ogata 2nd Edition Pearson Education

MH 4009 Sensors and Signal

Credit: 3
Category: PEC
Prerequisite(s): Introduction to Instrumentation Engineering (EI 2008)

Course Description:

This course will help students to learn different measuring techniques and instruments, error analysis during measuring, different types of sensors and transducers and their industrial application. The knowledge of this course will help to understand the structure of operation amplifier, application and types of filters for noise control and signal conditioning. The students can apply knowledge of this course to identify different measuring devices and sensor for measuring physical quantities.

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

CO1: apply different methods for the measurement of length and angle
CO2: elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
CO3: explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
CO4: analyse, formulate and select suitable sensor for the given industrial applications
CO5: understand signal-conditioning circuits
CO6: apply the various operational amplifiers and voltage to frequency converters

Topics:
- Definition and types of measurement and measuring instruments
- Types of error and error analysis
- Types of sensors
- Signal conditioning
- Types of filters

Textbook(s):
1. Doebelin, E.O. and Manic, D.N., Measurement Systems Applications and Design, McGraw Hill (2004).
2. Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai (2008).

Reference Book(s):
1. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).
2. Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, Tata McGraw Hill (2003).

MH 4081 Project-I

Credit: 3
Category: PROJ

Course Description:

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain research objective or advanced technical domain. The work encompasses two semesters and to be carried out in two phases (Project-I and Project-II). In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

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

CO1: conduct a detailed research survey or background study and summarize the theory and findings
CO2: formulate a research question or a general objective of the project
CO3: propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
CO4: conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
CO6: communicate effectively with a range of audiences and prepare technical reports

MH 4082 Project-II

Credit: 10
Category: PROJ

Course Description:

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

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

CO1: readily apply fundamental concepts in their area of study for executing the projects
CO2: demonstrate skill in using modern technical tools, apply advanced technical knowledge, integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
CO3: provide engineering solutions to predefined research question or project objective; design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
CO4: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
CO5: communicate effectively with a range of audiences and prepare detailed technical reports
CO6: demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

COURSES OF OTHER PROGRAMMES

AE 2004 Automotive Mechatronics

Credit: 3
Category: PCC
Prerequisite(s): Principle of Electronics Engineering (EC 2025)

Course Description:

This course is focused on the wide application of electronics in various automotive subsystems to the students of Automobile Engineering who has basic knowledge of electronics engineering. This course emphasizes on microprocessor 8085, sensors and actuators. The significance of the pin diagram and coding required to program a microprocessor can be appreciated. In view of changing emission norms the fuel injection system in IC engine vehicle plays an important role and students will learn about electronic injection control. Students will also learn about electronic chassis control, anti-lock braking system etc.

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

CO1: state the functions of microcomputer 8085
CO2: select the appropriate electronic components to be used in an automobile
CO3: design schematic of different sensors and actuators for various automotive systems
CO4: examine the efficacy of electronic engine management systems
CO5: formulate the electronic chassis control and safety mechanism
CO6: select among the algorithm of microprocessor programming for various applications

Topics:

- Microcomputer 8085
- Analog to digital converters and Digital to analog converters
- Sensors and actuators
- Solenoids, stepper motors and relays
- Electronic engine management system
- Electronic vehicle management system
- Display Devices
- Onboard diagnostics
- GPS navigation

Textbook(s):

1. Understanding Automotive Electronics, William B. Riddens, Butterworth Heinemann, Woburn, 5th edition 1998.

Reference Book(s):

1. Embedded System – Architecture, Programming, Design, Rajkamal, Tata McGraw Hill, 2003.
2. Instrumentation Devices and Systems, Raman, C.S., Sharma, G.R., Mani, V.S.V., Tata McGraw Hill, New Delhi, 1983.
3. Understanding Automotive Electronics, Bechhold, SAE- 1998.
4. Embedded System Design – A Unified hardware & Software Introduction, Frank Vahid, John Wiley, 2002.

EC 2011 Digital Electronics

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course covers all basic concepts in digital systems. The course starts with fundamentals of Boolean Algebra-different number systems and inter-conversions, binary codes and K-maps. This will be followed by designing of various combinational circuits such as adders, subtractors, decoders, encoders, magnitude comparators, multiplexer and de-multiplexers. Detail concept about memory elements (flip-flops) will be provided that will help the students to learn about various design techniques of sequential circuits like shift registers, counters and FSMs. Fundamentals of digital logic families, ADC and DAC will also be covered that will help the students to learn digital electronics principles comprehensively in today's perspective.

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

CO1: comprehend, simplify and realize Boolean expression
CO2: comprehend and analyze combinational circuits using logic gates
CO3: design various asynchronous & synchronous sequential circuits using Flip-Flops
CO4: design & implement Mealy and Moore model FSMs for different synchronous sequential circuits
CO5: analyze and differentiate between different logic families such as TTL & CMOS chips
CO6: comprehend and analyze the concept of different types of Analog-to-Digital converters and Digital-to-Analog converters

Topics:

- Introduction to Boolean Algebra
- Combinational Circuits
- Sequential Logic
- Finite State Machine (FSM)
- Logic Families
- A/D and D/A

Textbook(s) :

1. Fundamentals of Digital Logic – Anand Kumar - PHI, 2nd Edition, 2011
2. Digital Logic and Computer Design – M. Morris Mano – PHI,2011

Reference Book(s):

1. Digital Principles and Applications – Malvino & Leach –TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011

EC 2020 Microprocessors, Microcontrollers & Interfacing

Credit: 4
Category: PCC
Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The objective of this course is to teach the fundamentals of Microprocessor (like 8085, 8086) and Microcontroller (like 8051) systems to the students. In this course, the students learn about assembly language to program the Microprocessors, Microcontrollers and develop programs to solve simple applications.

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

CO1: comprehend the basic concept of Bus structure, a basic 8-bit Microprocessor (like 8085) system, its architecture, concept of stack, Addressing modes etc.
CO2: explain the architecture of a 16-bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation
CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
CO5: explain the features of the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16-bit processor
CO6: explain and analyze memory organization of a 8-bit Microcontroller (like 8051), its addressing modes, instructions, timers & counters and its serial communication

Topics:
- 8085 (8-bit Microprocessor)
- 8086 (16-bit Microprocessor)
- Interfacing Chips
- 8051 Family of Microcontrollers

Textbook (s) :
1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall,McGraw Hill Education Pvt Ltd., 3rd edition.

Reference Book(s):
1. Microprocessor Architecture, Programming and Applications with the 8085 - Ramesh S. Goankar, Penram International Publishing (India).
2. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd edition.
3. Microcontroller Theory & Applications - Deshmukh, McGraw Hill Education Pvt Ltd.

EC 2025 Principle of Electronics Engineering

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the efficacy of Electronic principles which are pervasive in engineering applications. Students will be able to understand the essence and applications of electronic components used in different electronic circuit. They will understand the working of diode and transistor and their characteristics, benefits of feedback in amplifier, oscillators, design of simple circuits like amplifiers (inverting and non- inverting), adders, integrator and differentiator using OPAMPS, a digital logic and apply it to solve real life problems.

Course Outcomes: At the end of course the students will be able to:

CO1: understand the properties of semiconductors and current conduction mechanisms
CO2: comprehend the working of P-N junction diodes; identify different diode circuits and analyze them
CO3: understand the working of BJT, different modes and configuration, identify and analyze their biasing circuits, understanding the working of CE amplifier and its properties
CO4: analyze the working of op-amp using either inverting or non -inverting configurations, timing circuit, regulated power supply ICs and their applications
CO5: comprehend the concept of feedback in electronic circuits, types of feedback, their applications
CO6: comprehend the working of different logic gates, combinational and sequential circuits, develop a brief idea about microprocessor and microcontrollers

Topics:

- Semiconductors
- Junction Diodes
- Bipolar Junction Transistor (BJT)
- Feedback Concept
- Operational Amplifiers (OPAMP) and 555 timer
- Digital Electronics

Textbook(s) :

1. Electronics- Fundamentals & Applications- D. Chattopadhyay and P.C Rakshit- 11th Edition (New Age International)
2. Electronic Devices and Circuits- D. A. Bell- 5th Edition (Oxford)

Reference Book (s):

1. Electronic Devices & Circuits- R. L. Boylestad- 10th Edition(Pearson)
2. Digital Principles and Applications- A. Malvino and Leach-7th Edition(TMH)

EC 2090 Microprocessor and Microcontroller Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This lab is utilized by 4th semester Electronics and Telecommunication Engineering, Electronics and Computer Science Engineering students, 5th semester Electronics and Electrical Engineering and Electronics and Instrumentation Engineering students. Students develop Assembly language programming skills on 8085, 8086 and 8051 kits. Students do their experiments in both hardware and software platforms. They use TALK software and design some Interfacing circuits on bread board like seven segment display to glow decimal digits 0-9 and four-way traffic control circuits and design of LEDs to glow in proper sequence. They also Interface with CRO to display square wave and interface with Digital to Analog Converter to display Triangular and Saw tooth wave forms.

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

CO1: develop Assembly language programming skills on 8085, 8086 Microprocessor and 8051 Microcontroller trainer kit
CO2: utilize PCLink communication software for Intel 8085 & 8086 Assembly language programming to execute programs and design practical circuits
CO3: design practical circuits like 4 way traffic light system, generation of square wave using CRO, interfacing of seven segment display using PPI
CO4: utilize 86DRV communication software for Intel 8086 Assembly language programming to execute programs and design practical circuits
CO5: utilize B30DRVM communication software for 8051 Microcontroller & Assembly language programming to execute programs and design practical circuits
CO6: formulate, design and solve real life engineering problems for executing projects

Topics:

- Familiarization with 8085 and 8086 Microprocessor Kit and verification of instruction sets
- Execution of sample Assembly language programs on 8085 MP Kit
- Introduction to TALK communication software and execution of Assembly language programs using Cross Assembler
- Design a circuit and write a suitable program to display decimal digits 0 to 9 using 8085 and seven segment display
- Design a four lane Traffic control system using PC, 8085 MP Kit and additional hardware
- Familiarization with 8051 Microcontroller Kit and execution of basic programs using TALK communication software & Cross Assembler
- Generation of a 2 KHz square wave on Port 1.3 (Pin-4) with Timer 0 interrupt, using TALK software and 8051 MC Kit
- Open Ended Experiments

EC 2096 Digital and Linear Integrated Circuit Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Analog Electronics (EC 2027) and Electronic Circuits & Network Laboratory (EC 2091)

Course Description:

This laboratory includes analog to digital converters, digital to analog converters, lab designer kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits for different experiments. Verilog, Xilinx, LabVIEW, TinkerCAD and PSpice simulation experiments along with the hardware implementation of simple digital and analog circuits are performed in this laboratory.

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

CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
CO2: analyze and simulate combinational logic circuits like adder. using Logic Gates in association with EDA Playground and TinkerCAD
CO3: analyze and simulate combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD
CO4: analyze and simulate sequential logic circuits like synchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD
CO5: design and simulate the analog circuits like R-C differentiator circuit in association with TinkerCAD
CO6: design and simulate the analog circuits like practical Integrator and Comparator using operational amplifier IC LM 741 in association with TinkerCAD

Topics:

- Logic Gates
- Half Adder
- 2 Line- to- 4-Line Decoder
- 2 bit Synchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- R-C Differentiator circuit
- Integrator circuit using Operational Amplifier IC LM 741
- Comparator circuit using Operational Amplifier IC LM 741
- Open ended experiments

EC 6108 Digital Image Processing

Credit: 3
Category: PEC
Prerequisite(s): Digital Signal Processing (EC3007), Introduction to Digital Signal Processing (EC3013)

Course Description:

This course introduces the concept of Digital image formation, representation and processing of digital image using digital devices such as computers. The processing or manipulation of digital image is achieved via both spatial and frequency domain with an aim to improve pictorial information for better human interpretation, storage, transmission and representation. Towards this goal the course provides both basic and in-depth coverage of image processing techniques such as image enhancement, restoration, color image processing, compression, segmentation, morphological processing and different mathematical transforms.

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

CO1: analyze different image processing applications and learn different techniques to create and apply on digital image for better interpretations of an image
CO2: implement various enhancement and restoration techniques
CO3: explain and analyze the concept of color image processing
CO4: evaluate different image compression techniques for various applications
CO5: explain the concept of morphological operations and image segmentation
CO6: interpret the effect of applying different image transforms

Topics:

- Fundamentals of image processing
- Spatial domain methods of image enhancement
- Frequency domain methods of image enhancement
- Image degradation model and restoration via Inverse filter, Weiner filter and constrained least square approach.
- Color image processing via different color models and inter conversion between them
- Different image transforms such as DFT, DCT, Hadamard, KL and SVD and its importance in processing of a digital image so that different types of redundancy can be overcome ,hence an adequate of image compression can be occurred.
- Morphological processing through dialation, erosion, opening and closing and discussion on few applications
- Region and edge based method of image segmentation and discussion on few applications
- Review of matrix algebra, 2-D convolution.

Textbook(s) :

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Prentice Hall, 3rd edition, 2008

Reference Book(s):

1. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall
2. Digital Image Processing, S.Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2009.
3. Digital image processing and Analysis, B. Chanda, D. Dutta Majumder, PHI, 2004.

EE 2011 DC AC and Special Electrical Machines

Credit: 4
Category: ESC
Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Construction, Principle of Operation of DC generator and motors, their characteristics, Losses and efficiency, necessity of starter, principle of operation of transformer, different tests, Regulation, Losses and Efficiency, construction and operation of Three-phase synchronous Machines, Voltage regulation, construction and operation of Three-phase induction motor, Torque-Slip characteristics, starting and speed control, construction and working of Single-Phase Induction Motors and Special Motors such as Stepper motor, shaded pole motor, repulsion motor, Universal Motor, Reluctance Motor, Hysteresis Motor.

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

CO1: know the construction, basic principle of operation and performance characteristics of DC machines
CO2: understand the construction, basic principle of operation and testing of Transformer
CO3: utilize the knowledge of three-phase induction motor and three phase synchronous machines
CO4: analyze the operation and applications of single-phase induction motors
CO5: assess the basic principle, operation and applications of special electrical machines
CO6: discuss the performance of Universal motor, Reluctance Motors, and Hysteresis motors

Topics:
- DC Generator
- DC Motor
- Transformer
- Three-phase Synchronous Machines
- Three-Phase Induction Motor
- Single-Phase Induction Motors
- Special Motor

Textbook(s):
1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013

Reference Book(s):
1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications.23rd Edition 2010.
3. Electric Machines, C. I. Hubert, Pearson Education,2nd Edition, 2003.

EE 2028 Linear Control System

Credit: 3
Category: PCC
Prerequisite(s): Electrical Circuit Analysis (EE 2015), Signals and System (EE 2022)

Course Description:

Open loop and closed loop control system, Mathematical modeling of mechanical system and electrical system, Transfer function from signal flow graph using Mason's gain formula, Time response of first and second order system, Minimization of Errors through P, PI and PID controllers, Routh- Hurwitz stability criterion, Construction of Root Locus and rules, Polar plots, Bode plots, Nyquist stability criterion, Concept of state, State variable, State model for LTI system, Lag, Lead and lag lead compensators.

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

CO1: recall the terminology of control systems
CO2: understand the mathematical model of physical systems
CO3: apply the concepts of time domain analysis of different systems
CO4: analyze the stability of a system by classical methods
CO5: evaluate the frequency domain response and different compensators
CO6: discuss about the state space modeling of different systems

Topics:

- Introduction to Control System
- Modeling of Physical System
- Time Domain Analysis
- Concept of Stability
- Root Locus Technique
- Frequency Domain Analysis
- Compensators
- State Space Analysis

Textbook(s):

1. Control System Engineering, by Noran S Nise, John Wiley Publication, 6th Edition, 2012.
2. Modern Control Engineering, by K. Ogata PHI publication, 5th Edition, 2010.

Reference Book(s)

1. Control Systems Engineering, by R. Anandnatarajan and P. Ramesh Babu, SCITECH,4th edition, 2016.
2. Control Systems Theory and applications, by Smarajit Ghosh, Pearson. Publication ,2nd Edition,2012
3. Automatic control system, by Hasan Saeed, S.K. Kataria and Sons, 6th revised edition 2008
4. Modern Control Engineering, by D. Roy Choudhury PHI publication, 5th Edition,2009.
5. Automatic Control Systems, by Benjamin C. Kuo, Prentice-Hall, 7th Edition,2009.
6. Control System Engineering, by I. J. Nagrath and M Gopal, New age international publication, 4th Edition,2011.
7. Control System, by D N Manik, Cengage Learning India Pvt, 1st Edition,2012

EE 2095 DC AC and Special Machines Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

The main objective of this laboratory is to provide the practical exposure to the student regarding operation of various electrical machines like DC generators, DC Motors, Alternators, Synchronous motors, Induction Motors, Special Motors and Transformers. Students are allowed to conduct various experiments for the validation of performance characteristics of all the machines. From this laboratory courses student will gain the skill to select correct machine for a specific application.

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

CO1: memorize the working principle and applications of different electrical machines
CO2: discuss the problems in industrial applications of electric motors
CO3: demonstrate of different electrical machines
CO4: distinguish between the different electrical machine according to the requirement in the industrial applications
CO5: learn about the safety precautions to be taken while using electrical equipment
CO6: design the equivalent circuit of the transformer and construct the circle diagram of an induction motor

Topics:

- No Load and Load Characteristics of a (i) D.C Shunt Generator and (ii) Separately Excited Generator
- Calculate the efficiency and losses of a single-phase transformer by the open circuit and short circuit test
- Design of the circle diagram using the No load and Block rotor test on three-phase induction motor
- Determine the load characteristics of Stepper motor

Textbook(s):

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013

Reference Book(s):

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.
3. Electric Machines, C. I. Hubert, Pearson Education, 2003.
4. Electric Machines, by Kothari. D P and I J Nagrath, , 3rd Edn, Tata McGraw-Hill, New Delhi. 2004.

EE 3011 Power Electronics and Drives

Credit: 4
Category: ESC
Prerequisite(s): DC AC and Special Electrical Machines (EE 2011)

Course Description:

Elements of Power Electronics, Thyristor characteristics, Power BJT, Power MOSFET and IGBT, Controlled rectifiers with R, R-L, R-L-E load and effect of freewheeling diode, Dual converters, Effect of source Inductance, 3-phase half wave and full wave controlled rectifiers, Chopper operation, Buck, Boost and Buck-Boost converters, Fly back converter, Single phase Half Bridge and Full bridge inverters, Sinusoidal pulse width Modulation, Single phase AC to AC phase control with R and RL load, Four quadrant operation of electric drives, PWM Inverter fed induction motor drives, Concept of V/f control, Concept of Stepper motors and control.

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

CO1: remember the working principles of different power electronics devices
CO2: understand the concepts of single phase and three phase controlled AC-DC Converters
CO3: apply the Power Electronic Devices for the control and operation of DC to DC Converters
CO4: analyze the single phase and three phase DC to AC Inverters
CO5: evaluate the phase controlled AC to AC voltage regulators and Cycloconverters
CO6: discuss the Electric Drives and their applications

Topics:
- Power Switching Devices
- AC to DC Converters
- DC to DC Converters
- DC to AC Converters
- AC to AC Converters
- Electric Drives

Textbook(s):
1. Power Electronics by P. S. Bimbhra, Khanna Publishers, 4th edition, 2012
2. Fundamentals of Electric Drives by G K Dubey, Narosa Publishers, 2nd edition 2007.

Reference Book(s):
1. Power Electronics By M. H. Rashid, Pearson Education, 3rd Edition, 2014.
2. Power Electronics, Converters, Applications and Design N. Mohan, Undeland and Robbins, John Wiely and Sons, Third Edition, 2002.
3. Fundamental of Power Electronics by S K Bhattacharya, Vikas Publishing, 1st edition-2005.
4. S. K. Pillai: A First Course on Electrical Drives, Second Edition, New Age International Publishers 2007.
5. N. K. De, P. K. Sen: Electric Drives, 7th Edition, PHI Learning Pvt. Ltd., 2004.
6. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013

EE 3097 Power Electronics and Drives Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Power Electronics and Drives (EE 3011)

Course Description:

This course utilizes the knowledge of Power Electronic to verify AC-DC converters, which are examined in details with R and RL loads. Analysis of DC-DC converters are done so that experimental verification can be facilitated. The waveforms and the output voltage equation of SMPS are experimentally verified. It also impart knowledge on performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics. Students will perform experiments related to topics studied in electric drives like various DC and AC motor drives and their control.

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

CO1: choose an appropriate converter for variety of needs
CO2: comprehend the principles of operation of various converters
CO3: apply AC-DC converters for rectification
CO4: analyze the parameters and the waveforms of the output of the converters
CO5: evaluate the electrical and mechanical parameters of a given motor
CO6: design different DC and AC motor drives electric drive industrial and domestic applications

Topics:

- Study of output voltage waveforms and parameters of three phase uncontrolled rectifier
- Study of single phase fully controlled AC-DC converter with R and RL laod
- Verify the performance of DC-DC converters
- Speed control of separately excited DC motor by armature voltage control method using single phase fully controlled AC to DC converter with and without load
- Speed control of 3 phase squirrel cage induction motor using V/F control method

Textbook(s):

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai: A First Course On Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference Book(s):

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, 2003

EI 2008 Introduction to Instrumentation Engineering

Credit: 3
Category: PCC
Prerequisite(s): Introduction to Electronics Engineering (EC 2025)

Course Description:

The course aims at developing fundamentals of measurement and instrumentation, their technological aspects of design and development, handling & applications, characterization & analysis, which are necessary for day-to-day practices in engineering domain especially for mechatronics undergraduates. The course deals with the basic principles of measuring instruments and precision measurement techniques in domain of mechanical, electrical and electronics engineering.

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

CO1: define various aspects of instruments characteristics, significance of measurements, and associated parameters
CO2: classify and compare different methods of measurement and instruments including mechanical, electrical and electronics
CO3: understand and apply the principles of basic metrology, instrumentation and measurement systems
CO4: simplify and provide solution to measurement related problems
CO5: carry out analysis for the selection of suitable instruments
CO6: model and design basic instruments and measurement methods

Topics:
- Measurement System and Metrology
- Mechanical Measurements
- Electrical Measurements
- Electrical Instruments
- Electronic Instruments

Textbook(s):
1. Engineering Metrology, R.K. Jain, 2005, Khanna Publishers.
2. Electrical and Electronic Measurements & Instrumentation, A. K. Sawhney – Dhanpat Rai, 2013.

Reference Book(s):
1. Electronic Measurement & Instrumentation, H. Cooper – PHI, 2nd Edition.
2. Engineering Metrology, I. C. Gupta, 7th edition, Dhanpat Rai & Sons.

EI 2096 Measurement Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Introduction to Electronics Engineering (EC 2025)

Course Description:

The course focuses on gaining practical knowledge of measurement systems and instruments, their specifications, handling &operations with suitable safety measures. This includes the needful practices of electrical and electronics measurements and associated instruments along with simulation tools such as MATLAB/OCTAVE and Multisim.

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

CO1: read and interpret the specifications of measurement systems and instruments from data sheet and user's manual
CO2: handle and operate electrical and electronics instruments with suitable safety measures
CO3: perform experiments for the measurement of electrical parameters and acquisition of signals
CO4: make necessary modifications in the instruments to extend their range
CO5: observe the measurement errors and estimate the instruments faults using instruments calibration with standards
CO6: carry out the statistical analysis of measurement data to evaluate the standard deviation and probable error

Topics:

- Measurement of resistance using Wheatstone bridge and Kelvin's double bridge
- Measurement of inductance using Hay's bridge and Owen's bridge
- Measurement of capacitance using using Schering bridge
- Calibration of voltmeter and ammeter using DC potentiometer
- Extension of range of voltmeter and ammeter
- Operation of function generator and CRO/DSO
- Data acquisition using DSO using NI MyDaq/Multisim
- Statistical analysis of measurement data and estimation of probable error using MATLAB/OCTAVE.

EI 3007 Sensors & Actuators

Credit: 3
Category: PCC
Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003), Introduction to Instrumentation Engineering (EI 2008)

Course Description:

The main aim of introducing this course is to provide the basic concept of instrumentation and its characteristics and details on identification, classification, construction, working and domestic as well as industrial applications of various transducers used for displacement, temperature, level, pressure and flow measurements. The course includes also sensing principle for the measurement of motion, force, torque using analog and digital transducers. It includes actuating principles for continuous drive actuators and stepper motors. It also includes methods for signal collection, conditioning and analysis. Various components will be experimentally tested and analyzed.

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

CO1: identify various transducers, sensors, micro-sensors, actuators and their brief performance specifications
CO2: understand the working principle of temperature sensors
CO3: understand the working principle of pressure sensors
CO4: understand the working principle of level sensors
CO5: understand the working principle of flow sensors
CO6: understand the working principle of force, displacement, acceleration sensors

Topics:

- Introduction to sensor and actuator
- Measurement of Pressure, Force and Weight
- Temperature Measurement
- Displacement & Velocity Measurement
- Level Measurement
- Flow Measurement
- Signal conditioning techniques
- Actuators

Textbook(s):
1. Industrial Instrumentation & Control, S.K. Singh,3rd Edition, TMH

Reference Book(s):
1. Transducer & Instrumentation, Murthy.DVS, 2001, Prentice Hall of India
2. Sensors & Transducers, Patranabis.D, 2003, PHI

EI 3022 Bio-Medical Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course focuses on the use of multiple sensors to monitor physiological characteristics of a human or animal. It involves measurement of biological signals like ECG, EMG, or any electrical signals generated in the human body.

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

CO1: identify various bio-medical signals and instruments
CO2: analyze various bio-medical transducers, sensors and their brief performance specifications
CO3: analyze the principle of various bio-medical instruments, transducers used to measure temperature, pressure
CO4: analyze the principle of various bio-medical instruments used to measure heart rate
CO5: differentiate between various bio-medical instruments
CO6: analyze applications of various bio-medical instruments in medical purposes

Topics:

- Biomedical Signals & Electrodes
- Blood pressure measurements
- Engineering analog of Heart
- X-ray imaging
- Computer aided tomography (CAT)
- Bio-telemetry
- Patient Safety

Textbook(s):

1. Hand Book of Biomedical Instrumentation- by R. S. Khandpur, 2nd Edition, Tata McGraw Hill.
2. Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, PHI learning Pvt. Ltd.

Reference Book(s):

1. Introduction to Biomedical Equipment Technology- by Joseph J. Carr, John M. Brown, 4th Edition, Pearson Education.

EI 3023 Neural Network and Fuzzy Logic Control

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Control Systems (EL 3001)

Course Description:

This course is about Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. Objective of this course is to impart adequate background knowledge so that in future students will be able to design and implement various machine learning algorithms in a range of real-world applications. The course covers learning based solutions for regression and classification, by using error minimization, concept of association, competitive learning, and fuzzy rule based methods. The course The course also covers applications of ANN and fuzzy logic for solving pattern recognition and control system.

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

CO1: analyze supervised and unsupervised learning for regression, classification and clustering
CO2: comprehend the concepts of feed forward neural networks
CO3: identify and describe appropriate Artificial Neural Network techniques in building intelligent machines
CO4: demonstrate the concept of fuzziness involved in various real world phenomena and need of fuzzy set theory
CO5: comprehend fuzzy rule based or expert system
CO6: analyze applications of Neural Network and Fuzzy logic in image processing

Topics:

- Introduction to Machine Learning
- Feed Forward Neural Network and Back-Propagation
- Pattern Association and Adaptive Resonance models
- Learning of ANN models based on Competition
- Fuzzy Set Theory and Fuzzy Membership
- Fuzzy-Inference-Systems
- Applications of Neural Network and Fuzzy Logic

Textbook(s) :

1. Fundamentals of Neural Networks, Laurene Fausett, Pearson Education, 2004
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw-Hill, 1998

Reference Book(s):

1. Introduction to Neural Networks Using Matlab, Sivanandam , S. N , Sumathi, S. and Deepa, S. N, 2005, TMH.
2. Fundamentals of Artificial Neural Networks, Mohammad H. Hassoun, 1st edition, 2019, PHI
3. Neural Networks and Fuzzy Systems, Bark Kosko, 1st edition, PHI

EI 3097 Sensors & Actuators Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Instrumentation Laboratory (EI 3091)

Course Description:

The main aim of introducing sensors & actuators lab is to provide idea of different sensors and automation process (PLC/DCS) for understanding the characteristics and performance of the level, temperature and flow closed process loop system and to give mathematical description and complete tuning procedures of level, flow, pressure and temperature loops and their applications in industry. PLC platform with HMI is also available, through which it can be performed different on-board applications and application based experiments like dc motor speed control using ladder logic. There is also a scope of performing experiments on different temperature sensors, displacement sensor, force sensor, level sensor and flow sensors on online and offline mode.

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

CO1: simulate and obtain the characteristics of open and close loop response of temperature, level and flow process loop stations using PID controller
CO2: realize the concepts of interacting and non-interacting liquid level system
CO3: realize the concept of PLC &DCS and its interfacing with real time system
CO4: control speed of DC motor actuator with PLC using ladder logic programming
CO5: obtain the performance of LVDT, RTD, Thermocouple, strain gauge and load cell
CO6: realize the characteristics of control valve

Topics:

- Simulation of characteristics of LVDT (Displacement sensor) and its hardware verification
- Simulation of characteristics of RTD (Temperature sensor) and its hardware verification
- Simulation of characteristics of Thermocouple (Temperature sensor) and its hardware verification
- Simulation of characteristics of Strain Gauge (Force Sensor) and its hardware verification
- Design of Orifice meter (Flow sensor) for a typical application
- Hardware Verification of Open and Closed Loop Performances of Flow Rate Regulatory Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Heat Furnace Process Using E-906 PID Controller
- DC motor speed control using PLC Ladder logic programming
- Measurement of level in a tank using simulation based capacitive type level probe and its hardware verification
- Study the characteristics of photodiode and phototransistor

EL 3022 Advance Control Systems

Credit: 3
Category: PEC
Prerequisite(s): Principle of Control Systems (EL 3001)

Course Description:

This course is intended for undergraduate students of the Electronics and Control Systems Engineering and Electronics & Electrical Engineering programs. The course will help in forming a strong foundation for the broad areas of Advance control theory. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems.Advance Control systems in this introductory course, we will start with the basics of Time and Frequency correlation. Subsequently, we will discuss the theory of Lead & Lag compensator, PID controller tuning, State space Analysis
Finally, we will introduce the basics of Non linear systems, And Discrete control systems. Wherever possible, applications of the theory in real world scenarios have been provided.

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

CO1: comprehend the importance and design of lead compensator and lag compensator to practical systems
CO2: analyse the importance and design of PID controller and its tuning methods
CO3: analyse the importance of state space approach and realization of physical systems
CO4: apply the knowledge of controllability and observability to perform various tests for finding it
CO5: comprehend the importance of nonlinear elements and apply it to make nonlinear to linear and its stability methods
CO6: design discrete control system and its applications to analyze the real time processes

Topics:
- Cascade and feedback compensation
- Design of Lead, Lag Compensator
- PID controller Tuning
- Introduction to State Space Analysis
- Solution of State equations and State transition matrix
- Nonlinear Control Systems
- Discrete Control Systems

Textbook(s):
1. Control System Engg, J. Nagrath& M. Gopal, 3rdEdition, New Age International Publisher
2. Modern Control Engg., By K. Ogata, 3rdEdition, PH

Reference Book(s):
1. Discrete Time Control System, K. Ogata, 2ndEdition, Pearson Education

HS 2002 Engineering Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Engineering Economics is a specialized need-based extension of applied Economics which is aimed at developing an understanding of the principles governing Economy's vital parameters like market, finance, Production,consumption and distribution.. The course focuses on learning methodical and rational conceptualization and developing the knowledge for effectively implementing these market principles in actual organizational activities and forums. The course intends to develop the ability of taking decisions related to project selection and implementation, optimization of market vitals like sales, revenue, profit, cost etc. It serves as the base of learning all Economics related elective papers offered in higher semesters as well as preparation for any competitive exams like civil services, MAT etc.

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

CO1: apply economic theory for optimisation of the economic variables of demand, supply,sales,profit, cost and revenue
CO2: apply the budgeting principles in making economic decisions during project appraisals
CO3: develop awareness towards all the economic issues related to the financial market, Budget, Money, Credit and Fiscal Policies etc.
CO4: relate and apply theoretical concepts in Economics with contemporary/modern business practices
CO5: understand the vitals of the financial market, know the source and methods of raising capital for an organization
CO6: understand the depreciation of asset principles and efficient inventory/resource management

Topics:

- An Introduction to Economics and Engineering Economics
- Basic Concepts of Economics: Market equilibrium and Consumers and Producer's equilibrium
- Elasticity and Demand Forecasting
- Optimization of Profit and cost
- Break Even Analysis
- Evaluation of Projects: Economic Appraisal Techniques
- Depreciation calculation and Inventory management
- Vitals of Money and capital market

Textbook(s):

1. Managerial Economics: Principles and Worldwide Applications. Dominick Salvatore,Siddartha K.Rastogi,8th Edition,Pub.Oxford University Press.ISBN: 9780199467068.
2. Engineering Economics –James L.Riggs, DavidD.Bedworth and Sabah U.Randhawa,4thEdition, McGraw Hill Education(India) Private Limited, New Delhi,2016.

Reference Book(s):

1. Principles of economics, Deviga Vengedasalam and Karunagaran Madhavan, Oxford University Press, New York,3rd Edition,2013.
2. Managerial Economics-Principles and Worldwide Applications-Dominick Salvatore, Adapted by Ravikesh Srivastava,7thEdition, Oxford University Press,2012.
3. Micro ECON-A South-Asian Perspective-by William A. McEachern and Simrit Kaur, Cengage Learning, 2013.

4. Engineering Economy-Zahid A. Khan, Arshad Noor Siddiquee, BrajeshKumar, Pearson Publication, 2012.
5. Engineering Economics – R.Panneerselvam, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.

HS 2008 Economic Environment of India

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The Course on Economic Environment of India is designed to cater encompassing discernment of Indian Economy to the students. The course precisely highlights the role of different sectors in Indian economy and also touches upon the normative aspect of striking balance among different sectors. It covers the status of public economics in Indian context. Besides, it ensures the students to have knowledge on the role of foreign sector.

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

CO1: develop the analytical understanding of the economic situation of the country
CO2: develop the skill to interpret the economic indicators during steady growth path and economic crisis
CO3: acknowledge the role of different policy making bodies in India related to economic affairs
CO4: develop the ability to analyze the occupational structure of the country and sectoral contribution to growth
CO5: examine the extent and role played by foreign sector in the form of exchange rate, FDI etc in the domestic economy
CO6: develop a critical understanding of the fiscal position of the country

Topics:

- Economic Crises and Way out: Economic Crisis of early 1990s-Macro Economic Reforms since 1991
- Primary Sector and Secondary Sector: Agriculture during the Reform Period; New Industrial Policy
- Tertiary Sector and Foreign Sector: Service sector as the engine of growth in India; Trade reforms
- Public Finance: Fiscal reforms in India post 1991; Centre-State Fiscal relationship

Textbook(s):

1. Dutt and Sundaram.Indian Economy. latest edition.

Reference Book(s):

1. Uma Kapila (2019), Indian Economy since Independence, New Delhi, Academic Foundation.
2. Balakrishnan, P. (2010): 'Economic Growth in India: History and Prospect'. Oxford
3. University Press, New Delhi.
4. Bhagwati Jagdish and Arvind Panagariya(2012): ' India's Tryst with Destiny'. Collins Business, Noida, India.
5. Jean Dereze and Amartya Sen (1996): 'Indian Development: Selected Regional
6. Perspectives'. Oxford University Press, New Delhi.
7. Ajijava Raychaudhuri and Prabir De (2012), International Trade in Services in India, New Delhi, Oxford University Press.

HS 2010 Financial Institutions, Markets and Regulations

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Financial Institutions, Markets and Regulations is a specialized need-based extension of Financial Economics. This course is designed to present the fundamental concepts and theories in financial market and promote the application to the workplace and professional practice. It introduces current financial concepts and tools towards money management in organizations participating in the local and global economies. The course covers the current best practices in financial analysis and planning through the application of financial concepts in a nutshell. These include financial vitals relate to money and capital markets, time value of money, cost of capital, risks and return, long-term financial budgeting. Inaddition, the course also introduces topics on lease financing, hybrid securities and derivatives, trust funds, mergers and acquisitions and related issues in current financial sector.

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

CO1: have comprehensive understanding of the nature and functions of the several types of financial institutions operating in the market
CO2: develop critical skills in applying the principles of finance and financial inter-mediation to the real world situations
CO3: effectively interact with the financial markets they need to approach for their future economic endeavors and/or in their place of employment
CO4: make economic decisions and analysis of issues related to security market transactions and policies
CO5: develop the understanding of the structure and functions of Indian financial institutions, instruments and policies
CO6: take decisions regarding saving, investments, portfolio contents and diversification to maximize their return and reduce associated risks

Topics:

- Financial systems: Significance of banks and all other Financial institutions
- Financial Innovations
- Overview of Structure of Financial Debts and Equity markets
- Functions of Financial Intermediaries
- Monetary authority: Reserve Bank of India: Its role, structure and functioning
- Subprime crisis
- Derivative markets
- Capital market authority: structure and functions
- Regulation of Capital market, Role of SEBI

Textbook(s):

1. Madura, Jeff (2008), Financial Markets and Institutions, 8th edition, Thomson Publications.

Reference Book(s):

1. Fabozzi, Frank, Modigliani, Franco, Jones, Frank (Feb 2009), Foundations of Financial Markets.
2. Eakins, Stanley G. (2005), Financial Markets and Institutions (5th Edition), Addison Wesley.
3. Howells, Peter, Bain, Keith (2007), Financial Markets and Institutions, 5th Edition.
4. Barth, James R., Caprio, Gerard, and Levine, Ross (2008), Bank Regulations are Changing: For Better or Worse?, Association for Comparative Economic Studies.

5. Goldstein, Morris (2006), Financial Regulation after the Subprime and Credit Crisis, Washington: Peterson institute.

HS 2012 Development Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Development Economics is a specialized need-based extension of Economics dealing with issues related to economic growth and development. It provides an in depth discussion of the different economic description of development and underdevelopment. It will put a deep insight into the most challenging economic issues of poverty, inequality and underdevelopment faced by the humanity. It will deal with the various existing, modern and developing strategies and policies to tackle these issues and foster the economy onto the path of development. The students will be able to assess the pros and cons of a proposed development intervention and its likely impact on the target population.

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

CO1: develop the understanding of issues related to economic growth and economic development
CO2: relate and apply the major growth theories in their related academic projects
CO3: develop the familiarity with major economic issues faced by the country like poverty, inequality, underdevelopment etc.
CO4: analyse and compare the development paths adopted across countries of the globe
CO5: analyse the empirical evidence on the pattern of growth and development
CO6: develop critical understanding of the existing, adopted and needed policies and strategies for sustainable growth and development

Topics:

- Concepts and difference between growth and development.
- Measures of growth and development
- Models of growth and development
- Poverty and Inequality : Perceptions, estimation and measures of improvement
- Impact of poverty and inequality on growth and development
- Cross country perspectives of development

Textbook(s):

1. Todaro, M. P. & Smith, S. C. (2015), Economic Development, Pearson (12^{th} Edition).
2. Thirlwall A. P. Growth and Development (6 th and 7 th edition)

Reference Book(s):

1. Debraj Ray : Development Economics
2. Meier and Rauch,: Leading Issues in Economic Development, OUP, Latest Edition
3. Kaushik Basu :Analytical Development Economics , OUP
4. Human Development Reports, various years
5. Bagchi A. K. The Political Economy of Underdevelopment, Cambridge University Press 1982.

HS 2081 Business Communication

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

This course is designed to give students a comprehensive view of communication, its scope and importance in business. This is an interactive course with a view to enhance language and soft skills with the aid of live demonstration within the framework of the syllabus. It is a foundation building measure to enable the students to excel in the corporate world and in day to day life.

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

CO1: develop competence in reading and comprehension, develop skimming skills for extracting the main idea(s) from the text, and scanning for keywords
CO2: enrich the fluency of the students with Collocations and Phrasal Verbs
CO3: use Email effectively and efficiently as per the organization hierarchy. To retain a logical flow while drafting emails, make aware students about the importance of succinct written expression in modern Business Communication
CO4: write standard and effective Cover Letters and Resume
CO5: bridge the gap between native language and target language i.e. English, make students communicative competent and develop their fluency in public speaking
CO6: prepare effective Power Point Slides. Maintain and arrange proper data structure in presentations. To learn skills of making effective presentation (verbal and non-verbal aspects)

Topics:

- Reading Comprehension – Activity based on BEC Training – Matching, Multiple Choice Questions, Open Close, Giving Appropriate Headings
- Collocation – Activity based on Word-Stock, Phrasal Verbs & Vocabulary Building
- E-mail – Activities based on Writing Appropriate Salutation, Paragraphs & Conclusion
- Resume Writing
- Thematic Discussions
- Speaking in Pairs – Everyday Activities & Detailed Introduction
- Activity based on PowerPoint Presentation

HS 3006 Entrepreneurship

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students in order to provide basic knowledge of an entrepreneur and opportunities for new entrepreneurship. To provide idea about various financial sources available for small and medium enterprise by different financial institutions. To provide knowledge how to manage working capital of an organization in an efficient manner. To have an idea about motivational tools for increasing the productivity of employees in an enterprise.

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

CO1: know the contribution of an entrepreneur in growth and development of socioeconomic condition of our country
CO2: understand the role of SSI units in growth and development of socioeconomic condition of our country
CO3: learn market survey, sales promotions and management of working capital through costing and book keeping
CO4: know different decision making technique and benefit of personal management system.
CO5: learn motivational methods of an enterprise
CO6: learn how to prepare a project report and knowledge about different tax system of an enterprise

Topics:

- Introduction to entrepreneurship
- SSI Units
- Market survey and research
- Marketing mix
- Financial management
- Working capital management
- Personnel management
- Motivation

Textbook(s):

1. Entrepreneurial Development, S.S.Khanka, S.Chand

Reference Book(s):

1. Industrial Organisation and Engg. Economics, Sharma & Banga, Khanna Publication
2. Entrepreneurship New Venture Creation, David H. Holt, Prentice Hall, PHI

HS 3008 Management Concepts And Practices

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course curriculum is designed for student in order to provide fundamental knowledge in management area. The students will be able to know about general management concepts and various specialization in management area like marketing, finance, production and strategy management. The marketing management portion of the course will benefit the students to develop their career in marketing line, as most of the organisations give priority for marketing skills. Finance and production management will help the students in their respective domain and serve as a guide in their corporate career. The strategy management portion of this course will serve as a guide for the students to contribute in strategy formulation of the organization and how to achieve that strategy within a stipulated time period.

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

CO1: perform the critical management functions effectively and develop ideas about implementing principles and theories of management in organizations efficiently
CO2: develop various marketing skills in order to be successful in corporate world
CO3: utilize different financial techniques for better management and control of organisational financial resources
CO4: take strategic decision for day to day operation through proper working capital management.
CO5: have competency in production planning as well as control measures will become easy in their professional career
CO6: do strategy formulation of the organization and how to achieve that strategy within a stipulated time period

Topics:

- Introduction to management
- Marketing mix
- Market research
- Financial management
- Working capital management
- Production planning and control
- Inventory management
- Strategy management

Textbook(s)

1. Modern Business Organisation and Management. Sherlekar & Sherlekar, Himalaya Publishing House.
2. Business Organisation and Management. M. C. Shukla, S. Chand

Reference Book(s)

1. Principles & Practices of Management. L. M Prasad
2. A framework for marketing management, Philip Kotler
3. Financial Management. I. M Panday
4. Production and Operation Management, Everett E. Adam Jr. Ronald J. Ebert

HS 3002 Organisational Behaviour

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students to provide an understanding about the behaviour of individuals, groups and the system in the organization. The course will help the students how to develop personality and leadership style for achievement of individual and organizational objective. To know about the benefit of motivation for increasing individual and organizational productivity. To Provide knowledge to work in groups and develop techniques for group decision making for organizational development.

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

CO1: know about organization, organizational behaviour its nature, scope and significance
CO2: develop their personality as per industry requirement
CO3: apply motivational techniques to make the employees work with confidence and satisfaction
CO4: develop different leadership style to adjust themselves in different organizational situations
CO5: improve the knowledge of group behaviour and techniques of group decision making
CO6: apply the concepts for managing changes in organization as well as the development of an organization's human resources

Topics:
- Introduction to Organisation and organisational behaviour
- Personality
- Motivation
- Leadership
- Group dynamics
- Organisational change
- Organisational development

Textbook(s) :
1. Organisational behaviour. Stephen P. Robbins, Timothy A. Judg, S. Sanghi, Pearson
2. Organizational Behaviour and Work, F. M. Wilson, Oxford University Press.

Reference Book(s):
1. Organizational Behaviour, Dipak Kumar Bhattacharya, Oxford University Press
2. ORGB, Organizational Behaviour, Nelson, Quick, Khandelwal, Cengage
3. Organisational Behaviour. Dr. S. S Khanka, S. Chand
4. Managing Organisational Behaviour, Moorhead & Griffin, Cengage Learning.

HS 3004 Human Resource Management

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed in order to provide knowledge and idea about human resource management and how to become a professional human resource manager. It will help the students to follow different HR processes like recruitment, training, performance appraisal effectively in organizational level. The students will able to learn how to manage industrial dispute and develop industrial relation in corporate sector. The course will enable the students to understand the workers participation in management concept through employee discipline and the process of effective bargaining system in the organisation.

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

CO1: develop personal and professional qualities of a manager in order to manage human resource of an organization effectively
CO2: meet the human resource requirement of the organization for achieving its objective effectively
CO3: follow different HR processes like recruitment, selection, training, performance appraisal effectively in organizational level
CO4: inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives
CO5: achieve strategic objectives of the organizations, by optimizing the potentiality of the human resource through workers participation in management
CO6: know the technique of managing and being managed by the organisation

Topics:

- Human resource management
- Human resource planning
- Recruitment
- Selection
- Training
- Performance appraisal
- Industrial relation
- Industrila dispute
- Collective bargaining
- Workers participation in management

Textbook(s):

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication, 2016
2. Human Resource Management, B. Varkkey & G. Dessler, Pearson, 2017

Reference Book(s):

1. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
2. Human Resource Management. S. S. Khanka, S. Chand, 2019
3. Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2018.

HS 4001 Professional Practice, Law and Ethics

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Professional Practice, Law and Ethics is designed to cater comprehensive insight of law and ethics to the students for practicing in their professional life. The course incisively highlights the role of morals and ethics in leading a sustainable profession. Besides, by containing different relevant laws like laws of contracts, intellectual property law and information technology law, the course provides foundation in law to the students which will help them a lot to face the real life situations with ease.

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

CO1: select appropriate engineering decisions in consideration of professional ethics in realization of more critical impact of engineering compared to general experiments
CO2: evaluate and prescribe risk reducing measures
CO3: comprehend the dynamics in engineers' roles and responsibilities with emerging issues in global scene
CO4: know the various compliance requirements and the regulatory bodies to protect environment
CO5: have a fair idea to protect their engineering inventions from unauthorized exploitation under intellectual property rights system and laws relating to information communication technologies
CO6: understand, analyze and prevent misuse of IT related transactions

Topics:

- Morals and ethics in engineering
- Engineering as social experimentation
- Engineer's responsibility for safety
- Global issues
- Law of contracts and law of torts
- Environmental laws
- Intellectual property law
- Information technology law

Textbook(s):

1. R. Subramaniam, Professional Ethics, Oxford University Press, 2013
2. Indian Contracts Act 1872
3. Patents Act 1970 (Unit-3)
4. Designs Act 2000 (Unit-3)
5. Information Technology Act 2000 (Unit-4)

Reference Book(s):

1. Mike Martin and Ronald Schinzinger, "Ethics in Engineering", McGraw Hill New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thomson Learning, 2000

HS 4003 Legal Issues and Requirements in Engineering

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course description:

It depicts on law of contracts and law of torts, Consumer Protection Act 1986, Environmental Protection Act 1986, Environmental Impact Assessment 2006, standards for emission, discharge of environmental pollutants from various industries, Intellectual Property Law, Protecting engineering invention, the U.S Utility model approach and need for Utility model in India, Protecting Software and other engineering technologies in cyberspace, maintaining data security and technological privacy in Cyberspace, e-contracts, electronic and digital signatures.

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

CO1: understand the various legal requirements in terms of contracts
CO2: interpret the product liability which an engineer is required to take care while processing his engineering innovations
CO3: illustrate the various compliance requirements and the regulatory bodies to protect the environment
CO4: demonstrate to protect their engineering inventions from unauthorised exploitation under intellectual property rights system and laws relating to information communication technologies
CO5: identify Legal Issues in a given case
CO6: analyse and prevent misuse of IT related transactions

Topics:

- Law of contracts and law of torts
- Environmental Laws
- Intellectual Property Law
- Information Technology Law

Textbook(s):

1. Gurdeep Singh “Environmental Laws” Eastern Book Company,2nd Edition 2016.
2. V K Ahuja “Law Relating To Intellectual Property Rights”Lexis Nexis, 3rd Edition. July 2017.
3. Pavan Duggal “Cyber Law”-Indian Perspective”. 2nd Edition 2016.
4. Avtar Singh” Law of Contracts” Eastern Book Company,12th Edition, Reprinted 2020.
5. Dr. R K Bangia “Law of Torts”. Allahabad Law Agency; 24th 2019 edition (2019).

Reference Book(s):

1. Rosencranz “Enviromental Law and policy in india”.Oxford University Press, 2001.
2. Howard b rockman “Intellectual Property Law for engineers and scinentists”.ISBN: 978-0-471-69740-4, Wiley-IEEE Press, June 2004.
3. Mireille Hidebrant “ smart technologies and the end of law”. ISBN: 978 1 78643 022 9.

IT 4027 Software Project Management

Credit: 3
Category: PEC
Prerequisite(s): Software Engineering (IT 3003)

Course Description:

The course provides an in depth examination of project management principles and modern software project management practices. The different process models for an IT project are examined in the context of the systems development lifecycle. Methods for managing and optimizing the software development process are discussed along with techniques for performing each phase of the systems development lifecycle. Various parameters of software project management like cost estimation, metrics to estimate cost, effort, quality, and reliability are also discussed in this course.

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

CO1: understand job roles of an IT project manager and conduct project-planning activities
CO2: determine an appropriate process model for an IT project
CO3: estimate project costs, timelines and quality
CO4: implement, monitor and control processes for successful resource, communication, risk and change management
CO5: design the organization structure for the IT project and manage the contract, people and team.
CO6: define the metrics and measure quality and reliability

Topics:

- Introduction to Software Project Management
- Project Evaluation and Programme Management
- An Overview of Project Planning
- Selection of Project Approach
- Software Effort Estimation
- Activity Planning and Resource Allocation
- Risk Management Monitoring and Control
- Managing Contracts & People and Team Working
- Software Quality

Textbook(s):

1. Bob Hughes and Mike Cotterell, Rajib Mall, “Software Project Management “, TMH-5e, 2011

Reference Book(s):

1. Henry.J, Addison, Software Project Management,-A Real-World Guide to Success, Wesley,2004.
2. Pankaj Jalote, Software Project Management in Practice, Pearson Education, 4e,2011.
3. S.A. Kelkar, Software Project Management, A Concise Study, Prentice -Hall , India, 3e, 2010.
4. Jerome D, Wiest, Ferdinand K Levy, A Management Guide to PERT/CPM, PHI,2e, 2008
5. Ince D, Sharp H, and Woodman M., Introduction to Software Project Management and Quality Assurance, McGraw-Hill, 1993

MA 2005 Mathematics-III

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

Students are taught Partial differential equations based on the propagation of heat, wave etc. Numerical analysis is included to get approximate solutions to those problems for which analytical solution is difficult to obtain. Students are given fundamental Probability and Statistical knowledge to use statistical analysis of data.

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

CO1: solve problems on Partial Differential Equation by separable method
CO2: analyze two dimensional wave and heat equations problems with boundary conditions and solve
CO3: determine roots of algebraic/transcendental equations through Newton and Lagrange method and obtain interpolating Polynomials
CO4: evaluate differentiation and integration and solve ODE and PDE through numerical technique
CO5: use the concepts of regression and co-relation and curve fitting by least square method
CO6: work out problems related to probability distribution and hypothesis testing

Topics:

- Partial Differential Equation
- Numerical Analysis
- Probability
- Statistics

Textbook(s):

1. Grewal B. S., Higher Engineering Mathematics, Khanna Publishers, 44th edition

Reference Book(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.
2. Engineering Mathematics by S. Pal and S. C. Bhunia, Oxford University Press.

ME 2013 Kinematics and Dynamics of Machines

Credit: 4
Category: PCC
Prerequisite(s): Engineering Mechanics (ME 1003)

Course Description:

This course would consist of the basic concepts of mechanisms, its velocity and acceleration analysis. It also consists of fundamental concepts of mechanical power transmission such as belts, ropes, chains and gear drives along with the analysis of different cam profiles. The latter half of the course describes dynamic force analysis of engine parts, turning Moment diagrams, flywheels, gyroscopic effect, working of different governors, Primary and Secondary balance of single and multi-cylinder engines and fundamental concepts of free, forced and damped vibration.

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

CO1: understand the basic kinematics of mechanisms, working principles of power transmission drives and cams profiles for different follower motion
CO2: understand the dynamic analysis of mechanisms, balancing along with the working principle and applications of governors, gyroscopes and flywheels
CO3: evaluate static and dynamic forces in reciprocating and rotating devices
CO4: analyze gyroscopic effects in case of plane discs, automobiles, ships and air crafts
CO5: Identify the number of degrees-of-freedom (mobility), types of links and joints within mechanisms. To assimilate the concept of synthesis and analysis of the most commonly used mechanisms
CO6: design flexible and rigid mechanical components to transmit power and to design and prescribe necessary components/systems to reduce effects of variations in the time-varying forces

Topics:
- Simple Mechanisms
- Velocity Analysis
- Acceleration Analysis
- Belt and Rope and Chain Drive
- Gear and Gear Trains
- Cams
- Force analysis
- Gyroscope
- Governors
- Balancing
- Vibration

Textbook(s):
1. Theory of Machines, S. S Rattan, TMH, 4th Edition

Reference Book(s):
1. Theory of Machines, J. Shigley, TMH
2. Machines and Mechanisms: Applied Kinematics Analysis, David H Myszka, PHI
3. Kinematics of Machinery through Hyper Works, J.S. Rao, Springer, 1st Edition
4. Theory of Machines, Sadhu Singh, Pearson
5. Theory of Mechanism and Machines, Sharma & Purohit, PHI
6. Theory of Machines and Mechanisms, John Joseph Uicker, Gordon R. Pennock, Joselph E.Shigley, Oxford Univ Pr (Sd), 2010

ME 2021 Fluid Mechanics and Hydraulic Machines

Credit: 4
Category: PCC
Prerequisite (s): Mathematics-I (MA1003), Mathematics-II (MA1004), Physics (PH 1007)

Course Description:

This course offers an extensive analysis of the basic laws of the fluid mechanics such as Newton's law of viscosity, Hydrostatics law, Pascal's law of pressure etc. The concept of stability of bodies in fully and partially submerged condition is discussed. Application of dimensional and model analysis is studied in order to predict the prototype. The concept of boundary layer theory widens the knowledge on the viscous effect of fluid adjacent to solid surface. It includes the impact of jet on stationary and moving vanes in order to understand the performance of hydraulic machines.

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

CO1: recall the properties of fluids, mechanism of viscosity, concept of continuum and classification of fluids based on Newton's Law
CO2: explain the effects of fluid pressure at a point, pressure measuring devices such as manometers etc.
CO3: apply the knowledge of buoyancy to determine the stability of submerged and floating bodies, computing the metacentric height and oscillation of a floating body
CO4: select different methods to predict the prototypes performance with the help of dimensional and model analysis
CO5: design the submerged bodies applying fundamental laws of fluid mechanics and boundary layer theory
CO6: evaluate the performance of various hydraulic devices such as turbine and pump

Topics:

- Properties of fluids
- Pressure and its measurement
- Hydrostatic forces on surfaces
- Buoyancy and floatation
- Kinematics of fluid flow
- Dynamics of inviscid flows
- Dimensional and model analysis
- Dynamics of viscous flow
- Boundary layer theory
- Fluid flow around submerged bodies
- Hydraulic Turbines
- Centrifugal pump
- Reciprocating pump

Textbook(s):

1. Fluid Mechanics and Hydraulic Machines, Sukumar Pati, McGraw Hill Education (India) Pvt. Ltd, New Delhi
2. Hydraulics and Fluid Mechanics Including Hydraulics Machines, P.N. Modi, Standard Publishers Distributors

Reference Book(s):

1. Fluid Mechanics, Y. Cengel and J. Cimbala, McGraw Hill Education (India) Pvt. Ltd, New Delhi
2. Fluid Mechanics, Frank M. White, McGraw-Hill Series in Mechanical Engineering.

3. A Text Book of Fluid Mechanics, R. K. Rajput, S. Chand Ltd.

ME 2023 Thermofluids

Credit: 4
Category: PCC
Prerequisite(s): Mathematics-I (MA 1003)

Course Description:

This course covers brief understanding of vast subjects in thermal and fluid science. After completion of the course, the students will be able to decide the feasibility of any process from thermodynamic points of view. Basis of power production in different ways like steam power cycle and internal combustion engine, are covered. Fluids are used in all types of engineering equipment, and understanding of fluid properties, fluid machines and head loss in flow; will help the students to maximize the benefits of these equipment.

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

CO1: recall different units and principle of measuring thermodynamic properties like temperature, pressure, energy etc.
CO2: explain working principle of different thermofluid engineering equipment such as heat engine, refrigerator, turbine and pump etc.
CO3: illustrate the ways of improving performance of different engineering systems
CO4: analyze effect of thermodynamic properties variation on performance of different fluid machines like turbines and pumps
CO5: design simple pipe networks, refrigeration systems and work producing engines
CO6: evaluate the performance of engineering equipment under varied temperature, pressure and fluids

Topics:

- Laws of Thermodynamics
- Steam Properties and Steam Power Cycles
- Refrigeration and Psychrometry
- Fluid Properties and Dimensional Analysis
- Flow in Pipes and Pipe Networks
- Fluid Machines

Textbook(s):

1. Introduction to Thermal and Fluid Engineering, Allan D. Kraus, James R. Welty, Abdul Aziz, CRC Press, 2019.

Reference Book(s):

1.Introduction to Thermal and Fluids Engineering, D. A. Kaminski, M. K. Jensen, Wiley, 2017.
2. Engineering Thermodynamics, Parthasarthi Chattopadhyay, 1st Ed., Oxford Univ. Press
3.A Textbook of Thermal Engineering (SI Units), R.S. Khurmi, J.K. Gupta, 15th Ed., S. Chand
4.A Textbook of Fluid Mechanics and Hydraulic Machines, R.K. Bansal, 9th Ed., Laxhmi Publ.
5.Fluid mechanics Fundamentals and Applications, Y.A.Cengel, J.N.Cimbala, 3rd Ed., Tata McGraw Hill Education P. Ltd.

ME 2024 Industrial Engineering and Operations Management

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

Industrial engineering section represents achieving maximum results with minimum efforts with increasing the efficiency of factors of production. The Operations research section aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints in different area such as production planning & control, inventory control, quality control, and supply chain management. This course is well equipped with different operations research tools such as liner programming, operations scheduling and project management. Analyze any real life system with limited constraints and depict it in a model form.

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

CO1: apply mathematics, science, and engineering
CO2: design, develop, implement and improve integrated systems that include people, materials, information, and equipment
CO3: formulate and solve linear programming problems
CO4: recognize types of transportation and assignment problems and apply solution techniques.
CO5: identify various CPM and PERT method
CO6: apply the various types of operation research methods

Topics:

- Production Systems
- Production Planning and Control
- Demand Forecasting
- Inventory Planning and Control
- Operations Scheduling
- Quality Control
- Project Management
- Linier Programming

Textbook(s):

1. Production and Operation Management, R. Paneerselvam, Prentice Hall of India, 3^{Rr} edition
2. Operation Research by Hira and Gupta, S. Chand

Reference Book (s):

1.Operations Management: Processes and Supply Chains, Larry P. Ritzman, Manoj K. Malhotra, Lee J. Krajewski, PHI, 10th, 2012.
2. Modern Production/Operations Management, Sarin Buffa, Wiley India Pvt Ltd, 8th,2011.
3. Industrial Engineering and Production management, Telsang Mertand, S.Chand, 2002.
4. Operation Research by S D Sharma

ME 2027 Material Science and Engineering

Credit: 3
Category: PCC
Prerequisite(s): Physics (PH 1007), Chemistry (CH 1007)

Course Description:

This course would encompass a comprehensive study of different types of materials, their crystal structures and their mechanical, thermal, optical and magnetic properties. Moreover students will be able to study the phase diagram of materials, heat treatments methods and corrosion performance and learn to elucidate their phases, processing and properties for commonly used materials like steel and cast iron. With this knowledge students will be able to apply to solve common economic, environmental and societal issues in material science and engineering with correlation to different specializations. Overall students will be able to correlate the structure of different materials with their concerned processing and properties and select the right material and design considerations for their simulations and experimental research activities.

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

CO1: comprehend the material requirement for an engineering application
CO2: understand the structure of different materials and their mechanical, electrical, thermal and optical properties
CO3: understand material selection criteria using the phase diagram with emphasis on interpretation of the iron-carbon phase diagram
CO4: comprehend the heat treatment principles to change the mechanical properties of steel
CO5: analyze the various corrosion prevention methods and apply them to our day to day lives
CO6: correlate material structure to its processing and properties and apply to various engineering applications

Topics:
- Introduction to Engineering Materials
- Structure of Materials
- Phase diagram and phase transformations in metals and alloys
- Advances in metallic, non-metallic and advanced materials
- Economic, environmental and societal issues in material science and engineering
- Material selection and design considerations

Textbook(s):
1. Callister's Material Science and Engineering, Adopted by R. Balasubramanium, 2nd edition, Wiley India Pvt Ltd.

Reference Book(s):
1. Material Science and Engineering, V. Ragvan, Prentice Hall of India, 4th Edition.
2. Engineering Metallurgy: Applied Physical Metallurgy, R. A. Higgins, 6th Edition
3. MIT Open coursewares https://ocw.mit.edu/courses/materials-science-and-engineering/
4. NPTEL course: https://nptel.ac.in/courses/113/102/113102080/

ME 2083 Machine Drawing and Computer Aided Design

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

The aim of this sessional course is to develop two-dimensional and three dimensional drawing ability of machine components among students. The course starts with imparting basic concepts of machine drawing and CAD. Basic tools of the CAD software (prently Solidworks) is introduced to the students followed by making simple three dimensional machine components like pulleys, nuts, cotter joints, piston, etc. After that, assembly drawings of components like nut-bolt, tail stock, cotter and knuckle joint, screw jack, machine vice, piston assembly are taught. Extraction of orthographic views and sectional views from part and assembly drawings are also part the course.

Course Outcomes: At the end of this sessional course, the students will be able to

CO1: understand and learn the basic tools of CAD software
CO2: draw two dimensional three dimensional part drawings of machine components
CO3: Learn to assemble different part models to develop assembly
CO4: Draw assembly of different machine components such as nut-bolt, tail stock, cotter and knuckle joint, screw jack, machine vice, piston assembly, etc.
CO5: find sectional views, orthographic views from 3-D models using modeling softwares
CO6: design part and assembly of new proposed machine components

Topics:

- Introduction of 2-D tools of CAD software
- Introduction of 3-dimensional tools in CAD software
- Drawing 3-D models of basic machine components
- Assembly tools of CAD software
- Assembly Drawing of basic machine components
- Orthographic views of solid model/assembly
- Sectional views of a solid model/assembly
- Parametric tools to draw any 3-D model

ME 2085 Manufacturing Practices

Credit: 2
Category: PCLC
Prerequisite(s): Nil

Course Description:

This course would encompass a comprehensive study and experimentation on foundry, welding, shaper machine and milling machine. Knowledge of the course will help the students to cast aluminium to any shape through sand casting technique, to join similar or dissimilar metals using gas welding, TIG welding and MIG welding, to machine flat surfaces using shaper machine, and to prepare a spur gears through indexing in universal milling machine. At the end of the course the students will be able to solve casting, welding, shaping and milling related industrial problems through extensive and systematic research.

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

CO1: create aluminium castings of desired shape using sand casting method
CO2: apply the principles of gas welding to create welded joints between similar or dissimilar metals
CO3: apply the principles of TIG welding and MIG welding to create welded joints between similar or dissimilar metals
CO4: understand the mechanisms of shaper machine and create flat surfaces of desired dimension
CO5: understand the principles of milling operation and indexing
CO6: create spur gears of different shapes and dimensions through indexing using universal milling machine

Topics:

- Foundry
- Welding
- Shaping
- Milling

Textbook(s):

1. Manufacturing Technology (Part I), P.N. Rao, Tata Mc-Graw Hill, Publication. Co.Ltd.
2. Manufacturing Processes, J. P. Kaushish, PHI Learning Pvt. Ltd.

Reference Book(s):

1. Manufacturing Technology: Materials, Processes and Equipment: Helmi A. Youssef, Hassan A. El. Hofy and M.H. Ahmed, CRC Press.
2. Principle of Manufacturing Materials and Processes: J.S. Cambell, TMH
3. Welding & Welding Technology - R. Little, TMH.
4. Manufacturing Science: A. Ghosh & A.K. Mallick, EWP
5. Advanced Machining Processes, V. K. Jain, Allied Publishers Pvt. Ltd.
6. A Text Book of production Engineering, P C Sharma, S. Chand Publications.

ME 2093 Machine Kinematics and Dynamics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Kinematics and Dynamics of Machine (ME 2013)

Course Description:

This laboratory provides the basic and advance knowledge of various kinematics and dynamics machines and their parts like the coefficient of friction calculation setup, screw jack apparatus, flywheel setup, cam and follower analysis, the principle of Hartnell governor, gyroscopic couple calculation setup, damped or undamped with free or forced vibration calculation apparatus. Furthermore, these machines' practical applications in the industry will be discussed briefly during laboratory hours. After completing all the experiments, the students can implement this laboratory's outcome in their project work.

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

CO1: analyze the velocities and accelerations of mechanisms and IC engine parts
CO2: illustrate Hook's joint, Davis and Ackerman Steering gears. Compound pendulum, Bifilar and Trifler suspension
CO3: assess the effect of friction on mechanisms and the kinematics of cam and followers
CO4: elaborate the gyroscopic couple and its effect to two wheelers, four wheelers, ships, air-crafts etc.
CO5: discuss the static and dynamic balancing of high speed rotary and reciprocating machine parts like gear, cam, belt and chain drives
CO6: analyse both the free and forced vibrations of machines and structures

Topics:

- Determination of the coefficient of friction between different sliding surfaces
- Determination of the Mechanical Advantage (M.A), Velocity Ratio (V.R), Efficiency of a Simple Screw jack, and also verify the Law of machine
- Determination of the moment of inertia of the flywheel
- Study of Hartnell Governor and plot the curve between speed and sleeve displacement
- Study of cam and follower apparatus and draw the curve between follower displacement and angle of a cam rotation for a cam follower pair, and also observe the jump phenomenon
- Comparison between applied couple and theoretical gyroscopic couple
- Study of the longitudinal vibration of helical springs connected in series and parallel
- Study of undamped torsional vibration of two rotor-system, and Determination of the natural frequency
- Study of damped torsional vibration, and Determination of the damping coefficient
- Determination of forced vibration of an equivalent spring, mass and damper system, and plot the curve between amplitude and frequency
- Determination of the undamped free vibration of an equivalent spring, mass and damper system, and Determination of time period
- Study of various types of gears like spur, helical, straight bevel, rack and pinion, and worm gear

ME 2099 Fluid Mechanics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Fluid Mechanics & Hydraulic Machines (ME 2021)

Course Description:

This laboratory is introduced at the undergraduate level primarily to provide a hands on experience to the students on the application of basic concepts of fluid mechanics. This includes experiencing the energy balance equation, use of fluid flow measuring techniques, understanding coefficient of discharge, perspective of friction factor along with minor and major losses in pipe flow. This laboratory also provides the technical knowhow of basic and advanced measuring instruments to record and analyse various fluid flow parameters such as pressure, temperature, density, velocity, volume flow rate, viscosity etc. The objective of the included experiments in this laboratory is intended to train the students as per the current industrial needs.

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

CO1: recall the concepts of energy balance and Bernoulli's equation, metacentric height and meta center, Reynolds number, free and forced vortex, flow through pipes, venturimeter, orifice meter, rotameter and nozzle
CO2: express the condition of stability of floating bodies and identify the metacentric height at different loading condition of the ship. Explain and predict the surface profile and flow pattern of free and forced vortex flow
CO3: use the flow measuring techniques and sophisticated instruments to effectively find out the actual flow rate and velocity in a pipe line considering the friction factor and loss coefficient into account
CO4: calculate the coefficient of discharge of various fluid flow measuring devices and identity the loss coefficients, friction factors along with the minor and major losses due to pipe fitting, sudden enlargement and contraction in pipe line
CO5: propose the possible solutions for high pressure pipe line problems
CO6: interpret and analyse the velocity, pressure and temperature profile of fluid flowing in pipe line

Topics:

- Experimental verification of Bernoulli's equation
- Determination of coefficient of discharge for a venturi meter
- Determination of coefficient of discharge for an orifice meter
- Calibration and error analysis of a rotameter
- Determination of the Darcy's friction factor and major losses in pipe flow
- Determination of loss coefficient and minor losses due to pipe fitting, sudden enlargement and contraction in pipe line flow
- Determination of the metacentric height of a ship model
- Determination of the surface profile and flow pattern of a vortex apparatus
- Determination of the coefficient of discharge for a converging and diverging nozzle
- Determining the coefficient of Pitot tube and measurement of flow velocity at different point along the cross section in a pipe line

ME 3020 Advanced Manufacturing Processes

Credit: 3
Category: PEC
Prerequisite(s): Basic Manufacturing Processes (ME 2010)

Course Description:

This course would focus on a comprehensive study of advanced manufacturing processes that includes various non-conventional machining, Scopes of micro manufacturing Hydro and Explosive forming, Micro forming, Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), Lean manufacturing, Manufacturing technology of SMAs. Moreover, knowledge of the course will definitely help the students to proper identify different non-traditional process, forming processes and micro fabrication processes. At the end of the course the students will be able to answer machining related industrial issues for better application of non-conventional processes in industry 4.0

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

CO1: know the different non- traditional machining processes for up growing high strength materials with complicated and miniaturized products
CO2: understand the challenging issues in production of micro dimensioned products
CO3: apply the advanced forming processes for production of precession parts
CO4: apply the different micro fabrication processes to produce micro components
CO5: understand the concepts of smart materials and their use to mankind
CO6: apply the non-conventional processes in industry 4.0

Topics:

- Various Non-conventional Machining
- Different Scopes of micro manufacturing
- Hydro and Explosive forming
- Micro forming
- Chemical Vapor Deposition (CVD)
- Physical Vapor Deposition (PVD)
- Lean manufacturing
- Manufacturing technology of SMAs.

Textbook(s):

1. Advanced Machining Processes, V. K. Jain, Allied Publishers Pvt. Ltd.; 1st edition (2007)
2. Introduction to Micromachining, V.K. Jain, Narosa Publishing house, 2010

Reference Book(s):

1. Manufacturing Technology, Part –II, P.N. Rao, TMH, 3rd Edition, 2014
2. High Velocity Forming of Metals, ASTM
3. An Introduction to Microelectromechanical Systems Engineering, Maluf, Nadim, Norwood, Massachusetts, U.S.A. Artech House, 1999, ISBN 10 0890065810 / ISBN 13 9780890065815
4. Smart materials and Structures, Gandhi, M.V. and Thompson, B.S., , Chapman and Hall, 1992

ME 3028 Supply Chain Management

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course would encompass the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the market place. With effective SCM implementation inventory, production, distribution, sales and vendor inventory are all tightly controlled. SCM means managing costs at every step and delivering goods to consumers as quickly as possible. It assumes that every product that is for sale exists because of the various participants in the supply chain. At the end of the course the students will be able to solve Supplier selection and Supply chain related industrial problems through extensive and systematic research.

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

CO1: understand the important role of supply chain management in today's business environment
CO2: understand the risk associated with various supply chain practices
CO3: evaluate the implications of globalization and/or outsourcing components of the distribution network
CO4: analyze the interdependence between financial, non-financial and operational metrics used in pricing
CO5: apply problem solving and decision making frameworks that propose defensible solutions for supply chain
CO6: design a coordinated and collaborative processes and activities among the business partners

Topics:

- Understanding the supply chain, decision phases in supply chain
- Designing the distribution network
- Transportation in the supply chain
- Pricing and revenue management in the SC

Textbook(s):

1. Supply Chain Management: Strategy, Planning, and Operation, Chopra Sunil and Meindl Peter, PHI,
2. Designing and Managing the Supply Chain, David Semchi-Levi,Philip Kaminsy, TMH,

Reference Book(s):

1. Supply Chain Management: Text and Cases, Janat Saha, Pearson Education,
2. Logistics and Supply Chain Management, Martin Christoper, Pearson Education,

ME 3047 Production and Operations Management

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course basically consists of two parts, one is production and the other one is management aspects of the industrial setup. In production domain this course covers the work study, aggregate planning, inventory control, etc. including overview and the solution of numerical problems. The other part consists of supply chain, project management and statistical quality control. In these area also detail description and numerical problems are done. Scheduling of man-machine along with the Johnson's rule is also included in the course. In order to have a better insight to the industrial setups, facility location and various plant layout are also included to this course.

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

CO1: understand (identify/write) the various components that make up the manufacturing planning and control system and the interaction among them
CO2: understand the concept and applicability for supply chain, inventory management, including those for quantity discounts, safety stocks, and order quantity and reorder point interactions
CO3: evaluate the algorithms that are appropriate for solving single-machine, two-machine, parallel-machines and flow shop scheduling problems
CO4: analyze the material requirement plans, manufacturing resource plans, and capacity requirement plans, lot sizing decisions, etc.
CO5: apply the best plant location using different tools and design the plant layout using different techniques
CO6: design the process capability using statistical control techniques, understand the attributes chart and importance of acceptance sampling

Topics:

- Overview of Operations Management
- Work Study and Aggregate Planning
- Project Management and Supply chain Management
- Facility Location and Layout, Scheduling
- Inventory Control and Quality Control

Textbook(s):

1. Production and Operations Management, R. Paneerselvam, Third Edition,2013

Reference Book(s):

1. Production and Operations Management, K. Aswathappa, K. Shridhara Bhat
2. Production and Operations management, S. N. Charry, TMH

ME 3049 Industrial safety

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course would encompass a comprehensive study of need for safety and its legislations, standards, policy with respective responsibilities at organization levels.
This also describe types of industries and areas of industrial safety with regard to process ,personal and environment. It enables identifying causes ,analyzing and investigation of causes of accident and its prevention ,types of Hazards i.e Mechanical, Electrical ,Chemical and safe practices .Fire and explosion and its detection ,prevention and control .This will help the students to estimate Risk and its management , financial implication and compilation of cost data, major hazard control and general outline of DOW index with practical knowledge of workplace safety.

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

CO1: understand Industrial safety programmes, laws, acts ,legislation ,standards and codes
CO2: familiarize with safety practices at personal,process and environmental level
CO3: evaluate financial cost associated with accidents and compilation of cost data
CO4: analyze different industry hazards ,critical areas and safe procedures
CO5: develop practical skills for good working environment
CO6: estimate risk and management ,outlines of DOW index

Topics:

- Industrial safety and its legislation
- Types of accidents in industry and causes
- Analysis of hazards and safe practices
- Financial cost analysis of accidents
- DOW analysis and risk assessment of hazards

Textbook(s):

1. Industrial Safety,Health and Environment Management systems,R.K Jainand SunilS.Rao, khanna publishers

Reference Book (s):

1. Checklist for work place inspection for improving Safety, “health and working condition”,Intl.Labour Organization Geneva,1987.
2. Safety and Failure of components ,”proceedings of Mechanical Engg”,London,Vol.184,part 38,1974.
3. Industrial Safety Management,L M Deshmukh,TMH,1st Edition, 2005

ME 3051 Finite Element Analysis

Credit: 3
Category: PEC
Prerequisite(s): Mathematics - I (MA 1003), Mechanics of Solids (ME 2029)

Course Description:

This course introduces the basic concepts of finite element methods, its brief story, and need of studying finite element methods. It is to teach in a cohesive way the fundamentals of the finite element method for the analysis of solid, structural, and heat transfer problems. The course will emphasize the solution of real-life problems using the finite element method underscoring the importance of the choice of the proper mathematical model, discretization techniques and element selection criteria. Applications include finite element analyses (selection of elements (1D or 2D), formulation of stiffness matrices, and shape functions), modelling of problems (1D or 2D), and interpretation of numerical results.

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

CO1: obtain an understanding of the fundamental theory of the Finite Element Analysis (FEA)
CO2: generate the governing finite element equations for systems governed by partial differential equations
CO3: formulate and solve various complicated beam problems using Galerkin‘s Technique
CO4: understand the use of the basic finite elements to solve the bar and truss problems
CO5: understand the application and use of the one-dimensional and two-dimensional problems
CO6: solve complicated engineering problems using FEM software
.
Topics:

- Introduction to Finite Element Method
- Direct Formulation
- Finite Element Formulation
- One-dimensional finite element analysis
- Two-dimensional finite element analysis
- FEA Software and its Applications

Textbook(s):

1. Textbook of Finite Element Analysis, P. Seshu, PHI.

Reference Book(s):

1. Finite Element Analysis, S. S. Bhavikatti, New Age International Publishers.
2. Fundamentals of Finite Element Analysis, D.V. Hutton, McGraw Hill.

ME 3055 Additive Manufacturing

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course would incorporate a comprehensive study on uses of additive manufacturing in the industry as well as in the research field. Learner will have an idea on advantages, limits and usability of additive manufacturing system. Various AM system on the basis of materials types and their selection process for manufacturing can be clearly understood by the learner. At the end of the course the students will be able to solve machining related industrial problems through extensive and systematic research.

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

CO1: understand the concept of additive manufacturing, its benefits and applications
CO2: know the various liquid, powder and solid material based technologies in Rapid Prototyping and Rapid Tooling
CO3: design solid models and converting it to STL file format required for part generation
CO4: focus on the various errors in the RP parts
CO5: develop rapid tooling techniques
CO6: apply reverse engineering for generating RP parts

Topics:

- Summary of Additive Manufacturing
- Classification of AM on the basis of material types such liquid, solid and powder
- Data processing for the AM system
- Issues in AM system
- Rapid tooling process
- Reverse Engineering process

Text book(s):

1. Rapid Prototyping: Principle and Applications, Rafiq I Noorani, Wiley & Sons, 2006

References Book(s):

1. Rapid prototyping: Principles and applications, Chua C.K., Leong K.F., and Lim C.S., Yes Dee Publishing Pvt. Ltd, Third edition, 2010.
2. Rapid Prototyping And Engineering Applications, Frank W. Liou, CRC Press, Special Indian Edition, 2007.
3. Journey from Rapid Prototyping to Rapid Manufacturing, Somnath Chattopadhyaya, LAP Lambert Academic Publishing, 2011.
4. Rapid Prototyping Technology: Selection and Application, Kenneth G. Cooper, Cooper Cooper, Marcel Dekker Inc, 1st Edition, 2001.
5. Rapid-prototyping-of-biomaterials-Principles-and-applications, Narayan, Roger, ed. Woodhead Publishing, 2014.
6. Medical modelling: the application of advanced design and rapid prototyping techniques in medicine, Bibb, Richard, Dominic Eggbeer, and Abby Paterson. Woodhead Publishing, 2014.

ME 3057 Machine Maintenance and Condition Monitoring

Credit: 3
Category: PEC
Prerequisite(s): Kinematics and Dynamics of Machines (ME 2013)

Course Description:

The course is aimed at developing a fundamental understanding of machine maintenance strategies by monitoring the system vibrations by utilizing transduces. The basics of signal acquisition and processing would be learnt. The exposure to techniques for determining the faults in rotating machinery including the non-destructive testing (NDT) methods would be given. This course will provide the detailed knowledge on wear and debris analysis, temperature monitoring and the advance maintenance practices.

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

CO1: understand the philosophy behind different maintenance techniques and select the best maintenance practices
CO2: use successfully different condition monitoring techniques to predict health of a machine
CO3: analyse and find out the root cause of defect in machine and system
CO4: apply different NDT methods to find out fault in machine and structure
CO5: know wear and debris analysis
CO6: know advanced maintenance practices

Topics:

- Maintenance strategies
- Transducers for condition monitoring
- Fundamentals of Signal processing
- Vibration Monitoring
- Rotating machinery fault analysis
- Vibration level classification
- Wear and Debris Analysis
- Temperature Monitoring
- Non Destructive Testing
- Advance Maintenance Practices

Textbook(s):

1. Maintenance Engineering and Management, Sushil Kumar Srivastava, S.CHAND

Reference Book(s):

1. Maintenance Engineering and Management, K.Venkataraman, PHI, 1st Edition
2. Plant Maintenance and Reliability Engineering, N.V.S. Raju, CENGAGE, 1st Edition

ME 3069 Total Quality Management

Credit: 3
Category: PEC
Prerequisite(s): NA

Course Description:

This course would encompass the improvement of quality and performance in all functions, departments, and processes across the company to provide quality services which exceed customer expectations. The ability to provide quality services allow for higher prices to be charged. TQM can be summarized as a management system for a customer-focused organization that involves all employees in continual improvement. It uses strategy, data, and effective communications to integrate the quality discipline into the culture and activities of the organization. Many of these concepts are present in modern quality management systems, the successor to TQM. Here are the 8 principles of total quality management: At the end of the course the students will be able to solve industrial problems through extensive and systematic research.

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

CO1: understand the paradigm shift i.e. Quality journey to TQM philosophy
CO2: understand the top most Quality awards for International recognition and Customer satisfaction
CO3: evaluate Techniques for improving Quality in Organization and supplier end for overall improvement
CO4: analyze Leadership concepts, Employee motivation, TOP management
CO5: apply learning and research skills to be a part of World Class Quality and Excellence
CO6: design and Develop the Processes with SPC, Process capability analysis for competitive edge

Topics:

- Total Quality Management and its evolution. TQM and TPM.
- Quality awards and certification
- Statistical Methods for Quality Control
- Planning
- Quality Auditing

Textbook(s):

1. Quality Management: concepts and Tasks, V. Narayana and N.S Sreenivasan, New Age International, 1996
2. Total Quality Management for Engineers, M Zeiri, Wood Head Publishers

Reference Book(s):

1. Total Quality Management, Dale H Besterfield, Pearson Education, 2003
2. The Management and Control of Quality, James R Evans and William M Lidsay
3. Total Quality Management, L Suganthi, PHI, 2004

ME 3081 Machine Design

Credit: 1
Category: PCLC
Prerequisite (s): Mechanics of Solids (ME 2012)

Course Description:

This sessional is intended to make the students learn how to design and determine geometrical dimensions of a component subjected to complex stress system. While solving the various numerical the basic requirement for machine elements, machines and manufacturing considerations in design can be understood easily. The practical significance is that a machine element subjected to point or distributed load, moment or a combination of both can be designed or selected for the available set of components for the industrial requirements with the imparted knowledge.

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

CO1: apply engineering analysis principles and methods to design different machine components, systems, or processes
CO2: solve competently and confidently basic and advanced design-related problems
CO3: design different types of temporary (like threaded, knuckle, cotter etc.) and permanent joints (riveted, welded etc.) and understand the basic design procedure
CO4: learn different methods of designing the temporary (like a threaded, knuckle, cotter etc.) and permanent joints (riveted, welded etc.)
CO5: select the most appropriate method out of available ones to design different Type of couplings, keys, and shafts
CO6: apply computer-based techniques in the analysis, design and selection of machine components

Topics:

- Design of Riveted joints.
- Design of circumferential and longitudinal joints in boiler.
- Design of welded joints.
- Design of bolted joints
- Design of cotter joints.
- Design of knuckle joints.
- Design of shafts.
- Design of keys.
- Design of couplings.
- Design of helical springs.

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