ACADEMIC CURRICULA 2018 - 2022

BACHELOR'S DEGREE PROGRAMME

B. Tech in Mechanical 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
MECHANICAL 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 MECHANICAL ENGINEERING

Programme Educational Objectives (PEOs):

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

1. Graduates shall be able to provide solutions to mechanical engineering problems involving design, manufacturing, heat power, 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 mechanical 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 MECHANICAL 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 2021	Fluid Mechanics and Hydraulic Machines	3	1	0	4	4
3	ME 2027	Materials Science and Engineering	3	0	0	3	3
4	ME 2029	Mechanics of Solids	3	1	0	4	4
5	ME 2031	Engineering Thermodynamics	3	1	0	4	4
6	EC 2025	Principles of Electronics Engineering	3	0	0	3	3
Total of Theory						22	22
Practical							
1	EC 2095	Electronics Engineering Lab	0	0	2	2	1
2	ME 2091	Material Testing Lab	0	0	2	2	1
3	ME 2097	Fluid Mechanics and Hydraulic Machines 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						30	26

SEMESTER- IV

Sl. No	Course	Course Title	L	T	P	Total	Credit
Theory							
1	ME 2010	Basic Manufacturing Processes	3	0	0	3	3
2	ME 2013	Kinematics and Dynamics of Machines	3	1	0	4	4
3	ME 2022	Internal Combustion Engines and Gas Turbines	3	0	0	3	3
4	ME 2024	Industrial Engineering and Operations Research	3	0	0	3	3
5	ME 2026	Engineering Metrology	3	0	0	3	3
6		HS Elective-I	3	0	0	3	3
Total of Theory						19	19
Practical							
1	ME 2093	Machine Kinematics and Dynamics Lab	0	0	2	2	1
2	ME 2092	Metrology and Instrumentation 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	ME 3019	Manufacturing Processes and Automation	3	1	0	4	4
2	ME 3021	Heat Transfer	3	1	0	4	4
3	ME 3023	Design of Machine Elements-I	3	0	0	3	3
4		Department Elective-I	3	0	0	3	3
5		Department Elective-II	3	0	0	3	3
6		Department Elective-III	3	0	0	3	3
Total of Theory						20	20
Practical							
1	ME 3093	Computational Techniques Lab	0	0	2	2	1
2	ME 3095	Heat Transfer Lab	0	0	2	2	1
3	ME 3097	Advanced Manufacturing Processes 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						28	24

SEMESTER- VI

Sl. No	Course	Course Title	L	T	P	Total	Credit
Theory							
1	ME 3014	Refrigeration and Air Conditioning	3	0	0	3	3
2	ME 3016	Metal Cutting and Tool Design	3	1	0	4	4
3	ME 3018	Design of Machine Elements-II	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	ME 3092	ICE and RAC Lab	0	0	2	2	1
2	ME 3096	Mechanical Engineering Lab	0	0	2	2	1
Sessional							
1	ME 3082	Minor Project	0	0	4	4	2
2	ME 3086	Computer Aided Design and Analysis	0	0	2	2	1
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						5	5
Sessional							
1	ME 4081	Project –I/Internship					3
2	ME 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	ME 4082	Project-II / Internship					10
Semester Total							13

MI – Minor HO – Honors

LIST OF HS ELECTIVES

HS Elective – I

Sl. No	Course Code	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 3025	Optimization Techniques	3
2.	ME 3026	Mecatronics	3
3.	ME 3027	Plant layout and Material Handling	3
4.	ME 3071	Renewable Energy Technology	3
5.	ME 3073	Mechanics of Composite Materials	3

Dept. Elective-II

1.	ME 3024	Mechanical Vibration and Noise Engineering	3
2.	ME 3028	Supply Chain Management	3
3.	ME 3043	Power Plant Engineering	3
4.	ME 3045	Metal Forming Processes	3
5.	ME 3047	Production and Operations Management	3

Dept. Elective-III

1.	ME 3022	Principles of Turbomachines	3
2.	ME 3051	Finite Element Analysis	3
3.	ME 3055	Additive Manufacturing	3
4.	ME 3057	Machine Maintenance and Condition Monitoring	3
5.	ME 3059	Computational Fluid Dynamics	3

Dept. Elective-IV

1.	ME 3061	Advanced Mechanics of Solids	3
2.	ME 3063	Automobile Engineering	3
3.	ME 3065	Combustion Engineering	3
4.	ME 3067	Cryogenics	3
5.	ME 3069	Total Quality Management	3

Dept. Elective-V

1.	EE 2009	Electrical Machines and Power Electronics	3
2.	ME 3029	Robotics and Flexible Manufacturing Systems	3
3.	ME 3030	Product Life Cycle Management	3
4.	ME 3052	Nano Technology	3
5.	ME 3054	Gas Dynamics and Jet Propulsion	3
6.	ME 3056	Tribology	3

HONORS COURSES OFFERED BY MECHANICAL ENGINEERING

Sl. No.	Course	Course Title	Prerequisite/ s
1	ME 4010	Metal Forming & Casting Processes	Manufacturing Processes and Automation(ME3019)
2	ME 4011	Theory of Machining	Metal Cutting and Tool Design(ME3016)
3	ME 4012	Non-Conventional Machining and Fabrication Processes	Manufacturing Processes and Automation(ME3019)
4	ME 4013	Theory of Advanced Fluid Mechanics	Fluid Mechanics & Hydraulic Machines(ME2021)
5	ME 4014	Theory of Advanced Thermodynamics	Engineering Thermodynamics(ME2031)
6	ME 4015	Theory of Advanced Heat and Mass Transfer	Heat Transfer(ME3021)
7	ME 4016	Mechanics of Solids and Structures	Mechanics of Solids(ME2029)
8	ME 4017	Noise and Vibration Control Engineering	Kinematics and Dynamics of Machines(ME2013)
9	ME 4018	Theory of Advanced Machines and Mechanisms	Kinematics and Dynamics of Machines(ME2013)

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

ME 2010 Basic Manufacturing Processes

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

Course Description:

This course will provide the student with an introduction to the basic manufacturing processes used in industry such as foundry processes, metal working processes, powder metallurgy and various welding processes. Knowledge of the course will help the students to relate the design requirements of a part to the possible manufacturing processes. Successful completion of the course will also provide the student with the benefits, limitations, and applications of different manufacturing processes for product manufacturing. The overall aim is to establish the technical knowledge for selection and planning of manufacturing processes and systems.

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

CO1: understand and select the appropriate casting processes for manufacturing industrial products
CO2: apply the suitable rolling process and sheet metal for different material and product
CO3: understand the forging process for various components and its application
CO4: understand the fundamental processes of extrusion and drawing
CO5: apply powder metallurgy process to produce powder of various materials and to manufacture new composite material
CO6: analyze the principle of various welding processes and identify the best welding technique for joining of various components and to produce defect free products

Topics:

- Foundry Process
- Metal working process
- Sheet Metal Working
- Powder Metallurgy Process
- Fabrication Processes

Textbook(s):

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

Reference Book (s):

1. Manufacturing Technology: Materials, Processes and Equipment: Helmi A. Youssef, Hassan A. El. Hofy and M.H. Ahmed, CRC Press, 2015
2. Principle of Manufacturing Materials and Processes: J.S. Cambell, TMH
3. Welding & Welding Technology - R. Little, TMH, 43rd reprint, 2014
4. Manufacturing Science: A. Ghosh & A.K. Mallick, EW.

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 2022 Internal Combustion Engines and Gas Turbines

Credit: 3
Category: PCC
Prerequisite(s): Engineering Thermodynamics (ME 2031)

Course Description:

This course would encompass a comprehensive study and working principle of conventional spark-ignition (gasoline), compression-ignition (diesel), two stroke & four stroke engines. Moreover, the complete description of carburetor, fuel injectors, supercharging, engine emission, cooling lubrication, and ignition system. Knowledge of the course will help the students to make the performance analysis of internal combustion engines (SI and CI engines) and justify the applicability. In the later part, this course presents the analysis of Gas turbine and gas turbine cycles for aircraft propulsion. At the end of this course, the students will be able to perform research problems related to IC engines and fuels.

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

CO1: underline the classification of heat engines and cycles of operation of IC Engines for different application
CO2: discuss the effect of various operating variables on engine performance
CO3: demonstrate the fuel metering and fuel supply systems for different types of engines
CO4: analyze the normal and abnormal combustion phenomena in SI and CI engines
CO5: formulate the performance Analysis of IC Engine and justify the suitability
CO6: estimate the performance of Gas Turbine

Topics:
- Introduction to IC engines
- Fuels
- Carburetion and Fuel injection
- Test and Performance of SI and CI engines
- Engine Emission, Cooling Lubrication and ignition systems
- Gas Turbines and Aircraft Propulsion

Textbook(s):
1. IC Engines, V Ganeshan, TMH, 4th edition
2. Gas Turbines, V Ganeshan, TMH, 3rd edition

Reference Book(s):
1. IC Engines, Mathur and Sharma, Dhanpat Rai & Sons
2. IC Engines, S.P. Sen, Khanna Publishers
3. IC Engines, Gill and Smith, OXFORD & IBH
4. An introduction to energy Conversion (Vol. II), Kadambi & Prasad, Wiley Eastern.
5. Gas Turbine Theory, Cohen, Rogers and Saravanamutto, Pearson Education

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 2026 Engineering Metrology

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

Course Description:

This course is designed to let the students understand the concept of metrology, the various aspects and factors of metrology. It also highlights the concept of inspection and the errors like systematic and random errors. The course also describes the various types of fits and tolerances in machine parts. Different measuring tools and comparators are cored in this course. Measurements like, force, torque, strain, pressure, temperature, surface roughness, etc. are being measured using various instruments. Modern measuring techniques such as Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), X-ray Diffraction Systems (XRD) are also covered in this course.

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

CO1: understand the different measurement techniques
CO2: understand the fundamental knowledge of various Metrology techniques
CO3: evaluate the tolerance and types of fits in various machine components
CO4: apply suitable metrological methods for measuring various entities
CO5: analyze the results from the various metrological methods
CO6: design the procedures for getting the final results

Topics:
- Metrology
- Standards of measurement
- Limits, Fits and Tolerances
- Simple measurement tools
- Screw Thread Measurement
- Surface Roughness
- Comparators
- Measurement of Force, Torque and Strain
- Measurement of Temperature and Pressure
- Modern Measurement Techniques

Textbook(s):
1. Engineering Metrology, R. K. Jain, Khanna Publication
2. Mechanical Measurements, T.G. Beckwith and M. Lewis Buck, Oxford & IBH Publishing

Reference Book(s):
1. Mechanical Measurements, R. S. Sirohi, H. C. Radha Krishna, New Age International, 1991
2. A course in Mechanical Measurements and Instrumentation, A.K. Sawhney, Puneet Sawhney, Dhanpat Rai & Co

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 2029 Mechanics of Solids

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

Course Description:

This course illustrates the concepts of stress and strain, deformation of solids, elastic constants, compound stresses and strains, shear force and bending moment diagrams, slope and deflection of beams, bending stress and shear stress in beams, stresses in the cylinder and spherical shells, torsion in solid and hollow circular shafts, strain energy under various loading conditions, theories of failure, columns and springs. The knowledge of this course will help the learners to analyse and design the various structural and engineering components.

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

CO1: understand the concept of stress, strain and deformation of solids under axial and complex loading conditions
CO2: describe and sketch the profiles for shear force, bending moment, slope and deflection of simple structural members under different load states
CO3: interpret the bending stress and shear stress in beams, and stresses in the cylinder and spherical shells
CO4: analyze the torsional stress in solid and hollow circular shafts and strain energy under various loading conditions
CO5: select the appropriate theory of failure for various engineering components considering components material characteristics
CO6: design and Analyze the eccentrically loaded columns and helical springs

Topics:

- Stress, strain and elastic constants
- Stress under axial load
- Compound stress and strain
- Shear force and bending moment diagrams
- Stress under bending and torsion
- Slope and deflection
- Strain energy
- Theories of failure
- Stresses in cylindrical and spherical shells
- Columns
- Stress in some other significant elements

Textbook(s):

1. Strength of Materials, G. H. Ryder, MACMILLAN
2. Strength of Materials, S. S. Rattan, TMH

Reference Book(s):

1. Mechanics of Materials, R. C. Hibler, PEARSON
2. Strength of Materials, R.K. Rajput, S.Chand
3. Strength of Materials, R. S. Khurmi, S. Chand
4. A Text Book of Strength of Materials, R. K. Bansal, Laxmi Publications Pvt Ltd

ME 2031 Engineering Thermodynamics

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

Course Description:

This course would lead to understanding of fundamental thermodynamic laws and consequently, their applications in analyzing various energy interactions that we come across in day-to-day life. Further, the knowledge on this course will help the students to disseminate the various forms of energy and their interactions involved in designing any thermal system. Additionally, this course includes the knowledge of designing thermal power plants by covering the characteristics of pure substances and the estimation of maximum available energy in a system. At the end, this course highlights mathematical definitions of various mechanical devices such as compressors, turbines, nozzles, boilers and condensers.

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

CO1: recall different terminology related to thermal engineering
CO2: recognize the need of learning thermodynamics
CO3: appreciate the 1st law of thermodynamics and apply that to flow processes
CO4: appraise the 2nd law of thermodynamics in applications related to heat engine, heat pump and refrigerators
CO5: read and comprehend steam table and Mollier chart in solving complex thermal problems
CO6: Compute availability

Topics:
- Thermodynamic systems and properties
- First law of thermodynamics and its application to flow processes
- Second law of thermodynamics and entropy
- Pure substances
- Exergy estimation
- Thermal devices

Textbook(s):
1. Thermodynamics, An Engineering Approach, Yunus A Cengel and Michael A. Boles, Mc Graw Hill Education, 7th Edition, 2011 (reprint 2013)

Reference Book(s):
1. Fundamentals of Classical Thermodynamics, Gordon J. Van Wylen , Richard E. Sonntag, Claus Borgnakke, John Wiley, Fifth Edition
2. Engineering thermodynamics, P. K. Nag, McGraw Hill Education, Fifth Edition
3. Engineering Thermodynamics, Gordon Rogers and Yon Mayhew, Pearson Education Ltd
4. Engineering Thermodynamics, Krieth, CRC Press
5. Engineering Thermodynamics, Jones and Dugan, PHI Learning Pvt. Ltd.
6. Engineering Thermodynamics, D. P. Mishra, CENGAGE.

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 2091 Material Testing Laboratory

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

Course Description:

This laboratory would comprise of various equipment and experiments to provide the exposure to basic mechanical characterization techniques and microstructure analysis. This laboratory helps the students to understand the mechanical behavior of various materials, effect of microstructural parameters (grain size, boundary fraction, Phase fraction, second phase particle etc.) on their deformation behavior, quality, and performance. The laboratory is equipped with different destructive testing equipment such as Universal testing machine, Impact testing machine, hardness tester and torsion testing machine along with sample preparation setup and optical microscope. A series of experiments are chosen for undergraduate students to demonstrate the basic principles in the area of mechanics of materials, structural analysis and strength of material. The laboratory also provides support to different research activities carried out by both internal as well as external research scholars (B.Tech, M.Tech and PhD) in terms of finding various mechanical properties (impact strength, tensile strength, compressive strength, shear strength, flexural strength, hardness, etc.) of material as well as microstructural quantification.

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

CO1: understand the fundamentals of mechanical properties of various ferrous and nonferrous metals
CO2: understand the different types of mechanical properties of material and their characterization techniques which are used in various fields of engineering
CO3: understand the mechanical properties of various metals from different thermo-mechanical processing, performance and testing aspects
CO4: develop and change the mechanical properties of steel and its alloys for different structural and automobile applications
CO5: understand the fundamentals of microstructure, microstructural characterization of material by using optical microscope
CO6: analyze the various microstructural parameters: grain size, grain boundaries, inclusions, precipitates phases) and their effect on mechanical properties of material

Topics:

- Determination of the impact strength of mild steel by Izod test method
- Determination the impact strength of mild steel by Charpy test method
- Determination the tensile strength of a mild steel specimen using UTM
- Determination the compression strength of a mild steel specimen using UTM
- Determination the flexural strength of a mild steel specimen by three point bending test using UTM
- Determination the hardness of the given specimen by Rockwell hardness tester
- Determination the hardness of the given specimen by Vickers hardness tester
- Determination the torsional shear stress, maximum torque of mild steel by Torsion testing equipment
- Metallographically sample (mild steel) preparation and observation of microstructure using an Optical microscope

ME 2092 Metrology and Instrumentation Laboratory

Credit: 1
Category: PCLC
Prerequisite (s): Engineering Metrology (ME 2026)

Course Description:

This laboratory is intended to describe the fundamental concepts of measuring instruments. It provides the in-depth knowledge about different inspection gauges, measuring instruments, and their field of application. The students can able to know the suitability and applicability of the instruments in effectively and efficiently. It is a kind of training which helps them to utilize in industrial application.

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

CO1: know the different inspection gauges and its application
CO2: know the working principal of different measuring instruments and its application
CO3: compare the results from different measuring instruments
CO4: calculate bore diameter by using four ball and two ball method
CO5: know the use of Sine bar method
CO6: study the profile projector

Topics:

- Study of different types of inspection gauges and their methods of application
- Determination of diameter and length of stepped shaft using Micrometer, Vernier Caliper and Vernier height gauge
- Determination of angle of an angle gauge plate by using sine bar method
- Determination of bore diameter by bore diameter by four ball and two ball method
- Determination of the included taper angle, large end, smaller end diameter (D_L and D_s) and check the outer roundness and uniformity of an externally tapered specimen
- Determination of the included taper angle, large end, smaller end diameter (D_L and D_s) and check the uniformity of an internally tapered specimen
- Determination of the chordal thickness of gear tooth using gear tooth Vernier caliper
- Determination of external radius of specimen

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 2097 Fluid Mechanics and Hydraulic Machines Laboratory

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

Course Description:

In this laboratory, the students are introduced to concepts of fluid mechanics and hydraulic machines. This helps the students to understand different means of pressure and flow measurements of fluid. Different devices used for this purpose are: pitot tube, venture meter, orifice meter, rotameter etc. Most common hydraulic machines like turbine and pumps are studied to understand principle of conversion of hydraulic energy to mechanical energy and vice versa. Important principles of fluid properties and effect of their variation in different hydraulic machines help the students to apply these concepts in industry to maximize the performance of such machines.

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

CO1: recall the principle of Bernoulli's in conservation of head in fluid flow
CO2: explain and use venture meter for flow measurement
CO3: illustrate the flow measurement with the help of orifice meter
CO4: analyze the effect of shape on metacentric height of any floating body
CO5: design Pelton wheel for a specific requirement after using characteristic curves
CO6: evaluate performance of centrifugal pump

Topics:

- Demonstration of the Bernoulli's principle in conservation of head in fluid flow
- Measurement of fluid flow rate through pipes with the help of ventury meter
- Calculation of the fluid flow through pipe with the help of orifice meter
- Evaluation of the metacentric height of any floating body
- Drawing the characteristic curves for Pelton wheel
- Drawing the characteristic curves for Francis Turbine
- Plotting the characteristic curves for reciprocating pump
- Plotting the characteristic curves for centrifugal pump

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 3014 Refrigeration and Air Conditioning

Credit: 3
Category: PCC
Prerequisite(s): Fluid mechanics and Hydraulic Machines (ME 2021), Engineering Thermodynamics (ME 2031), Heat Transfer (ME 3021)

Course Description:

The course is about analyzing different Vapor Compression, Vapor Absorption and Air Refrigeration cycles. It also includes, the suitable refrigerants used in these cycles for better performance with due consideration to environmental impact. The psychometric calculations, load calculation and requirements of air-conditioning for different applications are included. Summer, winter and year round comfort air-conditioning processes and systems are discussed. The performance parameters like COP, tonnage, capacities of evaporator, condenser and heat exchangers and compressor power are estimated. According to the requirements, component selections for refrigeration and air-conditioning systems are appropriately studied.

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

CO1: recall different thermodynamic cycles and moist air properties applicable in refrigeration and air-conditioning
CO2: explain the advantages and disadvantages of various cycles, processes and refrigerants
CO3: apply the fundamentals to calculate the different performance parameters like COP, compressor work, cooling or heating capacity, cooling or heating load, moisture removal rate etc.
CO4: select different components and refrigerants in refrigeration and air conditioning systems as per the requirements such as tonnage of the system, desired temperature, heat load and environmental and economic considerations etc.
CO5: design the system like vapor compression, vapor absorption, air refrigeration systems, summer, winter and all round air conditioning systems by taking into account different components and its interface
CO6: evaluate the different systems in refrigeration and air-conditioning in terms of COP, capacity and weight ratio, cost and impact on environment etc.

Topics:
- Introduction to refrigeration
- Refrigerants
- Air refrigeration system
- Vapour compression system and Multi-Pressure systems
- Vapour absorption systems
- Psychometrics
- Requirements of comfort air-conditioning
- Air conditioning system
- Refrigerant compressor

Textbook(s):
1. Refrigeration and Air Conditioning, C. P. Arora, McGraw Hill Education, 3rd Edition,
2. Refrigeration and Air Conditioning, R. S. Khurmi, and J. K. Gupta, S. Chand Ltd, 2013

Reference Book(s):
1. Refrigeration and Air Conditioning, R. C. Arora, PHI Learning Pvt. Ltd., 2013.

2. A course in Refrigeration and Air Conditioning, S.C. Arora and S. Domkundwar, Dhanpat Rai & Co (P) Ltd, 2013.
3. Refrigeration and Air Conditioning, Manohar Prasad, New Age International, 2003.
4. Refrigeration and air conditioning - Stocker and Jones.

ME 3016 Metal Cutting and Tool Design

Credit: 4
Category: PCC
Prerequisite(s): Manufacturing Process Automation (ME 3019)

Course Description:

This course would encompass a comprehensive study of geometry of cutting tools, types of cutting conditions, mechanisms of chip formation, mechanics of metal cutting, cutting tool materials, machinability studies, tool failure and tool life, advances in machining and design of cutting tools. Knowledge of the course will help the students to identify right cutting tool and to choose optimal machining parameters to machine any given material considering various aspects of machinability criteria and machining economy. 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 tool geometry and convert tool angles from one system to another
CO2: understand the mechanisms of chip formation and Conduct machining experiments to analyze and interpret the results
CO3: evaluate cutting forces and able to conduct complex mechanical engineering experiments to analyze and interpret the experimental data
CO4: analyze machinability, machining economy, selection of cutting tool material, evaluation of tool failure and tool life
CO5: apply advanced machining process techniques
CO6: design cutting tools, press tool and forging die

Topics:

- Geometry of cutting tools
- Mechanism of chip formation
- Mechanics of metal cutting
- Cutting tool materials, Machinability, Tool failure and Tool life
- Advances in machining
- Design of cutting tools

Textbook(s):

1. Machining and Machine Tools: A. B. Chattopadhyay, Wiley-India Pub.
2. A Text Book of Production Engineering: P.C. Sharma, S. Chand & Co.

Reference Book(s):

1. Metal Cutting Theory and Practice: A. Bhattacharyya, Jamini Kanta Sen of Central Book Pub, 1984.
2. Fundamentals of Metal Cutting and Machine Tools: B.L. Juneja, G.S. Sekhon, & Nitin Seth, New Age International Pub, 2005.
3. Metal Cutting Principles: M. C. Shaw, Oxford Pub, 2002.
4. Fundamentals of Machining & Machine Tools: Boothroyd & Knight, CRC press, 1988.
5. Tool Design: Cyril Donaldson, V. C. Goold, Tata McGraw-Hill, 1976.

ME 3018 Design of Machine Elements-II

Credit: 3
Category: PCC
Prerequisite(s): Design of Machine Elements-I (ME 3023), Mechanics of Solids (ME 2029), Materials Science and Engineering (ME 2027)

Course Description:

This course introduces the principles and methods to the design of different components, system or process. To deal competently and confidently with basic problems or ideas from disciplines outside one's speciality. It helps to design and determine geometrical dimensions of a component subjected to complex stress system, and also to implement and design the domain knowledge in practical systems. It discusses the design procedure of different I C Engine components like cylinder, piston, connecting rod, crankshaft, valves etc. It also helps the design procedure of different kinds of gears like spur, helical, bevel, and design procedure of hydrostatic and hydrodynamic bearings etc. Besides, the complex practical problems can be simulated and solved using engineering tools such as ANSYS. To design, model and solve using modern engineering tools.

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

CO1: understand the basic design requirement and suitable material selection for machine components
CO2: analyze and apply the domain knowledge in practical problems using engineering tools such as Solidworks and ANSYS
CO3: implement and design the domain knowledge in practical systems
CO4: design the component subjected to static and variable loads
CO5: determine the life of component subjected to complex loading
CO6: acquaint themselves with the design of IC engine components for the schematic evaluation of elements in an engine

Topics:

- Design against fatigue load (stress concentration factor, notch sensitivity, endurance strength and limit stress, LCF and HCF)
- Design of springs against fatigue load.
- Bolted joint under fluctuating load.
- Evaluation of fatigue life in machine components.
- Design of IC Engine Components
- Design of Gear Drives
- Sliding and Rolling contact bearings
- Strategies in design of machine elements

Textbook(s):

1. Design of Machine Elements: VB Bhandari (TMH)
2. A Textbook of Machine Design, S. Md. Jalaludeen

Reference Book(s):

1. Mechanical Engineering Design, Shigley J E, Mischiee C R (TMH)
2. Hand Book- Design Data Handbook, S. Md. Jalaludeen.
3. Machine Design, Dr. P.C. Sharma and Dr. D.K. Aggrawal.

ME 3019 Manufacturing Processes and Automation

Credit: 4
Category: PCC
Prerequisite(s): Basic Manufacturing Processes (ME 2010)

Course Description:

This course will provide the knowledge of different traditional machine tools, operations, cutting tools and applications. It will also enlighten the students on the various advanced non-traditional manufacturing processes as well as automated machine tools such as NC, CNC and DNC. This course will also give the fundamental knowledge to design the control systems for various applications. With the knowledge of this course, the students are able to identify the suitable traditional or non-traditional machining process to produce a component along with optimized process plan.

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

CO1: understand the constructional and functional details of machine tools and its related accessories
CO2: understand the industrial applications of the conventional machining processes
CO3: understand the advanced machining processes to machine difficult to machine materials with complicated and miniaturized product manufacturing
CO4: understand the designing principles of Jigs and fixtures for different machining operations
CO5: design the sequence of operations leading to optimized time and cost
CO6: understand the industrial automation with computer controlled machines and industrial robots

Topics:
- Traditional machine tools and processes
- Non-Conventional machining processes
- Design of jogs and fixtures
- Designing a process plan
- Industrial automation and fundamentals of robotics
- Designing of transfer function for control system

Textbook(s):
1. Manufacturing Processes, J. P. Kaushish, PHI Learning Pvt. Ltd.; 2nd Edition (2010)
2. Automation, Productions systems, and computer Integrated manufacturing, Mikell P. Groover, PHI Learning Pvt. Ltd-New Delhi (3rd edition)

Reference Book(s):
1. Advanced Machining Processes, V. K. Jain, Allied Publishers Pvt. Ltd.; 1st edition (2007)
2. A Text Book of production Engineering, P C Sharma, S. Chand Publications, 2010
3. Modern Machining Process, P.C. Pandey, H.S. Shan, TMH,3rd Edition
4. Introduction to Micromachining, V.K. Jain, Narosa Publishing house, 2010

ME 3021 Heat Transfer

Credit: 4
Category: PCC
Prerequisite(s): Mathematics-III (MA 2005), Engineering Thermodynamics (ME 2031), Fluid Mechanics & Hydraulic Machines (ME 2021)

Course Description:

The course aims to introduce the basic concepts and methods of heat transfer with practical applications. It provides an exposure to develop mathematical models for various industrial problems. It further elaborates the heat transfer with fluid motion with description of boundary layer and various experimental correlations. It includes radiation heat transfer with basic laws of radiation. Boiling and condensation heat transfer is discussed to understand the phase change heat transfer systems. Heat exchanger calculations to analyze the performance are explained.

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

CO1: describe the fundamentals of heat transfer processes in engineering problems
CO2: explain the different modes of heat transfer and it applications
CO3: apply analytical methods, numerical tools to develop mathematical models for different heat transfer applications
CO4: analyze the different mechanism of heat transfer with various experimental and theoretical correlations
CO5: design the thermal resistance network and heat transfer devices based on principles of different types heat transfer processes
CO6: evaluate the performance of various heat transfer application problems with the calculation of different parameters like efficiency, heat transfer coefficient etc.

Topics:
- Modes of heat transfer
- Conduction (Steady and Transient)
- Fin
- Lumped Capacitances
- Convective Heat Transfer (Forced and Natural)
- Radiation Heat Transfer
- Heat Transfer in Boiling and Condensation
- Heat Exchangers

Textbook(s):
1. Engineering Heat and Mass Transfer, M M Rathore, Laxmi Publications Pvt. Ltd, 3rd edition.
2. Heat and Mass Transfer, Y A Cengel and A J Ghajar, McGraw-Hill Publication, 4th edition.

Reference Book(s):
1. Principles of Heat Transfer, Frank Kreith, Raj M. Manglik, M.S. Bohn, Cengage Learning, 7th edition
2. Heat and Mass Transfer, R.K. Rajput, S. Chand & Company, 5th edition.
3. Fundamental of Heat and Mass Transfer, Frank P. Incropera, David P. Dewitt, Willey 1996, 4th edition.
4. Heat Transfer, J. P. Holman and S. Bhattacharya, McGraw Hill Education, 10th Edition.
5. Introduction to Heat Transfer, S. K. Som, PHI Learning Private Ltd, 2013.

ME 3022 Principles of Turbo-machines

Credit: 3
Category: PEC
Prerequisite(s): Fluid Mechanics and Hydraulic Machines (ME 2021) and Engineering Thermodynamics (ME 2031)

Course Description:

This course provides an introduction to the basic concept including Basic laws and Governing Equations of turbo-machine. The course covers brief review of essential fluid Mechanics and hydraulic Machines basics and thermodynamics fundamentals. Concepts of blade theory including Aero-foil Section, Drag and Lift Coefficients, Blade Terminology and Cascade Nomenclature are introduced. Compressors and Fans are studied in depth. At the end, course covers different type of turbine and pump with their performance parameter and performance characteristic, respectively.

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

CO1: recall the review of turbo-machine
CO2: explain the classification turbo-machine and their working principle
CO3: interpret the difference between compressor and fan
CO4: analyze various features of a turbine
CO5: design turbine and Pump
CO6: evaluate of performance of turbine, pump and compressor

Topics:
- Introduction of Turbo-machine
- Centrifugal Compressors and Fans
- Axial Flow Compressors
- Radial Flow Turbine
- Axial Flow Turbine
- Axial Pump

Textbook(s):
1. Turbo Machines, A Valan Arusu, Vikash Publishing House Private Limited

Reference Book(s):
1. Turbines, Compressors and Fans, S.M. Yahya, Tata McGraw- Hill Education.
2. Principles of Turbo Machinery, Turton R.K., Springer Publication.
3. Fundamentals of Turbo Machinery, William W., John Wiley and Sons.
4. Gas Turbine Theory, Cohen and Roger, Pearson Education
5. Fluid Mechanics, Thermodynamics of Turbomachinery by S.L. Dixon

ME 3023 Design of Machine Elements-I

Credit: 3
Category: PCC
Prerequisite (s): Engineering Mechanics (ME 1003), Materials Science & Engineering (ME 2027) and Mechanics of Solids (ME 2029)

Course Description:

This course focuses on various aspects of machine elements, manufacturing considerations and materials used. It enables to determine strength, stiffness and stability of a mechanical component by involving various analytical methodologies. It also deals with design of joints such as riveted, welded, cotter, knuckle, design of various types of threaded fasteners, design of machine parts used for power transmission such as shafts with keys and keyways, couplings, springs, and lever. At the end of the course, the student will be able to design a mechanical component with proper specifications, least manufacturing cost and high efficiency in operation.

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

CO1: identify basic requirements for machine elements, machines and manufacturing considerations in design
CO2: determine geometrical dimensions of a component subjected to complex stress system
CO3: apply technical skills and imagination to construct a proper design configuration
CO4: develop a link between fundamental concepts with realistic component design
CO5: design various temporary and permanent joints, fasteners
CO6: analyze and synthesize different power transmission elements and springs

Topics:
- Basic requirement for machine elements and machines
- Manufacturing considerations in design
- Design of fastening elements
- Design of transmission elements
- Design of springs
- Design of levers & brackets

Textbook(s):
1. Design of Machine Elements - V. B. Bhandari (TMH), 3rd Ed.
2. Design Data Hand Book, S. Md. Jallaludeen (Anuradha Pub.)

Reference Book(s):
1. Machine Design - Sharma/Agarwal (Katson publishing House)
2. Machines Design Data Book - P.S.G. College of Technology, Coimbatore.
3. Mechanical Engineering Design - Shigley J E, Mischiee C. R.; TMH
4. Mechanical Design of Machines, Maleev/Hartman (CBS)
5. Machine Design - Gupta J. K. and Khurmi R. S. (S. Chand Pub.)

ME 3024 Mechanical Vibration and Noise Engineering

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

Course Description:

This subject provides the brief study of various two and multi-degree freedoms of vibratory systems, torsional vibration of the rotor, geared system and branched system, wave equations for vibration of string, bar, and beams, sound and noise engineering with acoustics analysis. Furthermore, for calculating the vibratory systems' frequencies, the different differential equation methods like Newton's second, Energy method, Lagrange's method, etc., will be studied in this curricula. The last module of the course discusses the major sources of the noise and sound on the road and industries and their controlling methods.

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

CO1: elaborate the importance of vibration study in engineering
CO2: design the governing differential equation of a vibration system and its solution
CO3: develop models of dynamic system with varying degrees of freedom (SDOF, MDOF)
CO4: determine the natural frequency of certain physical systems and understand the advantage of providing damping in mechanical systems
CO5: discuss the concept of noise, its measurement and its adverse effects on human
CO6: select and explain the best noise control technique

Topics:
- Two degree of freedom systems of a vibratory system
- Multi-degree of freedom system of a vibratory system
- Torsional vibration of gear and rotor systems
- Vibration of continuous system like string, bar, and beam
- Introduction to acoustics
- Introduction of sound and noise engineering

Textbook(s):
1. Mechanical Vibrations and Noise Engineering, Ashok G. Ambekar, PHI

Reference Book(s):
1. Theory of Vibration and Application, William T. Thomson, CBS
2. Mechanical Vibrations, V. P. Singh, Dhanpat Rai & Co.(P) LTD
3. Textbook of Mechanical Vibrations, Rao.V. Dukkipati, PHI
4. Noise and vibration control, L. Beranek, McGraw-Hill

ME 3025 Optimization Techniques

Credit: 3
Category: PEC
Prerequisite(s): Operations Research (ME 4041)

Course Description:

This course would encompass a comprehensive study of importance of optimization in industrial process management. Knowledge of the course will help the students to apply basic concepts of mathematics to formulate an optimization problem. At the end of the course the students will be able to analyze and appreciate variety of performance measures for various optimization problems through extensive and systematic research.

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

CO1: understand importance of optimization of industrial process management
CO2: apply basic concepts of mathematics to formulate an optimization problem and solve it by simulation
CO3: analyze and appreciate variety of performance measures for various problems like game theory
CO4: define and Use Optimization Terminology and some multi-criteria decision making (AHP and ANP)
CO5: apply unconstrained & constrained search methods for optimization theory for continuous problems, including the necessary and sufficient optimality condition
CO6: apply constrained optimization theory for continuous problems, including the Karush-Kuhn-Tucker conditions and algorithms such as: quadratic & separable programming

Topics:

- Introduction to optimization
- Linear programming problem
- Concept of Dualities
- Sensitivities Analysis, IPP, NLPP
- Statistics & design of experiments
- Neural Networks, Fuzzy logic and Genetic algorithm

Textbook(s):

1. Engineering Optimization: Theory and Practice, S. S. Rao, New Age International (P) Ltd, 3rd Edition.
2. Soft Computing by D.K. Pratihar, Narosa Publications
3. Design & Analysis of Experiments, M.C. Montgomery, John Wiley & Sons, 2006
4. Quality & Robust Engineering, M.S. Phadke, Prentice Hall; 1 edition (May 22, 1989)
5. Taguchi Techniques in Quality Engineering, Phillip J. Ross, McGraw-Hill Professional; 2 editions (August 1, 1995)
6. Engineering Optimization, Ravindran and Phillips, McGraw Hill.

ME 3026 Mechatronics

Credit: 3
Category: PEC
Prerequisite(s): Principles of Electronics Engineering (EC 2025) and Fluid Mechanics & Hydraulic Machines (ME 2021).

Course Description:

Mechatronic Systems course encompassing mechanical engineering, electronic engineering and software engineering. This course is presented to cover all of these critical aspects including real-time computation tasks, analog interfacing, drives, digital logic, controllers, sensing and actuation systems. Through the course, students will be able to analyze and develop electro-mechanical systems, and techniques through extensive and systematic research.

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
CO3: apply the different drive systems for actuation of various parts and components of a system
CO4: 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:
- Introduction of mechatronics.
- Drives
- Hydraulic systems
- Pneumatics
- Controllers

Textbook(s):
1 Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Boltan, W., Longman, Singapore, 1999.
2 Mechatronics, HMT Ltd. TMH.

Reference Book(s):
1 Robotics Technology and Flexible Automation, S. R Deb and S. Deb., TMH, New Delhi, 1994.
2 Computer Automation in Manufacturing - An Introduction, T. O. Boucher, Chapman and Hall, 1996.
3 Mechatronics: Principles, Concepts and Applications, N. P. Mahalik, TMH

ME 3027 Plant Layout and Material Handling

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

Course Description:

This course would encompass a comprehensive study of plant layout and material handling system in the industries. Knowledge of the course will help the students to understand basic concept of the plant lay out, its classification and how to plan, analyze and design to improve manufacturing and services facilities of a plant. The topic helps them to apply the techniques to evaluate and design material handling and storage systems to increase the productivity of a plant. At the end of the course the students will be able to know about the relationship of material handling to plant layout, cost associated with material handling, safety and maintenance of material handling equipment.

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

CO1: understand the need, specification and implementation of plant lay out
CO2: how to plan, analyze and design to set up a plant
CO3: know the different methods to construct and improve the Plant lay out
CO4: understand the principal, classification and need of material handling in a plant layout
CO5: understand the selection and method of material handling system
CO6: understand the economic, ergonomics and design of the material handling equipment

Topics:

- Introduction of Plant Layout
- Design method of Plant Layout
- Introduction of Material Handling systems
- Material Handling principles, classification
- Cost, maintenance, safety and design of Material Handling equipment

Textbook(s):

1. Operations Management. P.B. Mahapatra, PHI.
2. Aspects of Material handling. K.C. Arora, Lakshmi Publications.

Reference Book(s):

1. Production and Operations Management. R. Panneerselvam, PHI.
2. Introduction to Material handling. Siddhartha Ray, New Age.
3. Plant Layout and Material Handling. R.B Chowdary and G.R.N. Tagore, Khanna Publishers.
4. Plant Maintenance and Reliability Engineering. N.V.S Raju, Cengage Learning.
5. Facility Layout and Location—An Analytical Approach. By R. L. Francis and J. A. White. (New Jersey: Prentice-Hall Inc., 1974.)

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 3029 Robotics and Flexible Manufacturing Systems

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

Course Description:

This course will offer awareness of historical development of robotics, different configurations, and kinematics-dynamics of the manipulators, actuators, sensory devices, different end effectors, and robot programming languages. This course will also cover the concepts of coding and classification of parts, flexible manufacturing system to support computer integrated manufacturing. With the expertise on the proposed course, the students are able to design and develop various manipulator configurations to perform the specific task related to industrial as well as non-industrial applications.

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

CO1: understand the fundamental concepts of robotics and design principles of joint variables of industrial manipulators
CO2: understand the fundamentals related to kinematics and dynamics of various configurations of the manipulator
CO3: understand the need and functional characteristics of drives, sensors and end effectors of a manipulator
CO4: acquire the programming skills to perform various tasks by the manipulator
CO5: understand the need the necessity of FMS and to design and develop an industrial manipulator to cater the needs of FMS
CO6: understand the importance of integration of information in FMS

Topics:

- Basic Concepts and configurations of Industrial Robots
- Kinematics and dynamics of the manipulator
- Robot drives and actuators
- Feedback devices and end effectors
- Robot languages and programming
- Group technology, FMS and CIM

Textbook(s):

1. Robotics technology and Flexible automation, S.R. Deb and S. Deb, TMH (2nd edition)
2. Automation, production systems, and computer integrated manufacturing, Mikell P. Groover, PHI (3^{rd} edition)

Reference Book(s):

1. Introduction to Robotics Mechanics and Control, J.J. Craig, Pearson Education, 2008.
2. Robotics and Control, R.K. Mittal & I.J. Nagrath, TMH.
3. Robotics; control, sensing, vision, and intelligence, K.S. Fu, R.S. Gonzalez and C.S.G. Lee, TMH
4. Fundamentals of robotics Analysis & Control, Robert J. Schilling, PHI

ME 3030 Product Life Cycle Management

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

Course Description:

Product life cycle management (PLM) is the way the product's entire life cycle is handled from its conception, through its design and development, to its operation and disposal/retirement. Furthermore, PLM enables the manufacturing firms to describe, manage, and communicate the information about their products with their customers, suppliers, and the resources within the enterprise.
The core of PLM is to build and manage all the data and the technologies used to access the information and expertise centrally. PLM is a discipline that emerged from tools such as CAD, CAM, CAE, and PDM, but can be viewed as the integration of these tools with methods, peoples, and the processes through all stages of a product's life. The course aims to strike a balance between theory and practice by focusing on 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 and with the complete integration of engineering workflows.

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

CO1: identify and analyse the product design and development processes in the manufacturing industry and define the components and their functions of product design and development processes and their relationships from concept to the customer over the whole product lifecycle
CO2: aanalyse, evaluate, and apply the methodologies for product design, development, and management and undertake a methodical approach to the management of product development to satisfy customer needs
CO3: enable generation of an innovative idea for product design in a systematic approach and apply the check the quality of the new design by using product design tools
CO4: understand the stages of product life cycle management and the components of the Product life cycle environment to integrate the various stages of PLM into engineering product ranges and portfolios that will eventuate into commercial success
CO5: integrate life cycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in an engineering environment
CO6: develop the methodology to evaluate the life cycle

Topics:

- Fundamentals of Product Development
- Generic Product Development Process
- Product design tools and technology
- Product Life Cycle Management
- Product life cycle environment
- Components of Product Life Cycle Management

Textbook(s):

1. Product design and development, Ulrich Karl T and Eppinger Steven D., McGraw Hill Pub. Company, 1995.
2. Product Design, Kevin Otto, Kristin Wood, Indian Reprint 2004, Pearson Education, ISBN 9788177588217
3. Product Life Cycle Management, Antti Saaksvuori, AnselmiImmonen, Springer,1st Edition (Nov.5,2003).

Reference Book(s):

1. Product Design and Manufacture, Chitale A. K. and Gupta R. C, Prentice-Hall of India, New Delhi
2. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, Semyon D. Savransky, CRC Press.
3. Systematic innovation: an introduction to TRIZ; (theory of inventive Problem Solving), John Terninko, AllaZusman, CRC Press.
4. Emotional Design, Donald A. Norman, Perseus Books Group New York, 2004
5. Product Life Cycle Management - Driving the Next Generation of Lean Thinking, Grieves Michael, McGraw-Hill, 2006.

ME 3031 Finite Element Method for Engineers

Credit: 3
Category: OEC
Prerequisite(s): Mathematics - I (MA 1003)

Course Description

This subject provides the basic and advance knowledge of the finite element method and its application to solve the various one, two, and three-dimensional engineering problems like a beam, rod, heat conduction, triangular nodes, etc. Furthermore, the governing differential equation methods like Rayleigh-Ritz and Galerkin Methods will be briefly discussed and implemented as a solution to the given problems. The last module of the course examines the various FEM commercial software and its use to formulate complicated structural and solid mechanics problems.

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

CO1: elaborate the fundamental theory of the FEA method
CO2: develop the governing FE equations for systems governed by partial differential equations
CO3: formulate with Rayleigh-Ritz and Galerkin Method
CO4: construct the finite element models for structural applications like truss and beam
CO5: apply the FE method for heat transfer problems
CO6: outline the application and use of the FE method to solve various engineering problems

Topics:

- Introduction and applications of FEM
- One dimensional beam and rod problems
- Shape functions, local and global coordinates system
- Two dimensional linear triangular element and three-dimensional elements problems
- Rayleigh-Ritz and Galerkin methods
- Application of FEM software to solve the various engineering problems

Textbook(s):

1. Introduction to Finite Elements in Engineering, T. R. Chandrupatla, A. D. Belegundu, Pearson, 4th Edition, 2015.

Reference Book(s):

1. Fundamentals of the Finite Element Method for Heat and Fluid Flow, Roland W. Lewis, Perumal Nithiarasu and K.N. Seetharamu, Wiley; 1st edition, 2004.
2. Fundamentals of Finite Element Analysis, D.V. Hutton, McGraw Hill.

ME 3032 Introduction to Fluid Mechanics and Heat Transfer

Credit: 3
Category: OEC
Prerequisite(s): Mathematics – I (MA 1003), Mathematics – II (MA 1004), Chemistry (CH 1007)

Course Description:

This course provides the fundamental knowledge about fluid flow and heat transfer phenomena. Particularly, it gives a root level approach to the problems related to kinematics and dynamics of fluid flow. The mechanism of fluid flow through Pitot tube, venturi meter and orifice meter are discussed with their practical applications. It also includes the conduction, convection and radiation heat transfer along with detail phenomena of boundary layer. The fundamental equations of conduction and convection in Cartesian and polar coordinates are discussed. The deep knowledge of this subject will be helpful for analysing the fluid flow as well as heat transfer problems.

Course Outcomes: After completion of the course, the students will be able to

CO1: recall the concept of fluid flow and heat transfer phenomena
CO2: express the mathematical formulation of a physical problem related to fluid flow and heat transfer
CO3: apply the fundamentals to cooling or heating of different equipment based on its various applications
CO4: analyse the different areas of thermos-fluid applications
CO5: design the heat transfer system using different modes of heat transfer
CO6: evaluate the different heat transfer systems in terms of cost, compactness, and impact on the environment with a view to establish a healthy working conditions

Topics:

- Introduction to Fluid and Heat transfer
- Kinematics of fluid flow
- Dynamics of fluid flow
- Conduction heat transfer
- Convection heat transfer
- Boundary layer theory
- Radiation heat transfer

Textbook(s):

1. Fluid Mechanics Fundamentals and Applications, J.M. Cimbala, Y.A. Cengel, Tata McGraw-Hill.
2. Heat and Mass Transfer, R. K. Rajput, S. Chand & Company.

Reference Book(s):

1. Heat and Mass transfer, P.K. Nag, Tata McGraw-Hill
2. Heat Transfer, J. P. Holman, Tata McGraw-Hill
3. Heat and Mass Transfer: Fundamentals and Applications, Y.A. Cengel, A.J. Ghajar, Tata McGraw-Hill.
4. Fluid Mechanics and Hydraulic Machines, S. Pati. Tata McGraw-Hill.
5. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som, G. Biswas, S Chakraborty, Tata McGraw-Hill.

ME 3033 Renewable Energy Sources

Credit: 3
Category: OEC
Prerequisite(s): Mathematics-I (MA 1003), Physics (PH 1007), Basic Electrical Engineering (EE 1003)

Course Description:

This course is intended to cover various prospects and needs of alternative and renewable energy sources in view of the present world energy scenarios. The in-depth discussions have been made on the energy conversion technologies for the various renewable energy sources like- wind, solar (both thermal and PV), biomass, geothermal, tidal, ocean and wave energy. An overview of the operating plants, utilizing renewable energy source, across the globe is presented at an introductory level. Thus, students will get an inside view of this course concerning the teething troubles like imbalance of fossil fuels demand and supply, and global warming, etc.

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

CO1: list the characteristics of the alternative and renewable energy sources and underline their need in present energy scenario
CO2: explain various aspects of the technologies developed for utilizing the renewable energy sources
CO3: apply the basic principles for converting the renewable energy sources into electricity
CO4: analyze the existing renewable energy technologies and their merits and demerits
CO5: design the various energy conversion technologies
CO6: assess the performance of the various existing technologies to convert the renewable energy sources to useful energy

Topics:
- Introduction of Renewable Energy
- Solar Power Generation
- Bio Power Generation
- Wind Power Generation
- Tidal and Wave Power Generation
- Geothermal Power Generation

Textbook(s):

1. Renewable Energy-Power for a Sustainable future, Godfrey Boyle, Oxford University Press, 3rd Edition, 2012.
2. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage, Tata McGraw Hill, 1990.

Reference Book(s):

1. V.S. Mangal, Solar Engineering‘, Tata McGraw Hill, 1992.
2. N. K. Bansal, Renewable Energy Source and Conversion Technology‘, Tata McGraw Hill, 1989.
3. G. L. Johnson, _Wind Energy Systems‘, Prentice Hall Inc, New Jersey.
4. N K Bansal, Non-Conventional Energy Resources, Vikas Publishing House Pvt. Ltd., 2014.
5. G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers, Fourth Edition.

ME 3034 Applied Thermodynamics

Credit: 3
Category: OEC
Prerequisite(s): Mathematics –I (MA 1003), Engineering Thermodynamics (ME 2031)

Course Description:

This course would help students to understand the fundamental thermodynamic laws and consequently, their applications in analyzing various energy interactions. The knowledge on energy interactions in various thermodynamic processes would help in designing efficient thermal systems. Further, this course includes the knowledge on various energy conversion cycles and analyzing their performances based on mean effective pressure. Additionally, this course involves the thermodynamic characteristic of both fuels and their combustion involving adiabatic flame temperature and enthalpy of formation. At the end, this course highlights various jet propulsion cycles and their nature of performance to understand both thermal and propulsive efficiency.

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

CO1: apply the knowledge of science and engineering fundamentals to model the energy conversion phenomenon
CO2: identify and formulate power production based on the fundamental laws of thermal engineering
CO3: investigate appropriate performance measurement related to heat engines
CO4: estimate the effectiveness of energy conversion process in mechanical power generation cycles for the benefit of mankind
CO5: appreciate concepts learned in laws of thermodynamics and learn how to sustain in energy crisis
CO6: communicate effectively the concepts of combustion in engines and model the propulsion system of aircraft

Topics:

- Thermodynamic systems and properties
- First law of thermodynamics and its application to flow processes
- Second law of thermodynamics and entropy
- Energy conversion cycles
- Fuels and combustion
- Jet and Rocket propulsion

Textbook(s):

1. Engineering Thermodynamics, P. Chattopadhyay, Oxford University Press, First edition, 2011.

Reference Book(s):

1. Thermodynamics – An Engineering Approach, Y. A. Cengel, M. A. Boles, Tata McGraw Hill Education Pvt. Ltd. New Delhi. 4th Ed, 2012.
2. Engineering Thermodynamics, P. K Nag, Tata McGraw Hill Education Pvt. Ltd., New Delhi. 4th Ed., 2008.
3. Fundamentals of Classical Thermodynamics, G. V. Wylen, R. Sonntag, C. Borgnakke, John Wiley & Sons, 4th Ed., 1996.
4. Engineering Thermodynamics-Work and Heat Transfer, G. Rogers, Y. Mayhew, Pearson Education Ltd., 7th Ed., 2012.
5. Engineering Thermodynamics, J. B. Jones, R. E. Dungan, Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Ed., 1996.
6. Fundamentals of Engineering Thermodynamics, E. Radhakrishna, Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Ed., 2011.

ME 3035 Biomechanics

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

Course Description:

This course encompasses a comprehensive study of mechanics of human body including skeletal joints, muscles, elbow, shoulder, knee, ankle, spinal column etc. Static and dynamic analyses of human body parts along with mechanical properties of biological tissues are focused. Knowledge of the course will help the students to design and develop artificial body parts and setups for physiotherapy applications.

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

CO1: apply principles of mechanics to model human body parts
CO2: analyze the stress factors and motion of different body parts to develop artificial joints, limbs, and other parts
CO3: understand the biomechanics of bones, tendons, ligaments, skeletal muscles and articular cartilage
CO4: create setups for physiotherapy applications
CO5: analyze the dynamics of human body parts and evaluate the uniaxial motion with constant acceleration
CO6: evaluate the uniaxial motion with constant acceleration

Topics:

- Introduction to biomechanics
- Statics Analyses of System in Equilibrium
- Applications of Statics to Biomechanics
- Stress and Strain
- Mechanical Properties of Biological Tissues
- Introduction to Dynamics & Linear Kinematics

Textbook(s):

1. Fundamentals of Biomechanics – Nihat Ozkaya and Margareta Nordin (Springer), 2nd Ed.

Reference Book(s):

1. Fundamentals of Biomechanics-Duane Knudson. (Springer)
2. Text book of Biomechanics and exercise therapy- Dr. C. Nagavani

ME 3036 Strength of Materials

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

Course Description:

The course on the strength of Materials lays the foundation on the understanding of stresses and strains in deformable solids subjected to axial, bending, torsional, thermal and combined loads. The course discusses in detail, the shear force and bending moments on beams. It introduces the concept of principal stresses in the analysis of structural members. The theories of failure are introduced to have an overall view of the design process, starting from fundamentals of stress and strain. In a nutshell, the course is aimed at nurturing the skill to solve real-life engineering problems on the strength of materials.

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

CO1: interpret stress strain diagrams and compute significant material characteristics
CO2: derive and apply stress equations under different load conditions to determine stress and strain
CO3: analyze a system under complex load system
CO4: derive and represent profiles for shear force, bending moment, slope and deflection of simple structural members under different load states
CO5: comprehend the concept of strain energy, derive and apply equations thereof in finding elastic profiles and stress under sudden or impact load
CO6: apply the concepts to analyze columns, cylindrical shells, spherical shells, springs and composite beams

Topics:

- Stress, strain and elastic constants
- Stress under axial load
- Stress under bending and torsion
- Compound stress and strain
- Shear force and bending moment diagrams
- Slope and deflection
- Strain energy
- Theories of failure
- Stresses in cylindrical and spherical shells
- Columns
- Stress in some other significant elements

Textbook(s):

1. Strength of Materials, S. S. Rattan, TMH

Reference Book (s):

1. Mechanics of Materials, R. C. Hibler, PEARSON
2. Strength of Materials, G. H. Ryder, MACMILLAN
3. Strength of Materials, R.K. Rajput, S.Chand
4. Strength of Materials, R. S. Khurmi, S. Chand
5. A Text Book of Strength of Materials, R. K. Bansal, Laxmi Publications Pvt Ltd

ME 3037 Quality Engineering and Management

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

Course Description:

This course aims to describe the significance and evolution of quality concept in manufacturing and service sectors. This course enables the student to understand different quality tools and techniques used to improve overall quality i.e. Total quality Management, ISO standards, Six Sigma etc. Implementation and monitoring of process control such as Statistical Process Control and evaluation of reliability of a system is also covered in this course.

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

CO1: compare and appreciate the contributions of Quality Gurus
CO2: understand quality engineering methods and tools
CO3: apply SQC methods to improve quality of products and services
CO4: understand the basic knowledge of total quality management
CO5: understand the concept of acceptance sampling and OC Curve
CO6: evaluate the reliability of an item and determine the reliability of a system

Topics:

- Introduction to Quality
- Quality Tools
- ISO Standard
- Six Sigma
- Total Quality Management
- Statistical Process Control
- Process Capability
- Acceptance Sampling Plan
- Reliability

Textbook(s):

1. Fundamental of Quality Control and Improvement, Mitra A, PHI
2. Quality Planning and Analysis, Juran J M and Gryna F M, Tata McGraw Hill

Reference Book(s):

1. Total Quality Management, J.R. Evans – Cengage
2. Quality Management, Bedi, Oxford
3. Quality Management, Gitlow Oppenheim Levine, TMH

ME-3038 Kinematics and Dynamics of Machinery

Credit: 3
Category: OEC
Prerequisite(s): Mathematics-I (MA 1003), Engineering Mechanics (ME 1003)

Course Description:

This course consists of basically two parts viz. kinematics and dynamics. It starts with basic concepts of mechanisms and kinematic inversions, their velocity and acceleration analysis. The mechanism behind working of flywheels and governors is also included. The dynamic part consists of free and force vibration analysis followed by rotating and reciprocating balancing, Primary and Secondary balance of single and multi-cylinder engines. Is also consists of different cam profiles and follower motion. The course ends with description of gear and gear trains.

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

CO1: understand the basic kinematics of mechanisms and their inversions
CO2: understand the working principle of working principle of gear drives, governors and flywheels
CO3: evaluate the parameters for balancing of rotating and reciprocating machines
CO4: evaluate and implement proper cams profiles for required follower motion
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 vibration

Topics:

- Introduction to Mechanisms
- Kinematic Analysis of Planar Mechanisms
- Kinematic Inversions
- Design of Flywheel and Governors
- Dynamics of Machines

Textbook(s):

1. Theory of Machines, Rattan S S, Tata McGraw-Hill
2. Mechanism and Machine Theory, Ambekar, A G, Prentice Hall, 2007.

Reference Book(s):

1. Kinematics and Dynamics of Machinery, Norton R L, McGraw Hill Education, 2017
2. Theory of machines and Mechanisms Si Edition, Gordon R. Pennock & Joseph E. Shigley John J. Uicker, Oxford University Press; 4th edition, 2014
3. Theory of Mechanisms and Machines, Amitabha Ghosh & Mallik A. K., East West Press

ME 3039 Mechatronic Systems

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

Course Description:

Mechatronic Systems course encompassing mechanical engineering, electronic engineering and software engineering. This course is presented to cover all of these critical aspects including analog interfacing, digital logic, real-time computation tasks, and power amplifiers, measurement and sensing, controllers, and pneumatics and hydraulic actuation systems. Through the course, students will be able to analyze and develop electro-mechanical systems, and techniques through extensive and systematic research.

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 used in industries as well as home appliances
CO3: apply the different drive systems for actuation of various parts and components of a system
CO4: 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:

- Introduction of Mechatronics
- Logic circuits
- Drives
- Pneumatics and Hydraulic actuation systems
- Controllers

Textbook(s):

1 Mechatronics: electronic control systems in mechanical and electrical engineering, Boltan, W., Longman, Singapore, 1999.
2 Mechatronics, HMT ltd. Tata McGraw-Hill, New Delhi, 1988.
3 A Text book of Mechatronics, Rajput, S Chand, New Delhi, 2008

Reference Book(s):

1 Robotics technology and flexible automation, S. R Deb and S. Deb., , Tata McGraw-Hill, New Delhi, 1994.
2 Computer automation in manufacturing - an Introduction, T. O. Boucher, Chapman and Hall, 1996.
3 Micromechatronics, modelling, analysis, and design with MATLAB, V. Giurgiutiu, S. E. lyshevski, CRC Press,2015
4 Mechatronics: Principles, concepts and applications, N. P. Mahalik, TMH

ME 3040 Engineering Materials

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

Course Description:

This course would comprise of a comprehensive study of importance of material science and metallurgy in various engineering applications, crystal structures, deformation behavior of material, microstructure-property-process correlation, thermo-mechanical processing, different alloy system and development, conventional manufacturing processes, additive manufacturing, fabrication of composites, rapid prototyping, various material characterization techniques, and nondestructive testing methods. Knowledge of the course will help the students right from selecting the suitable materials to creating and testing of products for different engineering applications, control the performance and productivity of material by modifying the microstructures and thermo mechanical processing routes. At the end of the course the students will be able to involve in the research, design and development of materials to advance the technology and products

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

CO1: understand the importance of crystal structures, defects and their effect on material properties and behavior
CO2: understand the various deformation mechanisms, heat treatment processes, thermo mechanical processing and correlate the microstructure -processes-properties of material
CO3: analyze the different alloy system, phase diagram and phase transformation to evaluate the effectiveness of alloy development
CO4: analyze importance of various conventional as well as advanced manufacturing processes and parameters to control the material characteristics and performance
CO5: apply different destructive and non-destructive testing methods to evaluate material properties and defects in material
CO6: select the structural materials for various Engineering applications, design and develop the new alloy, composites depending upon the advancement of application area

Topics:

- Introduction to Materials Science
- Phase Diagrams
- Materials Processing
- Powder metallurgy, fabrication of composites, rapid Prototyping
- Material Characterization
- Non-destructive testing

Textbook(s):

1. Fundamentals of Materials Science and Engineering, W. D. Callister, Wiley, 4th edition.
2. Manufacturing Processes by J. P. Kaushish, PHI Learning, 2nd edition.

Reference Book (s):

1. Engineering Materials, S. C. Rangwala, Charotar Publishing House, 2011.
2. Material Science, V. Rajendran and A Marikani, Tata McGraw-Hill, New Delhi,2009.
3. Material Science, M.S. Vijay and G. Rangarajan, Tata McGraw-Hill, New Delhi, 2011.
4. Material Science for Engineers, J.F. Shackelford and M.K. Muralidhara, 6th edition, PEARSON
5. Engineering Materials Technology, W. Bolton, 3rd Edition, Butterworth & Heinemann, 2001

ME 3041 Mechanical System Design

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

Course Description:

This course focuses primarily on the design and development aspect of different mechanical components. It enables the students to apply technical skills and imagination to come up with a proper design configuration. Students are able to determine the stresses, shear force and bending moment in different structural elements. It also enables them to get acquainted with the design of temporary, permanent fasteners and tribological system. This course puts emphasize on the importance of vibration study and proper selection of tribological elements in engineering. The governing differential equations of a vibration system are determined along with its solution.

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

CO1: evaluate various types of stresses in different structural elements
CO2: apply technical skill and imagination to construct a proper design configuration
CO3: acquaint themselves with the design of various temporary and permanent fasteners
CO4: understand the importance of vibration study in engineering
CO5: determine the governing differential equation of a vibration system and its solution
CO6: understand the importance of proper selection of tribological elements

Topics:

- Simple Stress and Strain
- Compound Stress and Strain
- Shear Force and Bending moment
- Design of Fastening Elements
- Degree of freedom systems
- Torsional Vibration and Vibration of continuous system
- Hydrostatic and Hydrodynamic theory of lubrication

Textbook(s):

1. Strength of Materials, S.S. Rattan, TMH
2. Design of Machine Elements: VB Bhandari (TMH)
3. Mechanical Vibrations and Noise Engineering, Ashok G. Ambekar, PHI.
4. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja, PHI

Reference Book(s)

1. Machine Design by Dr. P.C. Sharma and Dr. D.K. Aggrawal.
2. Strength of Materials, Lehri & Lehri, Kataria,
3. Theory of Vibration and Application, William T. Thomson, CBS
4. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.
5. Hand Book- Design Data Handbook by S. Md. Jalaludeen.
6. Machine Design Data book by V.B. Bhandari

ME 3042 Computer Controlled Manufacturing Systems

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

Course Description:

This course will offer awareness of historical development of automation, different automated machine tools, part programming, process planning, computer networks and future aspects in the manufacturing technology. With the knowledge of this course, the students are able to identify the suitable machine tool and can develop the part program to produce the part. Effective process plan can be developed to produce the job without delay in production. They can also through with computer networks while going through this course.

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

CO1: understand the importance of automation in the Manufacturing Industry
CO2: designing the sequence of operations leading to optimized time and cost
CO3: understand the essentials of manufacturing automation with automated machine tools such as NC, CNC and DNC
CO4: acquire the programming skills to produce various complex features with computer assisted part programming methodologies
CO5: understand the need the computers network in manufacturing industries
CO6: visualize the futuristic advancements in the manufacturing technology

Topics:

- Automated manufacturing systems
- Role of computers in process planning
- Part programming
- Computer networks
- Future aspects in automation

Textbook(s):

1. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson Education, ISBN 81-7808-511-9. 3rd Edition, 2007
2. CAD/CAM, Ibrahim Zeid, TMH

Reference Book(s):

1. Computer Integrated Manufacturing, Paul Ranky Prentice Hall of India
2. Computer Integrated Manufacturing System, Yorem Koren, McGraw-Hill, 1983

ME 3043 Power Plant Engineering

Credit: 3
Category: PEC
Prerequisite(s): Engineering Thermodynamics (ME2031), Fluid Mechanics & Hydraulic Machines (ME 2021)

Course Description:

The course starts with description of various sources of energy to run a power plant. The suitability of the location for establishing the power plant is then described. To understand the concept of running the power plant, different thermodynamic cycles are discussed. Further, to enhance the performance, the different components such as turbines, condensers, nozzles, cooling tower are explained.

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

CO1: state the conditions necessary to establish a power plant
CO2: describe the thermodynamic cycles used in power generation
CO3: apply the basic principles to maximize the performance and minimizing the cost
CO4: analyse the performance of the power plants in terms of its efficiency
CO5: design the power plant for high performance with minimal cost
CO6: evaluate the energy demand for power in an effective way

Topics:

- Sources of energy and Utilization
- Analysis of steam cycles
- Generation of steam
- Flow of steam through nozzles
- Steam Turbine
- Steam condensers and cooling tower
- Introduction to Nuclear power plants

Textbook(s):

1. Power Plant Engineering, P. K. Nag Tata McGraw-Hill Education, 2002

Reference Book(s):

1. Power Plant Engineering, R. K. Rajput Laxmi Publications (P) Ltd., Fourth Edition.
2. Power Plant Engineering, M. K. Gupta, PHI Learning, 2012.
3. Power Plant Engineering, P.C. Sharma, S. K. Kataria & Sons, 2009.

ME 3044 Robotics

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

Course Description:

This course would encompass a comprehensive study of Definition of Robot, Robot kinematics, Robot Dynamics, Robotic control, Computer vision etc. Knowledge of the course will help the students to know about Robot configuration, classifications, description of position and orientation of Robot. At the end of the course the students will have the idea about how Robot perceive object and strategies for extracting information from Sensors.

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

CO1: the relationship between mechanical structures of industrial robots and their operational workspace characteristics
CO2: apply spatial transformation to adopt forward kinematic equations of robot manipulators and solve inverse kinematics of simple robot manipulators
CO3: control Robot by different types of programming method
CO4: select the best robotic applications and be able to justify the overall advantages to Industry
CO5: explore the field of machine vision as a fundamental sensor technology in robotics
CO6: obtain the Jacobian matrix and use it to identify singularities and also to generate joint trajectory for motion planning

Topics:

- Introduction to Robotics
- Robot Kinematics
- Robot Dynamics
- Robot Control
- Perception
- Computer Vision
- Robot Programming and Artificial Intelligence

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. Industrial Robotics Technology –Programming and Applications- Mikell P. Groover, Mitchell Weiss, McGraw Hill International Edition.
2. Foundation of Robotics: Analysis and Control -Yoshikawa, Prentice Hall of India.
3. Robotics; control, sensing, vision and intelligence, K. S. Fu, R. s. Gonzalez and C. S. G. Lee, TMH

ME 3045 Metal Forming Processes

Credit: 3
Category: PEC
Prerequisite(s): Materials Science and Engineering (ME 2027), Basic Manufacturing Process (ME 2010), Mechanics of Solids (ME 2029)

Course Description:

This course would encompass a comprehensive study of different industry based metal forming processes such as rolling, forging, extrusion, drawing and some of the sheet metal operations. The numerical analysis of forming problems to find the power requirement, deformation mechanics and failure criteria, friction and lubrication conditions will be addressed in detail during the whole course. Knowledge of the course will help the students to identify right manufacturing process, suitable press unit, desirable die geometry and work environment which will support for quality as well as economic production. Though metal forming process is one of the most used manufacturing process in industry, this course will help the students to implement the knowledge to contribute towards improvement in productivity in future.

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

CO1: understand different types of metal forming process utilized in manufacturing industries
CO2: explain the plastic deformation of metals on industrial scale and analyze the behaviour of materials during forming processes
CO3: understand the concept of technological procedures in industrial manufacturing processes related to pressure shaping of metals and estimate the forming loads and power requirement for different forming processes
CO4: explain the essence of each technological operation employed in industrial pressure shaping of metals
CO5: understand the industrial limitations and safety measures for the kind of manufacturing
CO6: integrate knowledge gained in this course to select and design a complete metal forming system

Textbook(s):

1. Fundamentals of Metal Forming Processes, B. L. Juneja, New Age International Publishers, 2010.
2. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.

Reference Book (s):

1. Principles of Metal Working Processes, G.W. Rowe, CBS Publishers, 2005.
2. Metal Forming Hand book, ASM International.
3. Metal forming: Processes and analysis, Betzalel Avitzur , R. E. Krieger Pub. Co.

ME 3046 Introduction to Composite Materials

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

Course Description:

This course focuses on the comprehensive study of different types of composite materials, fabrication of polymer and metal matrix composites, characterization of composite materials, secondary processes involved in joining composite material and industrial application of composites. Knowledge of the course will help the students to identify right composite material and its fabrication process for industrial application. At the end of the course the students will be able to cope up with industrial problems related to analysis and fabrication of composite materials through extensive and systematic research.

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

CO1: understand the science and technology behind the composite materials
CO2: understand various types of fabrication processes
CO3: understand the properties of the composites material in the context of strength, fracture and safety in view of its structural application
CO4: know the secondary processes and joining of composite material
CO5: understand the industrial application of composites
CO6: understand fracture behaviour of composite materials

Topics:

- Introduction of composite materials
- Performance of structural and non-structural composites
- Fabrication of metal matrix and polymer matrix composites
- Characterization and secondary processes of joining of composites
- Industrial application of composite materials
- Fracture and safety of composite

Textbook (s):

1. Composite materials, K.K. Chawala, 2nd ed., Springer-Verlag, New York 1987.
2. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, Elsevier Science Ltd, Oxford, 2001.

Reference Book (s):

1. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Weinheim.
2. Ceramic matrix composites, K.K. Chawala, Chapman & Hall, London, 1993.
3. Advances in composite materials, G. Piatti, Applied Science Publishers Ltd., London.

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 3048 Fundamentals of Computational Fluid Dynamics

Credit: 3
Category: OEC
Prerequisite(s): Physics (PH 1007), Mathematics-I (MA 1003)

Course Description

The prime objective of this subject is to deliver fundamentals of computational fluid dynamics (CFD) and its applications to the practical problems. Initially, scope of the CFD is discussed along with some basic concepts like stability, consistency and convergence. Thereafter, the mathematical formulation of mass, momentum and energy are discussed with initial and boundary conditions. The subject also includes the detailed description of the finite difference, finite volume and finite element methods. Furthermore, the course describes the discretization and solution methods for linear algebraic equations. Finally, solution algorithm for fluid flow equations using SIMPLE, SIMPLEC and SIMPLER methods are explained.

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

CO1: recall the conservation equations of mass, momentum and energy and underline their different forms suitable in the frame work of CFD
CO2: describe the basic principles of finite element method, finite difference method, finite volume method, solution techniques for solving linear algebraic equations, stability, convergence, consistency
CO3: apply fundamental principles for solving differential equations governing various problems of fluid flow and heat transfer
CO4: compare solution techniques for linear algebraic equations, explicit method, implicit method, and various algorithms for solving Navier-Stokes equation
CO5: devise suitable schemes for solving problems of fluid flow and heat transfer considering the aspects of stability, consistency, accuracy
CO6: interpret correctly the results generated by various schemes and algorithms

Topics:

- Introduction
- Classification of partial differential equations
- Types of boundary conditions
- Errors, accuracy, stability, consistency
- Mathematical formulation of the physical phenomenon
- Discretization methods
- Finite difference formulation
- Finite volume formulation
- Flow field calculation by stream function vorticity method, primitive variable approach method
- Solution techniques for linear algebraic equations

Textbook(s):

1. Numerical Heat Transfer and Fluid Flow, S V Patankar, Hemisphere Publishing.

Reference Book(s):

1. Computational Fluid Dynamics, John D Anderson, Jr, McGraw Hill Book Company.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H. Versteeg , W. Malalasekera, Prentice Hall.

3. Computer Simulation of flow and heat transfer, P.S., Ghoshdasdidar, Tata McGraw-Hill Publishing Company Ltd.
4. Finite Difference Method, M. N. Ozisik, CRC.
5. Computational Fluid Flow and Heat Transfer, Muralidhar and T. Sundararajan, Narosa

ME 3050 Automobile Technology

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

Course Description:

The subject is an elective course designed to give introductory knowledge about different parts and mechanisms of various automobiles along with an overview of automotive maintenance & repair concepts for the student with little or no background in the automotive field. The course covers the construction, operation and maintenance of the engine, combustion system, transmission system, suspension system, steering, brakes, and automotive safety components. The course has also an introduction to the advanced features coming up in automobiles related to the reduction in environmental pollution and uses of alternative energy resources.

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

CO1: understand the construction and components of automotive vehicles
CO2: recognize the mechanisms and operation of different systems associated with automobiles
CO3: evaluate the operational and performance of different automobiles and its components
CO4: analyze the use of appropriate components and its selection depending on application
CO5: apply the concepts of automotive vehicle components to other allied applications
CO6: choose and Revise various mechanism in automobiles and similar industrial applications

Topics:

- Introduction
- Engine and Combustion System
- Transmission system
- Steering, Suspension and Braking
- Suspension System
- Brakes
- Automotive Safety
- Advanced Automobile

Text book(s):

1. Automobile Engineering, Jain and Asthana, Tata McGraw Hill, 1st Edition , 2002

Reference Book(s):

1. A Textbook for Automobile Engineering, S K Gupta, S Chand Publication
2. Automotive Mechanics, W H Course and D L Anglin , McGraw Hill
3. Automobile Engineering, K M Gupta, VOL-I &II, Umesh Publication
4. A Textbook of Automobile Engineering, R K Rajput, Laxmi Publication
5. Automobile Engineering, R B Gupta, Satya Publication

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 3052 Nanotechnology

Credit: 3
Category: PEC
Prerequisite(s): Chemistry (CH 1007), Physics (PH 1007), Materials Science and Engineering (ME 2027)

Course Description:

This course would encompass a comprehensive study of nanoparticles, nanowires, nanoshells, nanotubes, quantum dots and self-assembled monolayers. Knowledge of the course will help the students to synthesize various nanomaterials through different techniques and to characterize them through different spectroscopy and microscopy techniques. At the end of the course the students will be able to apply the concept of nanotechnology in various engineering industries.

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

CO1: understand the concept of nanoparticles, nanowires, nano shells, nanotubes, quantum dots and self-assembled monolayers
CO2: create nanomaterials through different synthesis routes
CO3: evaluate physicochemical characteristics through different spectroscopy and thermal analysis methods
CO4: analyze the microstructure and elemental composition of nano materials through microscopic imaging and XRD techniques
CO5: apply the concept of nanotechnology in engineering industries
CO6: apply the concept of nanotechnology medical applications, food and agriculture, data storage, risk assessment, management and ethical aspects

Topics:

- Introduction to nano materials
- Synthesis of Nanomaterials
- Physicochemical Characterization of Nanomaterials
- Imaging Techniques for Nanotechnology
- Applications of Nanotechnology

Textbook(s):

1. Textbook of Nanoscience and Nanotechnology, T. Pradeep, McGraw Hill, 2012.

Reference Books:

1. Nanotechnology: Fundamentals and Applications, R, Booker and Boysen Earl (Eds), I K International Publishing House Pvt. Ltd, 2008.
2. Nanoscience and Nanotechnology: Fundamentals of Frontiers, Shubra Singh and M.S. Ramachandra Rao, Wiley, 2013.
3. Fundamentals of Nanoscience, S. L. Kakani and Subhra Kakani, New Age International, 2017.
4. Introduction to Nanoscience, S. M. Lindsay, Oxford University Press, 2009.
5. Nanostructure and nanomaterial, G. Cao, World scientific, 2011.

ME 3053 Project Management

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

Course Description:

This course aims to Identify project goals, constraints, deliverable, performance criteria, control needs, and resource requirements in consultation with stakeholders and also to Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success. It also presents to manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders. It focuses on project organization. Project selection, project control and project monitoring.
.

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

CO1: develop plans with relevant people to achieve the project's goals
CO2: break work down into tasks and determine handover procedures
CO3: identifies links and dependencies, and schedule to achieve deliverable
CO4: estimate and cost the human and physical resources required, and make plans to obtain the necessary resources
CO5: allocate roles with clear lines of responsibility and accountability
CO6: understand the roles of project manager and selection of project

Topics:

- Attributes of a Project and Project Life cycle
- Project Organisation
- Project Manager
- Project Planning and Scheduling
- Supplier Selection
- Project Monitoring
- Project Performance

Textbook(s):

1. Project Management, James P. Clements & Jack Gido, Cengage Learning, 5th edition, 2012

Reference Book (s):

1. Project Management: *A Managerial Approach*, Jack R. *Meredith*, Samuel J. *Mantel*, Jr., 8th Edition, *Wiley Publications*, August 2011

ME 3054 Gas Dynamics and Jet Propulsion

Credit: 3
Category: PEC
Prerequisite(s): Engineering Thermodynamics (ME 2031), Fluid Mechanics and Hydraulic Machines (ME 2021).

Course Description:

This course introduces students to the fundamental concepts of compressible flow of fluids. Relevance of Mach number and its significance for classification of compressible flow are explained. Isentropic flow of an ideal gas through varying cross-sectional area such as convergent nozzle, convergent-divergent nozzle, chocking criteria etc. are discussed. Governing equations for capturing the effects of friction and heat transfer for flow through constant area duct are formulated and physical insights of the solutions are highlighted. Types of engines are introduced and performance analysis in terms of thrust, power and efficiency are carried out.

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

CO1: relate their knowledge of thermodynamics, fluid mechanics and heat transfer with the basics of compressible fluid flow and heat transfer
CO2: identify various types of compressible flow, stagnation and critical states, shocks, propagation of waves, flows with the effect of friction and heat transfer, propellants, jet propulsion and rocket propulsion engines
CO3: apply the fundamental principles for calculating stagnation and critical state properties and different performance parameters such as thrust, power, and efficiency of engines
CO4: analyze the effect of various parameters on the performance of nozzles and diffusers, engines
CO5: Design various components such as nozzles, diffusers, engines employed in gas dynamics and jet propulsion systems
CO6: Evaluate the performance of nozzles, diffusers, propellants, jet propulsion and rocket propulsion engines

Topics:

- Definitions and basic relations
- Energy equation
- Rate equations for a control volume
- Isentropic flow with variable area
- Wave motion
- Flow with normal and oblique shock waves
- Flow in constant area ducts with friction
- Flow in constant area ducts with heat transfer
- Aircraft and rocket propulsion

Textbook(s):

1. Fundamental of compressible flow with Aircraft and Rocket Propulson, S. M. Yahya,, New Age International (p) Ltd., New Delhi, 2005.
2. Gas Dynamics, E. Radhakrishnan, Prentice Hall of India, New Delhi, 2001.

Reference Book(s):

1. Fundamental of gas dynamics, 2nd edition– Zucker- Wiley publishers.
2. Elements of gas dynamics – Liepman & Roshko.
3. Compressible fluid flow, Patrich.H. Oosthvizen, William E.Carscallen, McGraw-Hill, 1997.
4. Gas Turbines, V. Ganesan, Tata McGraw-Hill, New Delhi, 1999.

5. Gas Dynamics and Jet Propulsions, P. R.S.L.Somasundaram, New Age International Publishers, 1996.
6. Gas Turbine Theory, H. Cohen, G.E.C. Rogers and Saravanamutto, Longman Group Ltd., 1980.

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 3056 Tribology

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

Course Description:

The Course, an off-shoot of Mechanical Engineering, has been designed to impart the pragmatic knowledge in context to the science of interacting surfaces and to offer a deeper insight in regard to the application as well as principles of friction, wear and lubrication. The domain of tribology happens to be interdisciplinary in nature and so accommodates the ingredients of plural disciplines like mechanical engineering, chemistry, material science, etc. Under the applicative scope of tribology, students are expected to get cognitive exposure pertaining to various tribological aspects of machine elements and a wide range of composite materials. The knowledge of tribology can be deployed meaningfully in checking the wasteful dispersal of energy on account of some uncalled for friction, and thereby contributes towards maintaining a green environment.

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

CO1: realize the importance of proper choice of tribological elements
CO2: design a tribological system for optimal performance
CO3: enhance students' awareness of tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals, and braking systems
CO4: demonstrate basic understanding of friction, lubrication, wear processes and Sommerfeld number
CO5: select tribological elements based on design considerations
CO6: apply the knowledge of wear and lubricants for different applications

Topics:

- Introduction to tribology
- Hydrostatic lubrication
- Hydrodynamic theory of lubrication
- Friction and power losses in journal bearings
- Air lubricated bearing
- Types of bearing oil pads
- Bearing materials

Textbook(s):

1. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja, PHI

Reference Book(s):

1. Engineering Tribology: G. W. Stachowiak, A. W Batchelor
2. Tribilogy, Friction and Wear of Engineering Materials: I.M. Hutchings, Elsevier Limited.
3. Introduction to Tribology of Bearing: B.C. Majumdar, S.Chand.
4. Theory and Practice of lubrication of Engineers: D.D. Fuller, John Wiley Sons 1998.

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 3059 Computational Fluid Dynamics

Credit: 3
Category: PEC
Prerequisite(s): Fluid Mechanics and Hydraulic Machines (ME 2021), Heat Transfer (ME 3021)
Course Description:

The focus of this course is to develop the fundamentals of computational fluid dynamics and its implementations to the practical applications. The course describes the finite difference, finite volume and finite element methods in details. The mathematical formulation of mass, momentum and energy are discussed with initial and boundary conditions. Furthermore, discretization of governing equations is demonstrated and solution methods for linear algebraic equations are explained with examples. The course also describes implicit and explicit methods, stability, consistency, convergence, etc. Finally, solution algorithm for Navier-Stokes equations using SIMPLE, SIMPLEC and SIMPLER methods are explained.

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

CO1: underline the Finite difference, finite volume and finite element methods
CO2: describe the discretization procedure for steady and unsteady conduction equations using finite difference methods
CO3: apply Gauss elimination method, Gauss-Seidel iteration method, Jacobi iteration method, SOR, tri-diagonal matrix (TDMA) for solving linear algebraic equations
CO4: differentiate implicit and explicit methods, stability, consistency and convergence
CO5: propose a stable and accurate algorithm for convection diffusion equation with suitable scheme
CO6: assess the SIMPLE, SIMPLEC and SIMPLER algorithm in finite difference and finite volume framework

Topics:
- Introduction
- Mathematical formulation of physical phenomena
- Different methods for solving linear algebraic equations
- Introduction to finite difference approximation, accuracy and errors
- Discretization methods
- Finite volume formulation
- Flow field calculation

Textbook(s):
1. Computational Fluid Dynamics, John D Anderson, McGraw Hill.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H, Versteeg, Malalasekhara, Prentice Hall.

Reference Book(s):
1. Computer Simulation of Flow and Heat Transfer, P. S. Ghoshdastidar, Tata McGraw Hill Publishing Company.
2. Computational Fluid Flow and Heat Transfer, Murlidhar and Sundarrajan, Narosa Publishers.
3. Numerical Heat Transfer and Fluid Flow, S. V. Patankar, Hemisphere Publishing.

ME 3061 Advanced Mechanics of Solids

Credit: 3
Category: PEC
Prerequisite(s): Mechanics of Solids (ME 2029)

Course Description:

This course is intended to impart deep knowledge of generalized stress, strain, displacement and force. While in the "mechanics of solids" course, the students were introduced to the various components of the stress and strain, likely the normal and shear, in the problems that was solved not more than one component of the stress or strain occurred simultaneously. In this course these problems in which more than one component of the stress or strain occurs simultaneously will be dealt. Thus, in this course generalized concepts and equations to facilitate three dimensional analysis of structures will be studied. The practical significance is that a machine element like non uniform shaft or curved beam 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: evaluate general 3-dimensional stress analytically in structural elements
CO2: find the 3-dimensional strain components in structural elements
CO3: derive the constitutive relation of a material in its generalized form (3-dimensional)
CO4: understand different theories of failure in order to design a machine element or a structural member
CO5: evaluate the stresses developed in the bending of straight and curved beams having general cross section and finding the deflection of such beams
CO6: evaluate the stresses in general prismatic bars under torsion

Topics:
- Analysis of stress
- Analysis of strain
- General Stress-strain relation
- Theories of failures
- Unsymmetrical bending
- Torsion of non-circular sections

Textbook(s):
1. Advanced Mechanics of Solids, L. S. Srinath, McGraw Hill Education.

Reference Book(s):
1. Advanced Mechanics of Materials, A.P. Boresi, R.J. Schimdt; Wiley.
2. Strength of Materials, Sadhu Singh, Khanna Publishers.
3. Strength of Materials, Beer and Johnson, McGraw-Hill Education, 2014

ME 3062 Thermodynamics and Hydraulic Devices

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

Course Description:

This course would include an introductory level study principle of thermodynamics, steam properties and its cycle, Bernoulli's principle and its application, steam generator and steam turbine, hydraulic turbine and pump. Knowledge of the course will help the students to learn fundamental concepts and principles of thermodynamics and fluid dynamics with their applications. At the end of the course, the students will be able to apply their developed knowledge and understanding to design and develop the numerous thermo-fluid mechanical devices.

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

CO1: state the principles of thermodynamics and fluid dynamics
CO2: explain working of different thermo-fluid mechanical devices
CO3: apply the concepts to know the operation of the thermo fluidic devices
CO4: compare the performance of different thermo-fluid mechanical devices used for industrial applications
CO5: design the improved thermo-fluid devices
CO6: evaluate the working of different thermodynamic systems

Topics:

- Principle of thermodynamics
- Principle of fluid dynamics
- Steam Turbine
- Hydraulic Turbine
- Boiler
- Centrifugal Pump
- Reciprocating Pump

Textbook(s):

1. Thermal Engineering, A. S. Sarao, Satya Prakasan, New Delhi.
2. Fluid Mechanics and Hydraulics Machines, R. K. Rajput, S. Chand.

Reference Book (s):

1. Engineering Thermodynamics, P K Nag, McGraw Hill Education, Fifth Edition.
2. Hydraulics and Fluid Machines, P. N. Modi and S. M. Seth

ME 3063 Automobile Engineering

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

Course Description:

This course is intended to describe the evolution of automobile and various subsystems to the students of Mechanical Engineering who has sufficient knowledge of machine and mechanics. This course emphasizes on chassis, starting and ignition systems for new automobile. The significance of the cornering force and cornering power required to steer a vehicle can be appreciated. In view of changing emission norms the fuel supply system in IC engine vehicle plays an important role and students will have ample knowledge of it. Students will fine tune their design skill by analyzing gear ratio, spring stiffness, braking efficiency etc.

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

CO1: state the evolution of automobiles and its structure
CO2: describe the chassis, starting and ignition systems for new automobile
CO2: sketch and calculate the cornering force and cornering power required to steer a vehicle
CO3: examine and select a suitable fuel supply system for automobiles
CO4: formulate and analyze the gear ratio in gear box, stiffness in suspension springs and the braking efficiency
CO5: design an efficient engine by analyzing the gear ratio, spring stiffness, braking efficiency
CO6: select and identify the most appropriate chassis and engine for latest automotive application

Textbook(s):

1. A Textbook of Automobile Engineering – R K Rajput, Laxmi Publications, New Delhi 2015

Reference Book(s):

1. Automobile Engineering, Jain and Asthana, Tata McGraw Hill, 1st Edition, 2002
2. Automobile Mechanics - J. Heitner, East West Press, 2006
3. Automobile Engineering - K.M. Gupta. Vol I & II Umesh Publications, 2012

ME 3065 Combustion Engineering

Credit: 3
Category: PEC
Prerequisite(s): Engineering Thermodynamics (ME 2031)

Course Description:

This course would encompass a comprehensive study of various energy sources, combustion applications, classification of combustion process according to mixing, species velocity, flame visibility etc. Application of thermodynamics on combustion, stoichiometry, absolute enthalpy and enthalpy of formation, enthalpy of combustion and heating values, adiabatic flame temperatures are also included in order to establish the fundamentals knowledge. Elementary reaction rates, unimolecular, bimolecular and termolecular reactions, collision theory; reaction rate and its functional dependence, Arrhenius equation are also discussed. Practical applications and fundamentals of laminar premixed and diffusion flames through conservation (mass, species & energy) equations & mass-fraction distribution flame velocity are explained to understand the physical and chemical behavior of combustion. Droplet evaporation basics and pollution emission during combustion such as; soot, NOx and SOx are further explored.

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

CO1: recall the basics of combustion and thermo chemistry relations
CO2: explain the fundamentals of chemical kinetics
CO3: illustrate the mechanism and explain technicality of laminar premixed flame
CO4: analyze the needs and the technical detail of laminar diffusion flame
CO5: formulate the physical process through mathematical relation of droplet evaporation
CO6: assess the causes of pollution and its minimization

Topics:
- Combustion and Thermo chemistry
- Chemical Kinetics
- Laminar premixed flame
- Laminar diffusion flame
- Droplet evaporation & combustion
- Pollutant emissions

Textbook(s):
1. Introduction to Combustion: Concepts and Applications, Stephen R Turns, McGraw Hill, 2000

Reference Book(s):
1. Combustion: Fundamentals and Application, Amitava Datta, Alpha Science International Ltd, 2017
2. Combustion Engineering, K. Kuo, New Age Pvt. Ltd.

ME 3067 Cryogenics

Credit: 3
Category: PEC
Prerequisite(s): Engineering Thermodynamics (ME 2031), Heat Transfer (ME 3021)

Course Description:

This course is about production, measurement and application of low temperature systems and devices. The course starts with material properties at low temperature and different thermodynamic cycles for gas liquefaction systems. Then the course discuss about gas purification and separation methods with detailed design of rectification column. Different refrigeration systems at cryogenic temperature are also discussed. The course ends with low temperature measurement systems and applications of cryogenics.

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

CO1: recognize historical developments in cryogenic systems
CO2: explain material behaviour at low temperature
CO3: demonstrate the applications of cryogenics
CO4: choose the measurement systems at low temperature
CO5: compare gas liquefaction and purification systems/methods
CO6: analyze system parameters and performance

Topics:

- Introduction to Cryogenics Systems
- Gas Liquefaction Systems
- Gas Separation and Purification Systems
- Cryogenic Refrigeration
- Measurement Systems for Low Temperatures
- Application of Cryogenics

Textbook(s):

1. Cryogenics Engineering, T M Flynn and Marcel Dekkar
2. Cryo-Cooler Fundamentals, G. Walker, Plenum Press New York

Reference Book(s):

1. Cryogenics Engineering, T M Flynn and Marcel Dekkar
2. Cryo-Cooler Fundamentals, G. Walker, Plenum Press New York

ME 3069 Total Quality Management

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

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 3071 Renewable Energy Technology

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-I (MA1003), Physics (PH 1007), Basic Electrical Engineering (EE 1003)

Course Description:

This course will provide a detailed understanding of the key renewable energy generation technologies and the factors which influence their exploitation. It provides the foundations necessary to understand the principles of solar, wind, biomass, geothermal and marine energy technologies. It describes the efficient distribution of renewable energy; their integration into usage into zero carbon built infrastructure. Finally, the economic and climate issues affecting the choice of renewable is explored.

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

CO1: list the potential, needs, the properties, advantages, disadvantages and the impact on the environment of the alternative and renewable energy sources
CO2: describe the technologies available for the conversion of renewable energy sources to the useful energy
CO3: apply the basic principles for determining the size of various equipment used in renewable energy technology
CO4: analyze the performance of various equipment used in renewable energy technology
CO5: design various components of flat plate collector, bio-gas plant, wind turbine
CO6: select the suitable material, component and technology required for efficient operation of different plants employed in renewable energy technology

Topics:

- Need for renewable energy sources and their merits and demerits
- Measurement of Solar Radiation, Solar Thermal Process, solar collector, Energy Storage, applications
- Biomass energy sources, physical processing, thermo-chemical processing, biochemical processing, vegetable oils and bio-diesel
- Energy and power in the wind, types of wind turbines, aerodynamics of wind turbines, power generation by a turbine, offshore wind energy
- Nature of tidal sources, physics of tidal energy, power generation from barrages
- Physical principles of wave energy, wave energy sources, wave energy technology, wave energy integrated systems
- Physics of geothermal resources, technologies for exploiting high enthalpy stream fields, technologies for direct use of geothermal energy, harnessing geothermal resources

Textbook(s):

1. Renewable Energy-Power for a Sustainable future, Godfrey Boyle, Oxford University Press, 3rd Edition, 2012.
2. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage', Tata McGraw Hill, 1990.

Reference Book(s):

1. V.S. Mangal, Solar Engineering', Tata McGraw Hill, 1992.
2. N. K. Bansal, Renewable Energy Source and Conversion Technology', Tata McGraw Hill, 1989.
3. G. L. Johnson, 'Wind Energy Systems', Prentice Hall Inc, New Jersey.

4. N K Bansal, Non-Conventional Energy Resources, Vikas Publishing House Pvt. Ltd., 2014.
5. G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers, Fourth Edition.

ME 3073 Mechanics of Composite Materials

Credit: 3
Category: PCC
Prerequisite(s): Mechanics of Solids (ME 2029)

Course Description:

This course focuses on the comprehensive study of characteristics and application of composite material, strength of unidirectional and orthotropic lamina, mechanical and stress-strain behavior of anisotropic material, and application of plate theory to understand stress variation in laminates. Knowledge of the course will help the students to analyze the stress-strain behavior of laminate composites using classical lamination theory. At the end of the course the students will be able to cope up with industrial challenges related to analysis and application of laminated composites through extensive research.

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

CO1: understand the characteristics and application of a composite material and different manufacturing methods of laminated fiber-reinforced composite materials
CO2: understand the strength of a unidirectional lamina, strength and failure criteria of an orthotropic lamina
CO3: evaluate the macromechanical behavior of a lamina, stress-strain relation for anisotropic material
CO4: determine various elastic constants
CO5: apply the classical lamination theory for understanding the stress-strain variation in laminate
CO6: familiarize with composite test procedures and design new composites

Topics:

- Introduction of composite materials
- Elastic behavior of unidirectional lamina
- Macro-mechanical behavior of a lamina
- Micro-mechanical behavior of a lamina
- Analysis of laminated composites
- Test Methods for measuring properties of composites

Textbook(s):

1. Mechanics of Composite Materials, R. M. Jones, Taylor and Francis

Reference Book(s):

1. Composite Materials, K. K. Chawla, SPRINGER-VERLAG.
2. Engineering Mechanics of Composite Materials, I. M. Daniel and Ori Ishai, Oxford University Press.

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

ME 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

ME 3086 Computer Aided Design Analysis

Credit: 1
Category: PCLC
Prerequisite(s): Design of Machine Elements-I (ME 3023), Mechanics of Solids (ME 2029), Materials Science and Engineering (ME 2027)

Course Description:

This sessional emphasizes the design of the different components and structures under variable loading system. The practical significance of this sessional is to get ideas on material consideration, calculation of geometrical dimensions of machine components for various conditions. This helps to gain practical knowledge while designing the I.C engine components, Gear drive for the mechanical power system, sliding contact and rolling bearings. Using Solidworks, ANSYS software, modelling and analysis of the various elements under various load conditions can be learnt.

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

CO1: understand the design requirements for different machine components and manufacturing considerations associated with this
CO2: apply fatigue failure criteria in the design and analysis of machine component subjected to various loading condition
CO3: familiarize themselves with the design of I.C engine components and make themselves aware of the tribological issues in the design of machine components
CO4: identify, formulate and solve engineering problems by designing appropriate gear drives for the mechanical power system
CO5: implement and design the domain knowledge in actual systems
CO6: analyze and apply the domain knowledge in practical problems using engineering tools such as Solidworks and ANSYS

Topics:

- Design against variable loading conditions
- Design of I.C Engine Components such as I.C engine cylinder, piston, connecting rod, crankshaft, valve and valve mechanism
- Design of different types of gear such as spur gear, Helical gear, Bevel gear
- Design of Sliding and Rolling contact bearings
- Evaluation of fatigue life in machine components using ANSYS
- Demonstration of temperature and stress/strain distribution in I.C Engine components using ANSYS

ME 3092 Internal Combustion Engine & Refrigeration Air Conditioning Laboratory

Credit: 2
Category: PCLC
Prerequisite(s): Internal Combustion Engine & Gas Turbine (ME 3003) and Refrigeration Air Conditioning (ME 3014)

Course Description:

This course studies the fundamentals regarding the operation of internal combustion engines which includes the performance like all types of efficiencies, fuel requirements, and environmental impact. It also includes the estimation of engine power, efficiency and emission characteristics. The laboratory also gives a practical insight to various HVAC systems which includes the application of refrigeration, air conditioning, waste heat recovery and evaporative cooling. It also includes the estimation of C.O.P. and capacity. Cut section model of all types of compressors, Air conditioners and condensers are used to give thorough knowledge of their parts, working and maintenance.

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

CO1: recall the working principles of various processes related to IC Engines, Air-Conditioning and Refrigeration
CO2: recognize the different components related to IC Engines, Refrigeration and air conditioning
CO3: interpret the effects of various important parameters such load, speed and fuel consumption in case of IC Engine and super heating, under cooling, DBT, WBT etc. in case of HVAC systems on system performance
CO4: analyze the experimental result / heat balance sheet for better performance and improved accuracy
CO5: design open ended experiment
CO6: justify the source of difference between experimental and theoretical results

Topics:

- To determine the Valve Timing Diagram of 4-stroke petrol and diesel engine
- To determine the overall performance characteristics of a Single Cylinder Four Stroke Diesel Engine
- To determine the overall performance characteristics of a Single Cylinder Four Stroke Petrol Engine
- To determine the overall performance characteristics of a Single Cylinder Two Stroke Petrol Engine
- Study and trial of vapour compression refrigeration System
- Study and trial on air conditioning test rig
- Study and trial on auto-air conditioning unit
- Study and determination of the COP, cooling and heating capacity of air to air heat pump
- Investigate of the COP of vapour absorption refrigeration system
- Trial on ICE plant unit
- Performance evaluation of evaporative cooling setup
- Investigation of two stage cascade refrigeration system

ME 3093 Computational Technique Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Mathematics-III (MA 2005)

Course Description:

This course would encompass a comprehensive study of solving the numerical methods using the computational techniques. This course will help the students to develop a practical approach to mathematical problem solving using computational techniques and to develop the ability to convert commonly used numerical tools and techniques into computer s. At the end of the course, the students will be able to understand the nuances of the numerical techniques and computer applications of the same through extensive and systematic research.

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

CO1: recall the different numerical methods
CO2: explain the procedure of solving the numerical methods following various computational techniques
CO3: apply the program developed using the numerical methods and execute by using MATLAB/SCILAB software
CO4: analyze the computational results with the existing analytical results
CO5: propose the suitable numerical method for solving an equation
CO6: compare the results obtained for the program developed using the numerical methods with the results obtained using existing commercial software and justify

Topics:

- Recapitulation of numerical methods and introduction to the basics of MATLAB
- Solution of algebraic and transcendental equations using bi-section method
- Solution of algebraic and transcendental Equations using Regula-Falsi method
- Performing matrix inversion and solving eigen-value problems using Gauss-Jordan Method
- Interpolation using Newton's forward / backward interpolation formula
- Numerical solution of ordinary differential equations using Picard's Method and Euler's Method
- Numerical solution of partial differential equations: Solution to Laplace equation
- Solving a system of linear equations: Computing the deflection of cantilever beam/plate/truss subjected to mechanical loading
- Solving an eigen-value problem: Determining the natural frequencies and mode shapes of a beam/plate structure
- Introduction to ANSYS, introduction to pre-processing, solution and post-processing stages

Textbook(s):

1. Ralston and P. Rabinowitz, A First Course in Numerical Analysis, McGraw Hill
2. S. C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, Indian Edition, McGraw Hill, 2012

Reference Book(s):

1. V. Rajaraman, Computer Oriented Numerical Methods , PHI, 2002
2. David Houcque, Introduction to Matlab for engineering students, Northwestern University

ME 3095 Heat Transfer Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Heat Transfer (M E3021)

Course Description:

This laboratory is intended to describe the fundamental concepts to students in the area of heat transfer and its applications. This provides knowledge about different modes of heat transfer, like conduction, convection and radiation. The practical significance of various parameters those are involved in different modes of heat transfer can be recognized. The knowledge of heat transfer 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: evaluate the thermal conductivity of given metal bars of different material and a solid disc
CO2: experiment the conduction heat transfer through fluids and assess their thermal conductivity
CO3: calculate the heat transfer coefficient for a pin fin
CO4: compare the heat transfer from flat, finned and pinned surfaces in forced convection and natural convection
CO5: estimate the overall heat transfer coefficient and efficiency of parallel and counter flow heat exchangers
CO6: test the emissivity of different surfaces and examine the Stefan Boltzmann Constant

Topics:

- Linear heat conduction experiment
- Radial heat conduction experiment
- Extended surface heat transfer
- Thermal conductivity of liquid
- Concentric tube heat exchanger
- Investigations of heat transfer in natural convection
- Investigations of heat transfer in forced convection
- Determination of Stefan-Boltzmann constant
- Determination of emissivity

ME 3096 Mechanical Engineering Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Advanced Manufacturing Processes Laboratory (ME 3097)

Course Description:

This mechanical engineering laboratory is intended to describe the indispensable concepts to students in the area for the development of practical knowledge with fundamental understanding of Lab view software, Measurement and Instrumentation, advance reliability center, Computer Integrated Manufacturing, and Robotics. Moreover, the practical significance of multifarious advanced concept of Mechanical Engg. analysis can be recognized. The knowledge of the CIM and robotics system can be furthermore enhanced for better implementation in the practical field. The students can be practically trained to exploit this knowledge in the industry.

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

CO1: develop a VI for numeric, boolean controls and indicators, temperature of a body using thermistor, acceleration of a body using accelerometer using Lab view software
CO2: experiment on condition monitoring equipments, bearing mounting and dismounting process.
CO3. experiment on pick and place an object using 6 axis aristo robot
CO4. experiment on automatic storage and retrieval system
CO5. measure the average arithmetic surface roughness using Surfest SV 2100 M4 machine and the 3D object in CMM
CO6. measure the cylindricity/ovality of cylindrical/ spherical object

Topics:

- Development on a VI numeric, boolean controls and indicators using Lab view software.
- Creation of a VI that converts degree centigrade to degree Fahrenheit built with sub VI using Lab view software.
- Development on a VI for measure the temperature of a body using thermistor.
- Development of a VI for acceleration of a body using accelerometer.
- Experiment on condition monitoring equipments.
- Experiment on bearing mounting and dismounting process.
- Experiment on pick and place an object using 6 axis aristo robot
- Experiment of automatic storage and retrieval system.
- Measurement of the average arithmetic surface roughness using Surfest SV 2100 M4 machine.
- Measurement of cylindricity/ovality of cylindrical/ spherical object.
- Measurement of the 3D object in CMM.

ME 3097 Advanced Manufacturing Processes Laboratory

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

Course Description:

Advanced Manufacturing Processes (AMP) laboratory is dedicated to providing cutting-edge facilities that attract the future manufacturing workforce to develop next-generation products. The demand for manufacturing in the industries entirely relies on global competition, rapidly changing environment, precise and high-quality products. This laboratory supports a multipurpose and interdisciplinary working environment for training and research-related activities. The focus of this laboratory is to develop indigenous products through efficient unconventional manufacturing processes and providing system-level manufacturing solutions. We have state-of-the-art facilities specifically dedicated to the R&D needs of manufacturers and the other facilities which have the flexibility to adapt to those needs.

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

CO1: evaluation of the material removal rate (MRR), tool wear rate (TWR) and surface roughness (SR) during the Electrode Discharge Machining (EDM) on different materials
CO2: experimentation on the effects of process parameters on the surface roughness during Fused Deposition Modelling
CO3: calculation of the various features of a hole during drilling with Ultrasonic Machining (USM) process
CO4: experimentation on the CNC turning of bio-compatible materials
CO5: comparison of machining performance in dry and wet CNC machining conditions
CO6: estimation of the overall surface quality during CNC milling of high strength alloys

Topics:

- Evaluation of the material removal rate (MRR), tool wear rate (TWR) and surface roughness (SR) during the Electrode Discharge Machining (EDM) on different materials
- Experimentation on the effects of process parameters on the surface roughness during Fused Deposition Modelling
- Calculation of the various features of a hole during drilling with Ultrasonic Machining (USM) process
- Experimentation on the CNC turning of bio-compatible materials
- Comparison of machining performance in dry and wet CNC machining conditions
- Estimation of the overall surface quality during CNC milling of high strength alloys

ME 4010 Metal Forming and Casting Processes

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

Course Description:

This course would encompass a comprehensive study of metal forming process and casting process. Knowledge of the course will help the students to understand basic concept of the plastic deformation of metals and analyze the behaviour of materials during forming processes. The topic helps them to know about industrial limitations and application of casting and design of the gating system of the casting process for the efficient casting. At the end of the course the students will be able to know about the cause and remedies of the casting.

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

CO1: understand metal forming process and the plastic deformation of metals
CO2: analyze the metal flow in metal forming processes
CO3: study the theories of friction and lubrication in metal forming and powder forming
CO4: study the casting process and design analysis of gating system
CO5: design analysis of gating system viz. riser, gate and pattern for defect free casting
CO6: study the cause and remedies of casting defects

Topics:

- Forming
- Analysis of metal flow in metal forming processes
- Casting
- Gating design

Textbook(s):

1. Technology of Metal Forming Processes, S. Kumar, PHI Ltd, 2008
2. Metal Forming: Fundamentals and Applications, T. Altan, S.Oh & H.L. Gegel, American Society for Metals, 1983

Reference Book(s):

1. Metal forming and the Finite-Element Method, S. Kobayashi, S. Oh, T. Altan, Oxford University Press, USA, 09-Mar-1989
2. Casting Technology and Cast Alloys, A.K. Chakrabarti, PHI Ltd., 2005
3. Manufacturing Technology, Vol. – I, P.N. Rao, Tata McGraw Hill, 2007 reprint
4. Plasticity for Mechanical Engineers, W. Johnson & P.B. Mellor, London, Princeton, N.J., Van Nostrand [1962]
5. Principle of Metal Working, G.W. Rowe, ISBN: 8123904282

ME 4011 Theory of Machining

Credit: 3
Category: PEC
Prerequisite(s): Metal Cutting and Tool Design (ME 3016)

Course Description:

This course would include an ample study of steriometry of cutting tools, cutting tool materials and properties, high speed machining, mechanics of metal cutting, dynamometer, design of cutting tool, thermal aspects in metal cutting, Dry machining, minimum quantity cooling lubrication, Tool wear, tool life, machinability, factors affecting the machinability, and Economics of metal cutting. Basic understanding of this course will help the students recognize the tool geometry, chip formation mechanism, analysis of cutting forces, tool wear mechanisms, evaluation of tool life and design aspects of cutting tools. At last, the students will be able to analyze the industrial related problems through experiment and research.

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

CO1: identify the necessity of manufacturing, purpose and principle of machining, demonstrate tool geometry and convert tool angles from one system to another
CO2: categorize between orthogonal and oblique cutting and chip flow deviation. Illustrate the mechanism of chip formation in machining ductile and brittle materials and able to conduct complex mechanical engineering experiments to analyze and interpret the experimental data
CO3: explain the benefits and the purposes of determining cutting forces and able to conduct complex mechanical engineering experiments to analyze and interpret the experimental data
CO4: assess failure of cutting tools, mechanisms and pattern of tool wear, the essential properties of cutting tool materials, and assess tool life, Machinability & economics of machining
CO5: conduct advanced conventional machining processes
CO6: design cutting tools for conventional machining

Topics:
- Geometry of cutting tools
- Mechanism of chip formation
- Mechanics of metal cutting
- Cutting tool materials, Machinability, Tool failure and Tool life
- Advances in machining
- Design of cutting tools

Textbook(s):
1. Metal cutting (Theory & practice), A. Bhattacharya, Central Pub.,1984
2. Fundamental of machining & machine tools, Boothroyd & Knight, Taylor & Francis Pub., 2006

Reference Book(s):
1. Metal cutting (Theory & practice), David A. Stephenson & J.S.Agapiou, Taylor & Francis Pub.2006
2. Metal cutting principles, M.C. Shaw, Oxford Pub., 2005
3. Metal cutting, Trent & Wright, Elsevier Pub.,4th edition, 2000
4. Metal cutting & tool design, V. Arsinov, MIR Pub., 3rd edition, 1996.

ME 4012 Non-Conventional Machining and Fabrication Process

Credit: 3
Category: PEC
Prerequisite(s): Manufacturing Processes and Automation (ME 3019)

Course Description:

This course would incorporate a comprehensive study of modern manufacturing process such as Ultrasonic machining, Abrasive machining processes, Electrochemical machining, Electro discharge machining & their modifications. Also it will introduce some new technology based manufacturing process such as TIG, MIG, MMAW, CO2 welding, SAW, Resistance, friction, diffusion, Ultrasonic, electron beam and laser welding process and Ultrasonic welding processes. At the end of the course students will be able to solve machining related industrial problems through extensive and systematic research activity.

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

CO1: conceptualize the principle, applications, advantages and limitations of non-conventional Manufacturing processes
CO2: prepare process plan in context of adaptability of the non-conventional manufacturing processes
CO3: develop mathematical model and compute material removal rate on different non-conventional manufacturing processes
CO4: comprehend and apply the science of welding to improve welding process performance
CO5: evaluate strategies towards mitigating the challenges in non-traditional forming processes
CO6: select materials and fabrication processes in context of weldability

Topics:

- Principle and application of all non-conventional manufacturing processes
- Mechanics of material removal, surface integrity and development of mathematical model for computing MRR
- Principle and applications of forming processes
- Principle and application of various welding processes

Textbook(s):

1. Modern machining process, P.C. Pandey, H.S. Shan, TMH, 33rd reprint, 2008
2. Non-conventional machining, P.C. Mishra, Narosa publishing house, 3rd reprint, 2005

Reference Book(s):

1. Manufacturing science, A. Ghose & A.K. Mallik, East-west press, 2001
2. Welding & Welding technology, R. Little, TMH, 2004.
3. Welding Engineering & Welding Technology, R. S. Parmar, Khanna Publisher, 1997

ME 4013 Theory of Advanced Fluid Mechanics

Credit: 3
Category: PEC
Prerequisite(s): Fluid Mechanics & Hydraulic Machines (ME 2021)

Course Description:

This course is a survey of fundamental concepts and methods of fluid dynamics with practical applications. It provides an idea for the exact solution of Navier-stokes equation for different types of flow applied to various geometry and air foil. The course elaborates the fluid motion with description of boundary layer, flow separation and stability theory for various geometry and analysis of importance of instabilities in fluid flow. It also includes turbulent flow and compressible viscous flow with different hypothesis, effect of shock waves for various flow pattern. Computational fluid dynamics methods are discussed for analysis of the flow performance.

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

CO1: describe the different fluid forces causing the fluid flow and the stress tensor
CO2: discuss the continuity and momentum equation in fluid motion
CO3: apply the conservation equations in different fluid flow problems
CO4: review the concepts of boundary layer and its estimation in different flows
CO5: analyze the type of flow, flow over different geometries with stability
CO6: develop the skill to apply analytical and numerical methods used to solve fluid dynamics problems

Topics:

- Fundamental concepts
- Basic equations in integral form for a control volume
- Incompressible inviscid flow
- Internal Incompressible viscous flow
- Boundary layer theory
- Compressible flow
- Introduction to CFD

Textbook(s):

1. Fluid Mechanics, R.N. Fox and A.T McDonald, John Wiley & Sons, 4th Ed., 1994.
2. Frank M. White, Fluid Mechanics, Tata McGraw-Hill, Singapore, Sixth Edition, 2008.
3. Frank M. White, Viscous Fluid Flow, Third Edition, McGraw-Hill Series of Mechanical Engineering, 2006.

Reference Book(s):

1. Fundamentals of Fluid Mechanics, Schlitching, Springer Links, 2000
2. Advanced Engineering Fluid Mechanics, K Muralidhar and G. Biswas, Second Edition, Narosa, 2005.
3. Boundary Layer Theory, H. Schlichting, Springer Verlag, 2000.
4. The dynamics and thermodynamics of compressible fluid flow, Vol. I & II, A.H. Shapin, The Ronald Press Co., 1955.
5. Foundations of Fluid Mechanics, S.W. Yuan, Prentice Hall of India, 1976.
6. Advanced Engineering Fluid Mechanics, Muralidhar & Biswas, Alpha Science International Ltd, 2005.
7. John D.Anderson Jr., Computational Fluid Dynamics: The Basics with Applications, McGraw-Hill Series of Mechanical Engineering, 1995

ME 4014 Theory of Advanced Thermodynamics

Credit: 3
Category: PEC
Prerequisite(s): Engineering Thermodynamics (ME 2031)

Course Description**:**

This course includes the advanced theory of thermodynamics such as energy analysis. This helps to understand the quality of energy and thus energy loss is minimized in a thermodynamic system. Exergy analysis for process and cycle is discussed in depth. Further concepts of Helmholtz function, Gibb's function, reciprocity relation, thermodynamic relations, Maxwell's relation, T-ds equations, specific heat relations, Joule-Thompson effect, Clausius-Clapeyron equation are described. Then, criteria of equilibrium, Gibb's phase rule and third law of thermodynamics are explained. Thermodynamic properties of homogenous mixture, multi-phase and multi component systems are analyzed. Concept of availability is applied in the frame work of chemical availability and combustion. Topics of irreversible thermodynamics such as stability, phase transition are covered.

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

CO1: recall the laws of thermodynamics
CO2: evaluate the useful and non-recovered work of a system during different processes
CO3: determine the different thermodynamic properties of systems
CO4: analyze the basic postulates in irreversible thermodynamics
CO5: aware of molecular-level understanding of key thermodynamic quantities such as heat, work, free energy and entropy
CO6: explain the availability analysis of different thermodynamic processes

Topics:

- Entropy generation, exergy
- Helmholtz function, Gibb's function
- Thermodynamic relations
- Equilibrium
- Gibb's phase rule
- Homogeneous mixture, multi component systems, irreversible thermodynamics

Textbook(s):

1. Fundamentals of Classical Thermodynamics, G.J. Van Wylen & R.E. Sonntag, Willy Eastern Ltd. 1989
   (Chapters: I, II & III)
2. Principles of Thermodynamics, J. Hsieg, McGraw Hill, 1978.

Reference Book(s):

1. Thermodynamic for Engineers, A.S. Michael, Prentice Hall, 1972.
2. Engineering Thermodynamics, 2nd Ed., P.K. Nag, McGraw Hill, 1995.
3. Thermodynamics, 4th Ed., J.P. Holman., McGraw Hill, 1988.
4. Statistical Thermodynamics, Lee and Sears, Addition Wesley, 1976.
5. Thermodynamics for Chemists, V. Nastrand & S. Glasstne, 1974.
6. Engg Thermodynamics for Engineers, M.D. Burghardt, Harper & Row, NY, 1987.
7. Advanced Thermodynamics for Engineers, K. Wark, McGraw Hill, NY, 1987.
8. Introduction to Chemical Engineering Thermodynamics, K. Smith & H.C. Van Ness, McGraw Hill, 1987

ME 4015 Theory of Advanced Heat and Mass Transfer

Credit: 3
Category: PEC
Prerequisite(s): Heat Transfer (ME 3021)

Course Description:

The course starts with the review of basic concepts of heat transfer. The different kinds of heat conduction like inverse heat conduction, anisotropic heat conduction, Non Fourier conduction are explored. The heat transfer associated with phase change problems are explained. Further, the process of heat transfers in moving heat source problems are discussed. The convective heat transfer process is elaborated to understand the physical nature of heat transfer associated with fluid motion. At the later stage the role of radiative heat transfer is explained. Finally, the description of heat transfer with species transfer helps in understanding the real world engineering problems.

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

CO1: recall the different modes of heat transfer
CO2: describe the different heat transfer processes
CO3: apply the concepts of different heat transfer mechanisms to know their physical nature
CO4: analyze the different heat transfer and mass transfer problems with theoretical and experimental correlations
CO5: design the heat transfer applications with experimental and numerical techniques
CO6: evaluate the heat transfer performance of different engineering applications

Topics:

- Modes of heat transfer
- Anisotropic Heat Conduction
- Inverse Heat Conduction Processes
- Porous Media Heat Transfer
- Moving Heat Source Problems
- Phase Change Problems
- Non Fourier Heat Conduction
- Convective Heat Transfer (Forced and Natural)
- Radiation Heat Transfer
- Mass Transfer

Textbook(s):

1. Fundamentals of Heat and Mass Transfer, F.P. Incropera and D. P. Dewit, John Wiley & Sons, 1998.
2. Principles of Heat Transfer, F Kreith, R. M. Manglik, M. S. Bohn; Cengage Learning; 7th edition, 2010.

Reference Book(s):

1. Heat and Mass Transfer, Y.A.Cengel, Tata McGraw Hill, 2003.
2. Heat Conduction, M. N. Ozisik, John Wiley and Sons, 1993.
2. Convective Heat Transfer, L.C. Burmister, John Willey and Sons, 1983.
3. Essential of Radiation Heat Transfer, C. Balaji, Wiley, 2014.
4. Analysis of Heat and Mass Transfer, E. R. D. Eckert and R.M. Drake, McGraw Hill, 1980.
5. Convective Heat and Mass Transfer, W.M. Kays and W. Crawford, McGraw Hill Inc., 1993

ME 4016 Mechanics of Solids and Structures

Credit: 3
Category: PEC
Prerequisite(s): Mechanics of Solids (ME 2029)

Course Description:

This course is intended to impart advanced knowledge of generalized stress, strain, displacement and force. While in the "mechanics of solids" course, the students were introduced to the various components of the stress and strain, likely the normal and shear, in the problems that was solved not more than one component of the stress or strain occurred simultaneously. In this course these problems in which more than one component of the stress or strain occurs simultaneously will be dealt. Thus, in this course generalized concepts and equations to facilitate three dimensional analysis of structures will be studied. The practical significance is that a machine element like non uniform shaft or curved beam 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: understand the behaviour of material under stress and evaluate principal stresses, their directions and stress invariants
CO2: draw the Mohr's circle for three dimensional state of stress
CO3: determine the strain invariants, principal strains and their associated directions
CO4: understand the generalized Hooke's law
CO5: analyze theories of failure and their application in designing the machine components
CO6: expertise to solve engineering problems like shear stresses in curved beams, axisymmetric bodies

Topics:
- Analysis of stress
- Analysis of strain
- General Stress-strain relation
- Theories of failures
- Unsymmetrical bending
- Axisymmetric problems

Textbook(s):
1. Advanced Mechanics of Solids, L. S. Srinath, McGraw Hill Education.

Reference Book(s):
1. Advanced Mechanics of Materials, A.P. Boresi, R.J. Schimdt; Wiley.
2. Strength of Materials, Sadhu Singh, Khanna Publishers.
3. Strength of Materials, Beer and Johnson, McGraw-Hill Education, 2014

ME 4017 Noise and Vibration Control Engineering

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

Course Description:

This course will enable students to understand the basic principles of vibration theory and systems with two degrees of freedom. Examples of two degrees of freedom are considered best for introducing concepts in multi-degree freedom systems. Students will be able to design the dynamic vibration absorber - important application of two degree freedom systems. It will enable them to determine the natural frequencies and mode shapes. The noise emanating from a machine can be analyzed and measured. The student can determine the best noise control method. The physiological effect of noise and vibration level in humans can also be determined.

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

CO1: understand and model a two degrees of freedom dynamic systems
CO2: determine the natural frequencies and mode shapes
CO3: design a dynamic vibration absorber
CO4: measure the noise source and evaluate the combined effects
CO5: understand and determine the best noise control method
CO6: determine the physiological effects of noise and vibration level in humans

Topics:

- Multi-degree of freedom systems
- Continuous systems
- Basics of Noise Engineering
- Noise Control
- Design for quieter machines and processes

Textbook(s):

1. Vibration and Acoustics by C. Sujatha, TMH

Reference Book(s):

1. F S Tse, I E Morse and R T Hinkle, Mechanical Vibrations, CBS Publ., 1983.
2. J S Rao and K Gupta, Theory and Practice of Mechanical Vibrations, New Age Publication, 1995
3. Harold Lord, Gatley and Eversen, Noise Control for Engineers, McGraw-Hill
4. R. H. Lyon, Machinery Noise and Diagnostics, Butterworths, 1987.
5. J. W. Dally and W.

ME 4018 Theory of Advanced Machines and Mechanisms

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

Course Description:

This course is the advance of the kinematics and dynamics of machines. Both graphically and analytically different types of mechanism can be synthesized. Various optimization methods will be used for synthesizing path and motion generation for achieving the precision points. Displacement analysis for different special mechanism will also be analyzed in this course. Different parts of the robot and its control system are also in this course.

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

CO1: understand the concept fundamental to the synthesis and analysis of mechanisms
CO2: explore synthesis techniques to create potential linkage design solutions for some typical kinematic applications
CO3: synthesize linkages for specified output positions analytically
CO4: design the synthesis of the spatial mechanism by using a different technique
CO5: know the control systems and components of Robot
CO6: solve mathematical models of the active mechanism by using computer-aided methods

Topics:

- Review of Kinematic synthesis
- Synthesis of planer mechanisms
- Synthesis of spatial mechanisms
- Synthesis of mechanism, Application to robotics
- Robot and its control system

Textbook(s):

1. Norton, R.L., 1999, “Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and machines”, 2nd Ed., WCB McGraw-Hill.

Reference Book(s):

1. Hartenberg, R.S., Denavit, J., 1964, “Kinaematic Synthesis of Linkages”, McGraw-Hill, New York.
2. Sandor, G.N., Erdman, A.G., 1984“Advanced Mechanism Design Analysis and Synthesis”, Vol. - 1, Prentice-Hall, New Jersey.

ME 4061 Operations Research

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Mathematics-III (MA 2005)

Course Description:

This course would encompass a comprehensive study on decision making problem formulation. It will assist the students to understand the theory of optimization methods and its algorithms developed for solving various types of problems. Knowledge of the course will also help the students to develop and promote research interest in applying optimization techniques in problems of Engineering and Technology. At the end of the course the students will be able to solve decision making 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 importance of optimization in industrial process management
CO2: apply the basic concepts of mathematics to formulate an optimization problem and solve it by simulation
CO3: analyze and appreciate variety of performance measures for various problems like game theory
CO4: identify the decision making solution alternatives
CO5: apply unconstrained & constrained search methods for optimization theory for continuous problems, including the necessary and sufficient optimality condition
CO6: evaluate and measure the performance of an algorithm

Topics:

- Formulation of optimization problems
- Sensitivity Analysis, Transportation Problem, Assignment Problem
- Integer Linear Programming Problem
- Dynamic Programming Problems
- Game theory
- Constrained linear programming,

Textbook(s):

1. Operation Research: An Introduction, H. A. Taha, PHI, 2007.

Reference Book(s):

1. Operation Research, S.D Sharma, Laxmi Publications, 2009.
2. Introduction to Operations Research, AP Verma, S.K. Kataria & Sons, 2012.
3. Frederick S. Hillier and Gerald J. Lieberman - Introduction to Operations Research, 10th Edition McGraw-Hill Higher Education, 2015.

ME 4070 Manufacturing Processes

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

Course Description:

This course will offer a detailed understanding of manufacturing processes used in industry such as casting, forming, welding and various conventional and non-conventional machining processes. Knowledge of the course will help the students to relate the design requirements of a part to the possible manufacturing processes. Successful completion of the course will also provide the student with the benefits, limitations, and applications of different conventional and non-conventional machine tools and engineering materials for product manufacturing. The overall aim is to establish the technical knowledge for selection and planning of manufacturing processes and systems.

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

CO1: understand and select the appropriate casting processes for manufacturing industrial products
CO2: apply the suitable rolling process and sheet metal for different material and product
CO3: understand the forging, extrusion process for various components and its application
CO4: analyze the principle of various welding processes and its application
CO5: understand the various conventional machine tools and its related accessories
CO6: applying the different non- traditional machining processes for up growing high strength materials

Topics:

- Foundry Process
- Metal working process
- Fabrication Processes
- Conventional Machine Tools
- Non-conventional machining

Textbook(s):

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

Reference Book (s):

1. Manufacturing Technology: Materials, Processes and Equipment: Helmi A. Youssef, Hassan A. El. Hofy and M.H. Ahmed, CRC Press, 2015
2. Principle of Manufacturing Materials and Processes: J.S. Cambell, TMH
3. Welding & Welding Technology - R. Little, TMH, 43rd reprint, 2014
4. Manufacturing Science: A. Ghosh & A.K. Mallick, EW.
5. Modern Machining Processes: P. C. Pandey and H.S. Shan, Tata Mc-Graw Hill, Publication. Co. Ltd.

ME 4074 Quality Engineering

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

Course Description:

This course aims to describe the significance and evolution of quality concept in manufacturing and service sectors. This course enables the student to understand different quality tools and techniques used to improve overall quality i.e. Total quality Management, ISO standards, Six Sigma etc. Implementation and monitoring of process control such as Statistical Process Control and evaluation of reliability of a system is also covered in this course.

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

CO1: compare and appreciate the contributions of Quality Gurus
CO2: understand quality engineering methods and tools
CO3: apply SQC methods to improve quality of products and services
CO4: understand the basic concept of ISO, Six Sigma, TQM
CO5: understand the concept of acceptance sampling and OC Curve
CO6: evaluate the reliability of an item and determine the reliability of a system

Topics:

- Introduction to Quality
- Quality Tools
- ISO Standard
- Six Sigma
- Total Quality Management
- Statistical Process Control
- Process Capability
- Acceptance Sampling Plan
- Reliability

Textbook (s):

1. Fundamental of Quality Control and Improvement, Mitra A, PHI

Reference Book (s):

1. Total Quality Management, J.R. Evans – Cengage
2. Quality Management, Bedi, Oxford
3. Quality Management, Gitlow Oppenheim Levine, TMH

ME 4076 Production Planning and Control

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

Course Description:

The current competitive business environment is forcing the organizations to adopt the latest tools, techniques and strategies for managing their resources in the most effective and efficient manner. The topics of the course deals with the management of resources and activities that lead to production of goods of right quality, in right quantity, at right time and place in the most cost-effective manner. The course focuses on the basic concepts, issues, and techniques adopted worldwide for efficient and effective operations. The topics include operations strategy, product design and development, work study, facility planning and layout, aggregate production planning, inventory and quality management.

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

CO1: describe the various components that make up the manufacturing planning and control system and the interaction among them
CO2: select the best method and different timing using time study procedure
CO3: know about the factors affecting plant location and the techniques used for plant layout
CO4: develop the algorithms that are appropriate for solving single-machine, two-machine, parallel-machines and flow shop scheduling problems
CO5: show how (i) the material requirement plans, manufacturing resource plans, and capacity requirement plans can be developed, and (ii) lot sizing decisions can be made for a manufacturing system
CO6: develop the models that are applicable for inventory management, including those for quantity discounts, safety stocks, and order quantity and reorder point interactions

Topics:
- Product Design and Development
- Work study
- Plant layout and Location
- Aggregate Production Planning
- Scheduling and Sequencing
- Inventory control
- Quality Control

Textbook(s):
1. Production and Operation Management, R. Paneerselvam, Third Edition,2013

Reference Books:
1. Production and Operation Management, K. Aswathappa K. Shridhara Bhat
2. S.N. Charry, Production and operations management, TMH

ME 4078 Work System Design

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

Course Description:

Work System Design deals with the systematic examination of the methods of doing work with an aim of finding the means of effective and efficient use of resources and setting up of standards of performance for the work being carried out. The systematic examination of work involves what is done? And how it is done? As well as what is the standard time to do the work? This is required to have an in-depth analysis of all the elements, factors, resources and relationships affecting the efficiency and effectiveness of the work being studied. The course also aims at scientifically establishing the time required for a qualified worker to carry out a work element at a defined rate of working. Ergonomic aspects of work system design are also included in the course contents. The scope of this course is not only limited to the manufacturing applications but it is also relevant for service sector industry.

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

CO1: calculate the basic work content of a specific job for employees of an organization
CO2: analyze and calculate the level of risk in a job causing stress
CO3: determine the rate of a worker engaged on a live job and calculate basic, allowed and standard time
CO4: analyze the existing methods of working for a particular job and develop an improved method through questioning technique
CO5: develop analyzing skills among the students with respect to work place design, working postures and lifting tasks
CO6: devise appropriate wage and incentive plan for the employees of an organization

Topics:

- Productivity
- Method study
- Time study
- Incentive Plan
- Ergonomics

Textbook(s):

1. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education, 2000.

References Book(s):

1. Work Measurement and Methods Improvement, Lawrence S. Aft, John Wiley and Sons, New York, 2000
2. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", Mc Graw Hill, 1997.
3. International Labour organization, "Work-study", Oxford and IBH publishing company Pvt. Ltd., N.Delhi, 2001.

ME 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

ME 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

ME 4092 Thermofluids Laboratory

Credit: 3
Category: PEC
Prerequisite(s): Physics (PH 1007)

Course Description:

This laboratory is designed to understand the basic concepts of thermodynamics, fluid mechanics, heat transfer and refrigeration through various experiments. Study of IC engines is useful to understand the basic principles of thermodynamics. Most common hydraulic machines like turbines and pumps are studied to understand principle of conversion of hydraulic energy to mechanical energy and vice versa. Measurement of thermal conductivity is introduced know the basic heat transfer process. Heat exchanger is very versatile device used in various industries like thermal power plant, refrigerator etc., and experiment on it helps the students to understand the means of heat transfer from one fluid to another. Experiment of refrigeration will help the students to know about the basic refrigeration process used in refrigerator. At the end of the course, students will be confident to face the challenges of industry problems.

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

CO1: recall the principle of Bernoulli's in conservation of heat in fluid flow
CO2: explain and use venturi meter for flow measurement
CO3: illustrate the flow measurement with the help of orifice meter
CO4: analyze the effect of discharge and head, on performance of hydraulic machineries
CO5: design heat exchanger for required rate of heat transfer from one fluid to another
CO6: evaluate coefficient of performance of refrigeration test rig

Topics:

- Demonstration of the principle of Bernoulli's in conservation of head in fluid flow
- Measurement of the flow fluid through pipes with the help of venturi meter
- Calculation of the fluid flow through pipe with the help of orifice meter
- Evaluation of the metacentric height of any floating body
- Drawing the characteristic curves for Pelton wheel
- Plotting the characteristic curves for reciprocating pump
- Plotting the characteristic curves for centrifugal pump
- Model study of internal combustion engines
- Parallel flow concentric tube heat exchanger
- Trial on refrigeration test rig on batch mode

ME 4094 Operations Research Laboratory

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

Course Description:

The Operations Research as part of the Industrial Engineering deals with the optimization of complex processes and systems. In particular, the Operations Research (O. R.) field deals with the development, improvement and implementation of integrated systems as well as with the mathematical, physical and social sciences including the principles and methods of engineering. Therefore, the O. R. Laboratory through the O. R. techniques implements methods and assesses the results obtained when implementing these methods in complex real world problems

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

CO1: use quantitative methods and techniques for effective decisions–making
CO2: convert the problem into mathematical model
CO3: analyze the real life problem with limited constraints and depict it a model form
CO4: demonstrate knowledge and develop techniques about computational learning
CO5: develop effectively and efficiently the adequate algorithms and software to solve complex computation problems
CO6: evaluate and measure the performance of an algorithm

Topics:

- Solve the LPP model in Excel
- Big M Method in Excel,
- Game Theory and Transportation Problem in Matlab
- Soft computing Techniques:
- Genetic Algorithm
- Artificial Immune System(AIS)
- Particle sum optimization (PSO)
- Ant Colony optimization (ACO)
- Ant Bee Colony optimization(ABC)

COURSES OF OTHER PROGRAMMES

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 analyse them
CO3: understand the working of BJT, different modes and configuration, identify and analyse 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 2095 Electronics Engineering Laboratory

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

Course Description:

The course objective is to give students the practical knowledge of designing and analysing various electronic circuits such as Rectifiers, Diodes and Transistor characteristics, applications of operational amplifiers, digital electronics circuits and 555 timer as Multivibrator so that they will be able to understand the practical aspects of Principles of Electronics Engineering theory.

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

CO1: identify the different active and passive components & apply different measuring devices and instruments for measurement and testing of the various active and passive components
CO2: analyze the different types of waveforms and calculate their amplitude & frequency
CO3: design and analyze simple circuits using elementary electronic components e.g. different sources, resistors, capacitors and non-linear elements such as diodes & transistors and analyze its working operation & characteristics
CO4: learn how operational amplifiers are modelled and analyzed, and to design Op-Amp circuits to perform operations such as summing, integration and differentiation on electronic signals
CO5: analyse the working operation and verify the truth table of different logic gates and flip-flops
CO6: design and analyse 555 timer as A stable Multivibrator and the study the performance characteristic of Monostable Multivibrator using 555 timer

Topics:

- Familiarization with electronic components
- Familiarization with electronic equipment (CRO & Function Generator).
- Study the V-I characteristics of P-N Junction diode and Zener diode
- Full wave rectifier with and without filter
- Clippers and clampers
- CE NPN Transistor characteristics
- Inverting and non-inverting op-amp(LM741)
- Differentiator and integrator amplifier using op-amp(LM741)
- Logic gates and flip flops (Study of truth table)
- Monostable and astable multi vibrator using 555 Timer

EE 2009 Electrical Machines and Power Electronics

Credit: 3
Category: PEC
Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Principle of operation, Types of DC Machines, Losses and Efficiency, Characteristics of different DC Machines, Speed control of DC Motor, construction and operation of Three-phase induction motor, Torque-Slip characteristics, Construction, Principle of Operation of single phase and three phase transformer, different tests, Regulation, Losses and Efficiency, Three Phase Transformer Connections, Power Semiconductor Devices, Thyristor Characteristics.

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

CO1: remember the Construction, principle and efficiency of different DC machines
CO2: understand the Speed control and characteristics of DC machines
CO3: evaluate the performance characteristics, different methods of starting and speed control of three phase induction motors
CO4: apply phasor diagram to find the voltage regulation of a Synchronous generators
CO5: remember the construction, principle, losses, efficiency and Phasor diagram of transformers
CO6: remember the working principles of various power electronic semiconducting devices

Topics:

- DC Generator
- DC Motor
- Three Phase Induction Motor
- Synchronous Generator
- Single Phase Transformer
- Three Phase Transformer
- Power Electronics Devices

Textbook(s):

1. Electrical Machinery by P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Power Electronics, by P S Bhimbra, Khanna Publishers, 5th Edition, 2011.

Reference Book(s):

1. Electrical Machines by Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machines, by P. K. Mukharjee and S. Chakravorti, Danpat rai Publication,2nd Edition, 18th reprint 2013.
3. Electrical Machines, by P. Purkait and I. Bandyopadhyay, Oxford University Press. 1st Edition, 2017.

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.

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.

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